

**Jacques Cousteau National Estuarine  
Research Reserve**

**Management Plan  
2009 - 2014**

# Jacques Cousteau National Estuarine Research Reserve

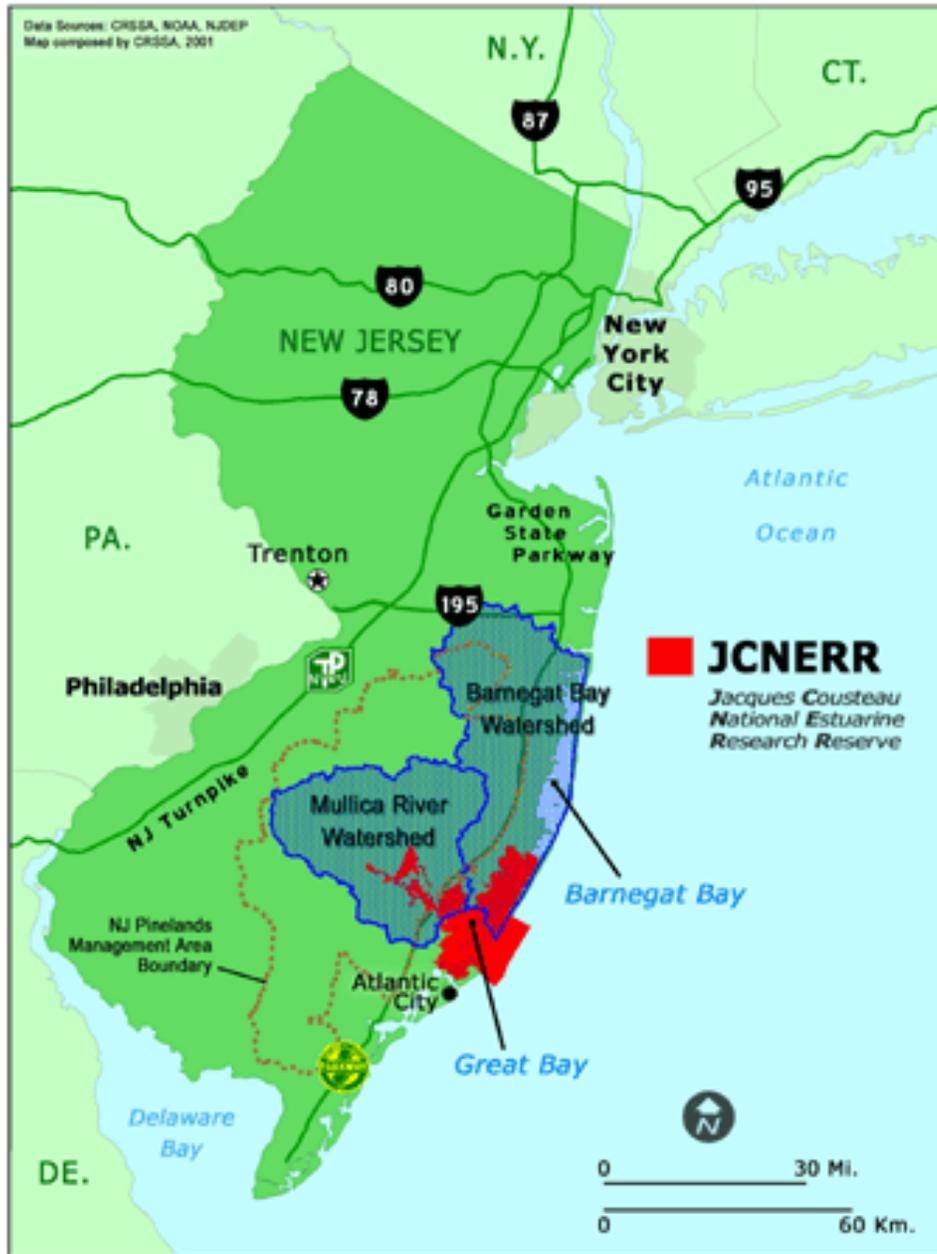
## Management Plan 2009 - 2014



**Jacques Cousteau National  
Estuarine Research Reserve  
130 Great Bay Blvd.  
Tuckerton, NJ 08087**

This management plan has been developed in accordance with NOAA regulations, including all provisions for public involvement. It is consistent with the congressional intent of Section 315 of the Coastal Zone Management Act of 1972, as amended, and the provisions of the New Jersey Coastal Management Program October 10, 2009





**Map of the Jacques Cousteau National Estuarine Research Reserve within The Greater New Jersey Region.**

This map was prepared by the JC NERR. The information in this map is subject to change. The information provided is only an approximate graphical representation.

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# I. EXECUTIVE SUMMARY



## JC NERR Management Plan 2009 - 2014

### I. EXECUTIVE SUMMARY

This document is the first revision of the management plan for the Jacques Cousteau National Estuarine Research Reserve (JC NERR). The initial plan was completed in 1997 and established the JC NERR. Many of the original goals and objectives for research, education, and stewardship remain valid, but have been reviewed and/or modified in the context of recent accomplishments, partnerships, advice and guidance from key partners, and periodic needs assessments.

This revision presents the mission, goals and objectives of the National Estuarine Research Reserve System (NERRS) and the JC NERR. Plans are presented for the next five years with respect to administration, boundary and acquisition, public access, facilities construction, research and monitoring, coastal training, education, stewardship, resource protection, and integration. The four goals of the JC NERR are:

#### **Goal 1. Research**

**Key management information needs, especially with respect to eutrophication, habitat loss and alteration, effects of climate change and sea level rise on coastal communities and resources, and resource conservation are supported with advanced coastal and estuarine research and observing capabilities at relevant time and space scales.**

The JC NERR addresses scientific and technical aspects of coastal management issues through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by the National Estuarine Research Reserve System research and monitoring plan (2006-2011) which identifies goals, priorities, and implementation strategies. This approach, when used in combination with the education and outreach programs, ensures that scientific information has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries. Research within the Reserves is designed to fulfill the Reserve system goals as defined in program regulations. These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System.
- Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research.
- Conduct and coordinate estuarine research within the System, gather and make available information necessary for improved understanding and management of estuarine areas.

#### **Goal 2. Coastal Training**

**Coastal decision-makers use science-based information to manage New Jersey's natural resources.**

The Coastal Training Program (CTP) of the JC NERR provides up-to-date scientific information and skill-building opportunities to coastal decision-makers who make decisions that affect

## I. Executive Summary

coastal resources. Coastal decision-makers receive the science-based content and tools they need to address critical resource management issues of concern to local communities. Additionally, the CTP provides a critical feedback loop to ensure that professional audiences inform local and regional science and research agendas. Programs are developed in a variety of formats ranging from seminars, hands-on skill training, participatory workshops, lectures, and technology demonstrations. Participants benefit from opportunities to share experiences and network in a multidisciplinary setting, often with a Reserve-based field activity.

Partnerships are important to the success of the CTP program. Reserves work closely with state coastal programs, protected area networks and a host of local partners to determine key coastal resource issues of target audiences. The CTP requires a systematic program development process, involving periodic review of the Reserve niche in the training provider market, audience assessments, development of a three to five year program strategy, a marketing plan and the establishment of an advisory group for guidance, program review and perspective in program development. The CTP implements a performance monitoring system, wherein staff report data in operations progress reports according to a suite of performance indicators related to increases in participant understanding, applications of learning and enhanced networking with peers and experts to inform programs.

### Goal 3. Education and Outreach

**The K-12 community and the general public possess increased awareness and understanding of estuaries and coastal watersheds and how they are affected by human behavior and natural change.**

Education programs provide on-site education opportunities for the community, teachers and other targeted audiences. Programs include general information about the Reserve including its ecological, economical, and historical values, and how they relate to natural resource protection and management issues. Educational programs are designed to integrate with other relevant programs in the Reserve region.

Formal education programs focus on elementary and secondary school teachers, enhancing their ability to present science in innovative ways which will stimulate student interest. Hands-on field enrichment opportunities are promoted and educators are immersed in real-time scientific research being conducted in the Reserve. In addition to field experiences, educators work with the Education Coordinator to develop practical applications that bring their experiences into the classroom.

Habitats within the Reserve serve as centers for general public education. Visitors to the Reserve gain awareness and understanding of the estuarine system through our exhibits at the Seaport and through our public programs. These activities explore ongoing research throughout the Reserve, as well as cultural, historical, and economic issues. Scientists are invited to present their research through seminars and describe how their studies are relevant to community members. In coordination with land management partners, JC NERR staff offer these community-based programs throughout the Mullica River-Great Bay watershed and beyond.

## JC NERR Management Plan 2009 - 2014

### Goal 4. Stewardship

**Resource managers use reserve science to protect, conserve and restore estuarine habitat, resources and water quality.**

In the JC NERR, science-based stewardship is a principal goal integrated throughout the research, education, and coastal training program. The JC NERR does not own or directly manage large tracts of land and therefore lacks “on the ground” physical forms of stewardship. Rather, the JC NERR defines stewardship in the broader sense of providing relevant information, education, and training to achieve our mission. This stewardship role has been broken down into different themes, each corresponding to a different spatial area of our estuarine and watershed system. These themes present the JC NERR with a variety of training opportunities based on land management, human use and unique ecological conditions.

The JC NERR will continue to implement the Mullica River Conservation Initiative, a land protection initiative with conservation agencies to conserve a contiguous greenway of ecologically and recreationally valuable land throughout the Mullica and Wading River Watersheds. This initiative, a partnership with New Jersey Conservation Foundation (NJCF) recently added 208 acres to the core reserve land which addressed gaps in protection of the Mullica River watershed. The total acreage of the JC NERR has thus been increased from 114,665 to 114,873 acres. These properties will be managed by the NJCF and include:

Bear Creek Preserve (100 acres) offers a rare chance to view water and wading birds up close in various wetland habitats. The 100-acre preserve is located where the Bear Creek flows into the lower Mullica River. The Hanselman Preserve (57 Acres) captures the gradient of coastal forest habitats from pitch pine lowland and Atlantic white cedar forest to deciduous shrub-scrub wetlands to salt marsh flats. The Rudolph Property (31 acres) is dominated by a mixed pitch pine – scrub oak upland. It is adjacent to several out-parcels of the Bass River State Forest. One portion of the property extends to the east and has frontage on the Wading River. The Lee Property (20 acres) is a pitch pine and Atlantic white cedar forest in southern New Jersey. The under story is a typical mix of low bush blueberry and huckleberry. This parcel will help protect tidal wetlands, one of the Reserve’s key habitat areas.

Inclusion of these land parcels acknowledges the JC NERR as a natural field laboratory that enables research and data collection on natural processes and human impacts occurring within the reserve, and provides a basis for increased public awareness and understanding of the complex nature of estuarine systems, their values, benefits and management challenges. These land holdings will enhance the educational, outreach and research opportunities for the Reserve, and add tremendous recreational value for diverse users.

## II. Introduction



## **II. INTRODUCTION**

### **A. Purpose and Scope of the Revised Management Plan**

The Jacques Cousteau National Estuarine Research Reserve was established in 1997 to “improve management of New Jersey coastal environments through science, education and stewardship.” This mission drives reserve goals, objectives and strategies aimed at addressing the key coastal management issues in the Mullica River-Great Bay watershed and throughout the New Jersey coastal zone.

During the past three decades, land use patterns in New Jersey have shifted from “The Garden State” to a more urbanized landscape. Nowhere is this more apparent than in the majority of the state’s coastal zone which features a highly developed shoreline and coastal communities subject to human impacts and the emerging effects of climate change. As the most densely populated state in the nation, New Jersey is projected to be the first state to reach full buildout status. Development and associated human activities are affecting water and habitat quality throughout the state. Proposals to develop remaining open space and to tap into the Kirkwood-Cohansey aquifer pose threats to the ecological integrity and character of the state’s estuaries and coastal watersheds. As a result, programs at the JC NERR focus on three key management issues:

- Nutrient inputs into coastal waters
- Human alteration of habitat and water quality
- Effects of climate change on coastal and estuarine systems

Research, education, and outreach programs of the JC NERR will address these issues in a manner that links management information with science, and enriches educational programs across all grade levels with real-world experiences and training. Responding to needs in its home location in Ocean County, the JC NERR will continue to deliver many of its nationally renowned programs in this region, but also will scale up these programs for delivery throughout New Jersey with key partners and two satellite reserve facilities.

Lands within the JC NERR are entirely in public ownership and managed by a variety of local, state and federal agencies. As a result, a significant level of resource protection is in place. For this reason, JC NERR programs have focused on research, education and coastal training, and support services for stewardship programs. These areas of emphasis will continue over the next five years.

### **B. National Estuarine Research Reserve System**

#### **1. National Estuarine Research Reserve System Mission and Goals**

The National Estuarine Reserve System was created by the Coastal Zone Management Act (CZMA) of 1972, as amended, 16 U.S.C. Section 1461, to augment the Federal Coastal Zone Management (CZM) Program. The CZM Program is dedicated to comprehensive, sustainable management of the nation’s coasts.

The Reserve system is a network of protected areas established to promote informed management of the Nation’s estuaries and coastal habitats. The Reserve system currently

## II. Introduction

consists of 27 Reserves in 22 states and territories, protecting over one million acres of estuarine lands and waters.

### Mission

As stated in the NERRS regulations, 15 C.F.R. Part 921.1(a), the National Estuarine Research Reserve System mission is:

...the establishment and management, through Federal-state cooperation, of a national system of Estuarine Research Reserves representative of the various regions and estuarine types in the United States. Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation...

### Goals

Federal regulations, 15 C.F.R. Part 921.1(b), provide five specific goals for the Reserve system:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the System;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

### **2. National Estuarine Research Reserve System Strategic Goals 2005 – 2010**

The Reserve system began a strategic planning process in 1994 in an effort to help NOAA achieve its environmental stewardship mission to “sustain healthy coasts.” In conjunction with the strategic planning process, ERD and Reserve staffs have conducted a multi-year action planning process on an annual basis since 1996. The resulting three-year action plan provides an overall vision and direction for the Reserve system. As part of this process, the Reserve system developed a vision: Healthy estuaries and watersheds where coastal communities and ecosystems thrive; and mission: To practice and promote coastal and estuarine stewardship through innovative research and education, using a system of protected areas. The following goals are outlined in the 2005-2010 Strategic Plan.

## JC NERR Management Plan 2009 - 2014

### Goals

1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research and education.
2. Increase the use of Reserve science and sites to address priority coastal management issues.
3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

### **3. Biogeographic Regions**

NOAA has identified eleven distinct biogeographic regions and 29 subregions in the U.S., each of which contains several types of estuarine ecosystems (15 C.F.R. Part 921, Appendix I and II). When complete, the Reserve system will contain examples of estuarine hydrologic and biological types characteristic of each biogeographic region. As of 2008, the Reserve system includes 27 Reserves and two Reserves in the process of designation (Figure 1). Designated and proposed Reserves are listed below.

estuarine research reserves



- |  |                                   |
|--|-----------------------------------|
| 1. Wells, Maine                            | 16. Rookery Bay, Florida          |
| 2. Great Bay, New Hampshire                | 17. Apalachicola, Florida         |
| 3. Waquoit Bay, Massachusetts              | 18. Weeks Bay, Alabama            |
| 4. Narragansett Bay, Rhode Island          | 19. Grand Bay, Mississippi        |
| 5. Connecticut *                           | 20. Mission-Aransas, Texas        |
| 6. Hudson River, New York                  | 21. Tijuana River, California     |
| 7. Jacques Cousteau, New Jersey            | 22. Elkhorn Slough, California    |
| 8. Delaware                                | 23. San Francisco Bay, California |
| 9. Chesapeake Bay, Maryland                | 24. South Slough, Oregon          |
| 10. Chesapeake Bay, Virginia               | 25. Padilla Bay, Washington       |
| 11. North Carolina                         | 26. St. Louis River, Wisconsin *  |
| 12. North Inlet-Winyah Bay, South Carolina | 27. Old Woman Creek, Ohio         |
| 13. ACE Basin, South Carolina              | 28. Kachemak Bay, Alaska          |
| 14. Sapelo Island, Georgia                 | 29. Jobos Bay, Puerto Rico        |
| 15. Guana Tolomato Matanzas, Florida       |                                   |
- \* Proposed Reserve

● designated ○ proposed

Figure 1. List and Locations of National Estuarine Research Reserves.

#### **4. Reserve Designation and Operation**

Under Federal law (16 U.S.C. Section 1461), a state can nominate an estuarine ecosystem for Research Reserve status so long as the site meets the following conditions:

- The area is representative of its biogeographic region, is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
- The law of the coastal State provides long-term protection for the proposed Reserve's resources to ensure a stable environment for research;
- Designation of the site as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation; and
- The coastal State has complied with the requirements of any regulations issued by the Secretary (of Commerce).

Reserve boundaries must include an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation.

If the proposed site is accepted into the Reserve system, it is eligible for NOAA financial assistance on a cost-share basis with the state. The state exercises administrative and management control, consistent with its obligations to NOAA, as outlined in a memorandum of understanding. A Reserve may apply to NOAA's ERD for funds to help support operations, research, monitoring, education/interpretation, stewardship, development projects, facility construction, and land acquisition.

#### **5. National Estuarine Research Reserve System Administrative Framework**

The Estuarine Reserves Division of the Office of Ocean and Coastal Resource Management (OCRM) administers the Reserve system. The Division establishes standards for designating and operating Reserves, provides support for Reserve operations and system-wide programming, undertakes projects that benefit the Reserve system, and integrates information from individual Reserves to support decision-making at the national level. As required by Federal regulation, 15 C.F.R. Part 921.40, OCRM periodically evaluates Reserves for compliance with Federal requirements and with the individual Reserve's Federally-approved management plan.

The Estuarine Reserves Division currently provides support for four system-wide programs: the System-Wide Monitoring Program, the Graduate Research Fellowship Program, the CTP, and the K-12 Estuarine Education program (KEEP). Even though no funds have yet been disbursed to individual research reserves for implementation of the KEEP program; it has received the support and approval from the NERRS system as the fourth system-wide program to be implemented. They also provide support for Reserve initiatives on restoration science, invasive species, K-12 education, and Reserve specific research, monitoring, education and resource stewardship initiatives and programs.

C. The Jacques Cousteau National Estuarine Research Reserve

1. Summary of Setting

The Mullica River-Great Bay estuary, located in the southeast corner of New Jersey is regarded as one of the least disturbed estuaries in the dense urban corridor of the northeastern United States (Figures 2 and 3). Upon approval of this management plan, the JC NERR will encompass 114,873 acres, incorporating a diverse variety of terrestrial, wetland and aquatic habitats (See JC NERR Site Profile (Appendix A) for complete characterization.) These habitats range from the Pinelands forest ecosystem to wetlands and barrier islands (Figure 4).

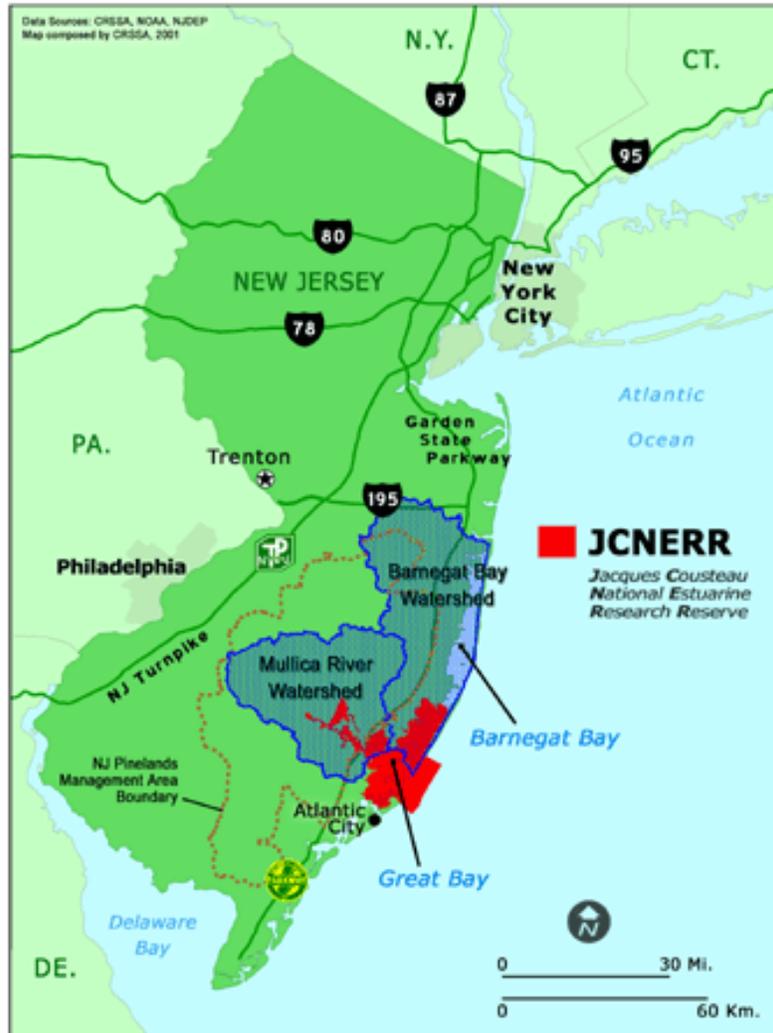


Figure 2. Location Map of The Jacques Cousteau National Estuarine Research Reserve within The Greater New Jersey Region. Note the Reserve's geographic position relative to the major metropolitan areas of Philadelphia and New York City.

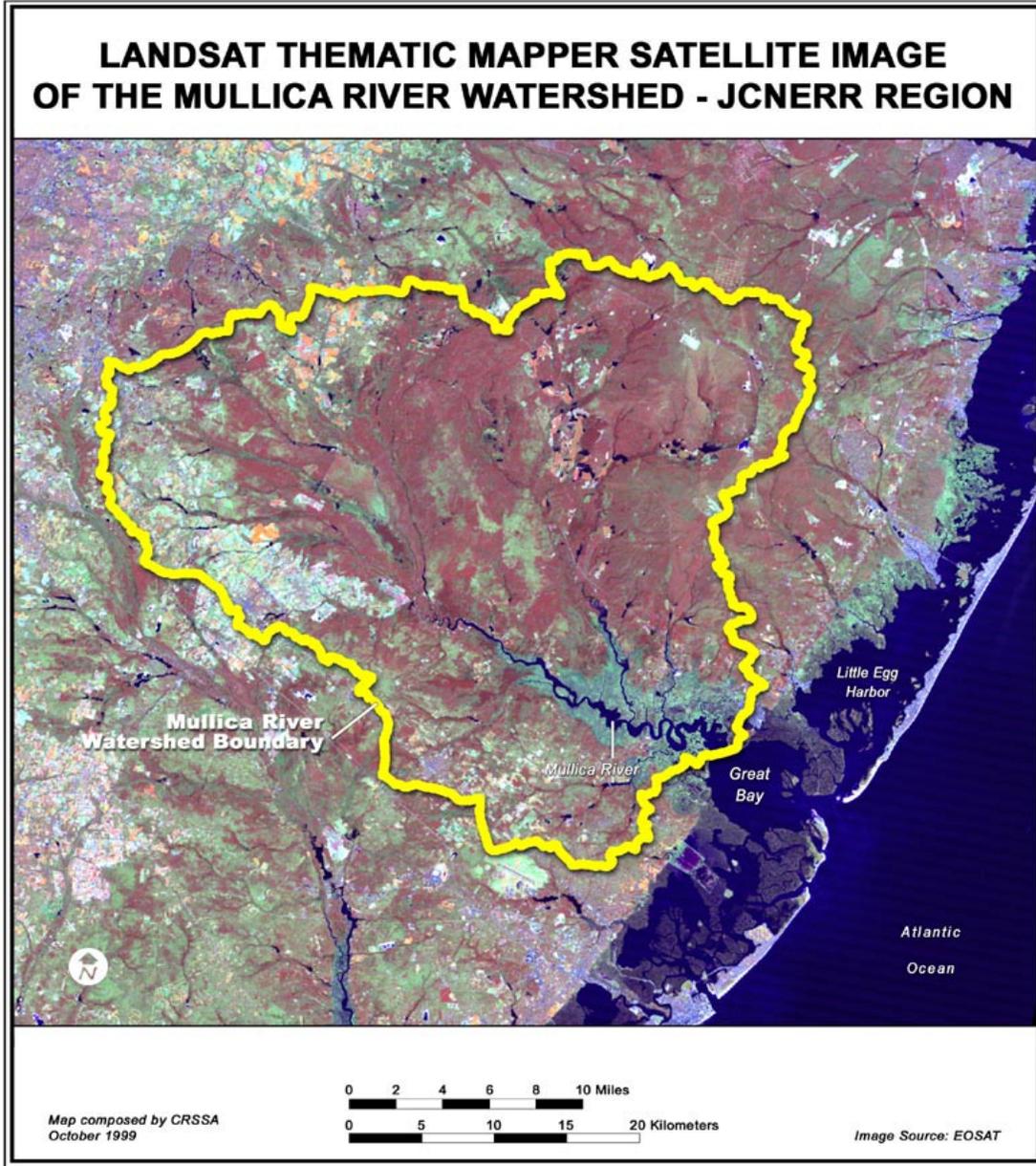
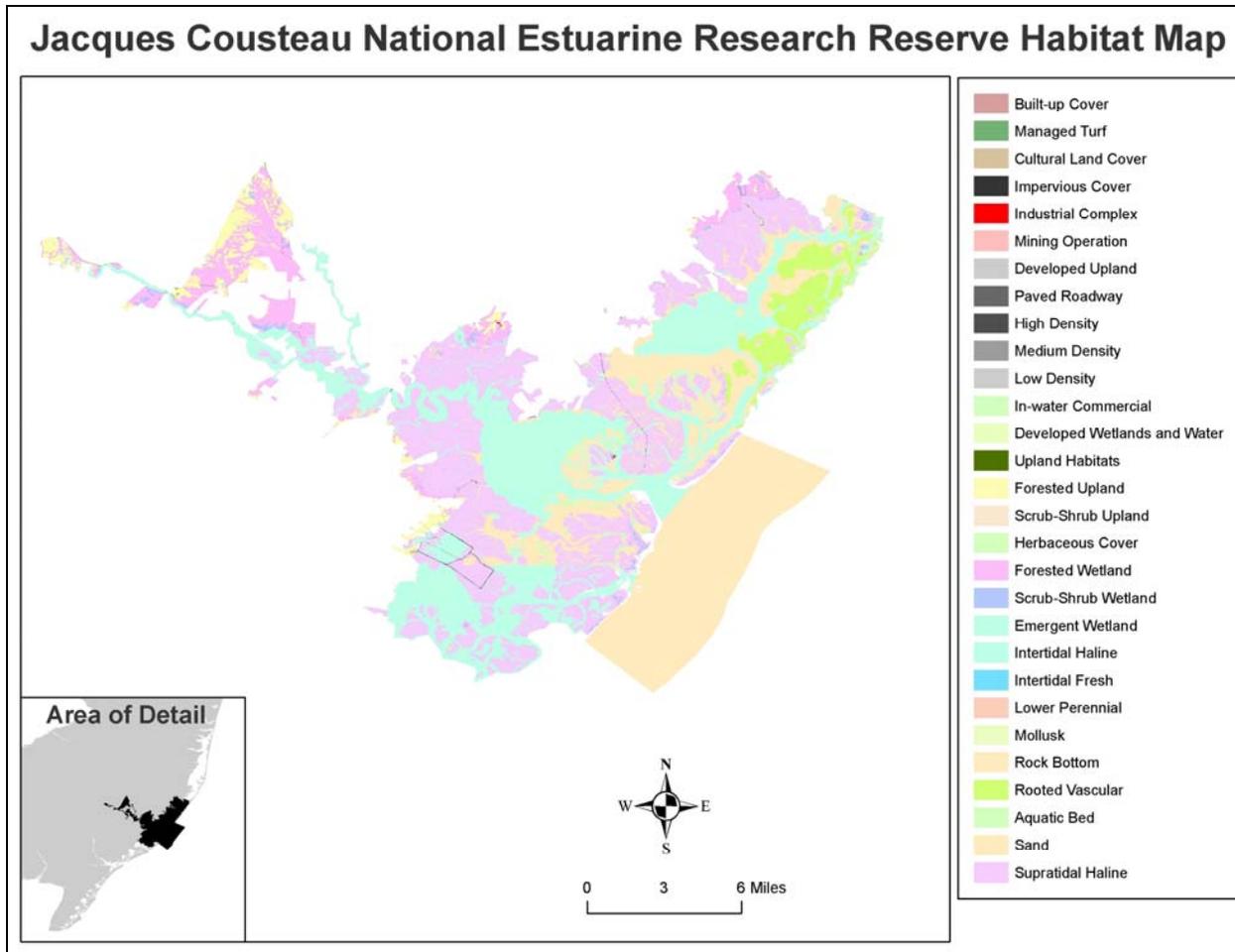
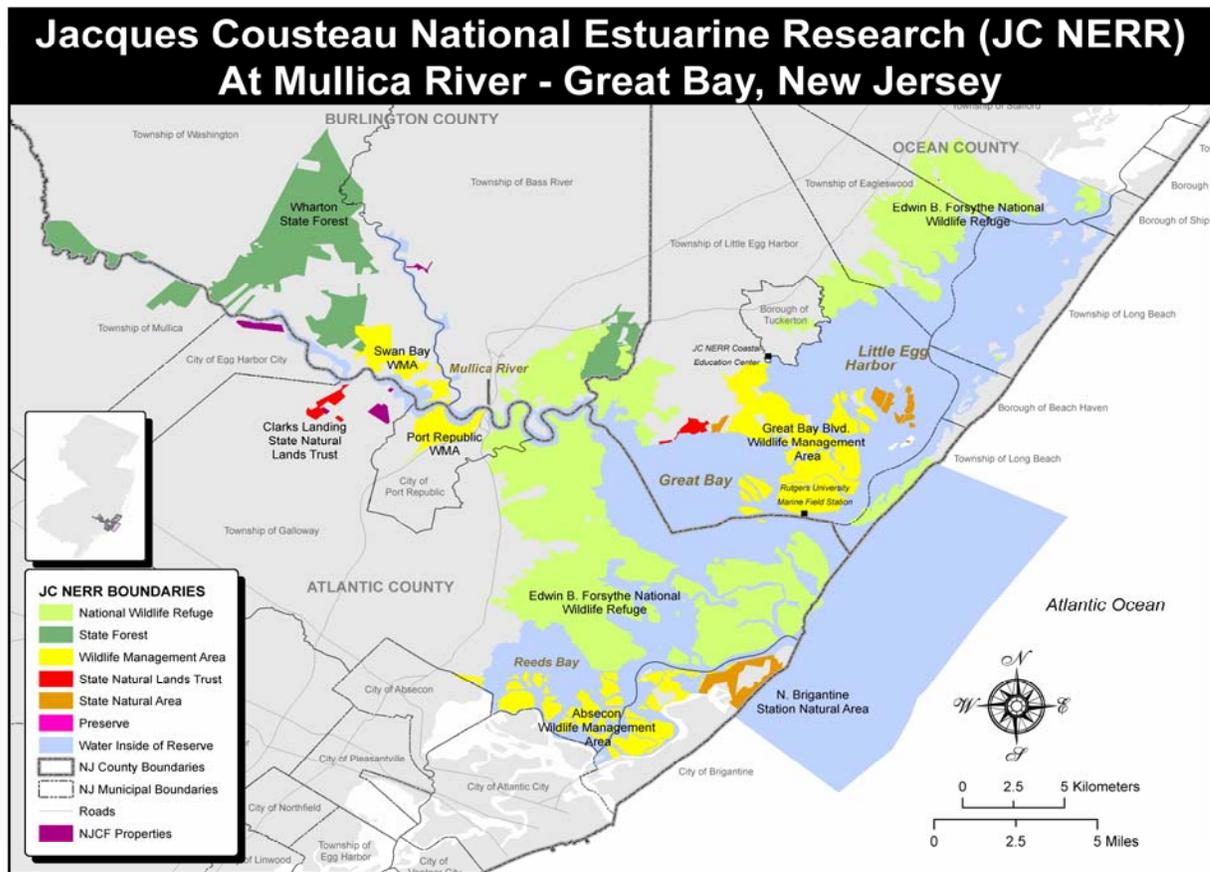


Figure 3. Landsat satellite image of the Mullica River-Great Bay Watershed and Estuary.



**Figure 4. Habitat Map of the Jacques Cousteau National Estuarine Research Reserve. (All habitats are included.)**

The lands that comprise the JC NERR are managed as a partnership of state and federal landholders, with Rutgers-Institute of Marine and Coastal Sciences as the managing institution for the Reserve (Figure 5). Recently, the JC NERR has expanded the core boundary to include additional properties as noted in section VI. Boundary and Acquisition Plan with this document. These properties provide additional buffer areas for key land and water areas that will be included in future research and monitoring programs. Core facilities for the JC NERR include a primary complex that contains offices, a classroom, wet lab, and dormitory. A separate facility houses a public exhibit, and additional research space is located at the Rutgers Marine Field Station.



**Figure 5. JC NERR Land Owners and Managers Including Recent Acquisitions.**

In general, the climate in New Jersey and the Reserve is temperate characterized by well-defined seasons. The Reserve lies between the Delaware River Valley, Delaware Bay and the Atlantic Ocean all of which have a moderating effect on weather and climate conditions.

The Mullica River-Great Bay estuary is located on the Atlantic Coastal Plain, created over the last 170-200 million years by depositional and erosional processes. The low relief with sandy soil underlain with several water-bearing sand layers and confining clay layers give rise to a unique surface and groundwater system. The Cohansey and Kirkwood formations form the principal aquifers in the region, and may contain as much as 17 trillion gallons of water. These tremendous water reserves are due to the sandy soils, flat terrain, and evenly distributed precipitation. The nature and extent of these aquifers govern the character and integrity of Reserve habitats. For example, streams flow in shallow, broad valleys on the predominately sandy soils with cedar forests marking the water course through the uplands. Most of the streams drain eastward and southeastward on the Atlantic slope toward the ocean. Rivers, streams and other bodies of water in the Pine Barrens are stained brown from the humic acids of decaying vegetation and high iron content.

## II. Introduction

The Mullica River drainage basin is confined to the Pine Barrens region and includes the Bass, Wading, Oswego, and Batsto Rivers, as well as several smaller sub-basins. The total drainage basin area is 1,470 square km (569 square mi.) upstream of Great Bay. Approximately 45 percent of the total precipitation entering the system infiltrates into the groundwater system. Groundwater thus constitutes a major conduit that contributes to the estuary.

### a. Upland Forests

In the upland forests, the water table is generally two or more feet below ground level and may be as deep as 60 to 70 feet. This contrasts sharply with the lowlands, where water is near or above the surface during part of the year. The upper headwaters of the Mullica River contain many white cedar swamps, Sphagnum bogs, and cranberry bogs. The difference in moisture conditions gives rise to two distinct floristic complexes—upland forests and lowland forests.

The upland areas support two major vegetation types, namely pine-oak forests and oak-pine forests. The dominant tree is the pitch pine. In no other region of North America does the pitch pine cover such an extended area. Fire plays an integral role in determining the composition of upland areas. Differences in resistance to fire damage, shade tolerance, and reproductive strategies govern the selective action of fire on various plant species. Both pitch pine and oaks have the ability to resprout from dormant buds lying beneath the soil surface.

Upland streams are stained brown from the humic acids of decaying vegetation, with flow generally slow due to the gentle topography. Stream water is acidic with an average pH of 4.4, and is low in alkalinity and high in humic compounds. These areas provide habitat for a number of orchids and insectivorous plants.

Upland vertebrate amphibian and reptilian species include the tiger salamander, wood turtle, timber rattlesnake, pine snake and the Pine Barren frog. The southern bog lemming and bird species, including the barred owl and the redheaded woodpecker, also inhabit this area.

### b. Lowland Habitats

In lowland forests, water levels near the surface exert year-round influence on vegetation patterns. These forests are composed of Atlantic white cedar, red maple, pitch pine, black gum, gray birch, sassafras and sweetbay magnolia. Cedar swamps and sphagnum bogs are scattered throughout the pine lowlands. A dense canopy is formed by the cedars inhibiting an understory community. Fauna in this region includes birds such as the osprey, peregrine falcon, black duck, ruddy duck, and the great blue heron; reptiles such as the bog turtle; and amphibians such as the long-tailed salamander and the eastern mud salamander.

Brackish marshes are dominated by cattail, salt reed grass, and three square rush. Fauna includes egrets, terns, skimmers, and the common gull species. Other marsh birds include herons, ibises, sparrows, warblers, bobolinks, and godwits.

Tidal salt marshes form an extensive and functionally significant component of the margin between the pinelands and Great Bay. High salinity salt marshes, dominated by stands of saltwater cordgrass, salt meadow grass, and spike grass occur near the coast and along the lower Mullica River. Insect and spider fauna of the marsh surface have been particularly well studied with a focus on the planthoppers. Fish of the marsh surface pools and intertidal creeks are

## **JC NERR Management Plan 2009 - 2014**

dominated by killifishes and silversides. Fish of the subtidal creeks are much more diverse and seasonally variable.

Coastal habitats feature dunes, barrier islands and open water environments. Dune covered regions are generally characterized by an herbaceous community dominated by dune grass, goldenrod, searocket and, in protected areas of the back dune, beach heather. Fauna includes shorebirds such as plovers, terns and skimmers.

Barrier islands such as Little Beach and its associated salt marsh islands represent a major nesting, migration and wintering area for waterfowl, marsh birds and shorebirds. Species commonly found here include grebes, herons, egrets, brants, bitterns, rails, sandpipers, gulls, terns, skimmers and piping plovers. Several osprey nests are on the island, as well as a rookery of black-crowned night herons.

Great Bay represents a major migratory stop and wintering area for many waterfowl, shorebirds and raptors. During winter, the waterfowl population exceeds 70,000 individuals including more than 40 distinct nesting colonies for 15 species. The estuary supports 61 species of finfish. Major anadromous fish are the striped bass, alewife and blueback herring. Shellfish populations are extensive, especially for surf clams.

### **2. Human Environment / Impact**

Geographic Information Systems (GIS) are used to create, manipulate and analyze digital spatial data, and have been critical to map land use and future developmental pressures in the Mullica River Watershed and Barnegat Bay Watershed (Figure 6). This information also has been used to support buildout analyses of relevant watershed areas. These and other remote sensing activities have been done in partnership with the Center for Remote Sensing and Spatial Analysis (CRSSA) at Rutgers University.

The term “buildout” refers to a GIS model that predicts development based on zoning laws, Pinelands Management Area (PMA) regulations, and N.J. Coastal Area Facility Review act (CAFRA) regulations.

Hydrologic flow from land through runoff, groundwater, rivers, and streams connect upstream watersheds with estuary systems. The increase of human population and the resulting land cover/land use change can alter this hydrologic cycle, changing environmental conditions within connected estuary systems. There are two major watersheds that provide freshwater to the JC NERR system; the Barnegat Bay Watershed (508,240 acres) and the Mullica River Watershed (420,167 acres). These two watersheds are very different with respect to population, land use land cover, and impervious surface both present and future (predicted).

#### **a. Population**

The Barnegat Bay Watershed had a 2000 population of 513,400 people (United States Census Bureau). Future population predictions based on municipal zoning files, PMA regulations, and CAFRA rules for the Barnegat Bay Watershed range between 783,231 and 896,920 people (Lathrop and Conway, 2001).

Jacques Cousteau National Estuarine Research Reserve Land Use Land Cover

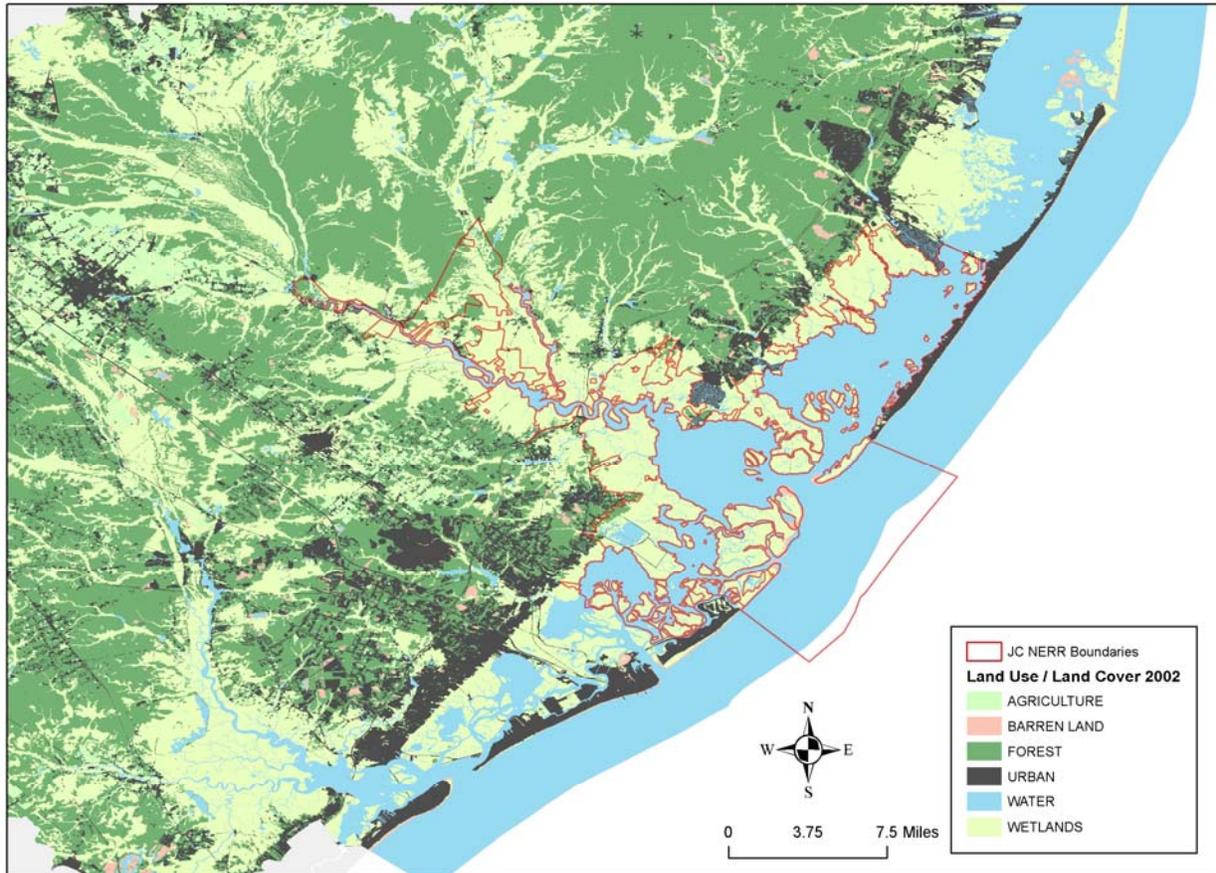


Figure 6. 2002 Land Use - Land Cover Map of the Great Bay Mullica River Watershed.

The Mullica River Watershed had a 1990 population of 76,383 people or 0.182 people per acre. In 2000 the population increased to 83,501 or 0.199 person/acre which is an 8% increase in population over a ten year period. Future population predictions based on municipal zoning files, PMA regulations, and CAFRA rules for the Mullica River Watershed range between 110,472 and 123,680 people. This would represent a 32% to 48% percent increase in population from 2000 with a resultant density between 0.263 and 0.294 person/acres respectively.

**b. Land Cover**

Land Use and Land Cover within the Mullica River Watershed has been compiled for two time periods, 1995 and 2002 (Table 1). Older historical data from 1986 was excluded from this analysis due to differences in data collection and analysis. Between 1995 and 2002 there was a net increase of 2,420 acres or 346 acres per year of urban land. Both forest and agricultural areas were lost, 1,110 acres for the former and 1,352 acres for the latter. Future development within the watershed is expected to be limited by zoning and spatially directed to town centers. (Lathrop et al, 2003).

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| Type               | 1995 acres | 2002 acres | Net change 95-02 | Annual Net change 95-02 |
|--------------------|------------|------------|------------------|-------------------------|
| <b>Urban</b>       | 24,167     | 26,586     | 2,420            | 346                     |
| <b>Agriculture</b> | 23,883     | 22,772     | -1,110           | -159                    |
| <b>Barren</b>      | 2,160      | 2,294      | 134              | 19                      |
| <b>Forest</b>      | 187,652    | 186,300    | -1,352           | -193                    |
| <b>Wetland</b>     | 135,124    | 135,423    | 299              | 43                      |

**Table 1. Mullica River Watershed Land Use Land Cover from 1995 – 2002.**

Land Use and Land Cover within the Barnegat Bay Watershed has been compiled for three time periods, 1995, 2002, and 2006 (Table 2). Older historical data from 1986 was excluded from this analysis due to differences in data collection and analysis. A total of 1,650 acres of new urban land was created per year between 1995 and 2002. This slowed down slightly between 2002 and 2006 to 1,109 acres per year. Most of this urban land was created from the conversion of forested land areas with a total of 13,278 acres of forested areas converted to urban areas between 1995 and 2006 (Table 2a) (Lathrop and Haag, 2007.)

| Type               | 1995 acres | 2002 acres | 2006 acres | Net change 95-02 | Annual Net change 95-02 | Net Change 02-06 | Annual Net Change 02-06 |
|--------------------|------------|------------|------------|------------------|-------------------------|------------------|-------------------------|
| <b>Urban</b>       | 87,757     | 99,308     | 103,746    | 11,551           | 1,650                   | 4,438            | 1,109                   |
| <b>Agriculture</b> | 5,302      | 4,576      | 4,205      | -726             | -104                    | -371             | -93                     |
| <b>Barren</b>      | 9,199      | 8,935      | 9,034      | -264             | -38                     | 99               | 25                      |
| <b>Forest</b>      | 156,827    | 147,401    | 142,579    | -9,425           | -1,346                  | -4,822           | -1,206                  |
| <b>Wetland</b>     | 90,165     | 89,325     | 89,048     | -841             | -120                    | -277             | -69                     |

**Table 2. Barnegat Bay-Little Egg Harbor Watershed Land Use Land Cover from 1995, 2002, and 2006. Total area was slightly different between years due to the fact water was excluded from the analysis.**

|                 |             | 2006 Land Cover |             |        |         |         |
|-----------------|-------------|-----------------|-------------|--------|---------|---------|
|                 |             | Urban           | Agriculture | Barren | Forest  | Wetland |
| 1995 Land Cover | Urban       | 86,606          | 102         | 151    | 569     | 19      |
|                 | Agriculture | 215             | 950         | 43     | 110     | 2       |
|                 | Barren      | 1,761           | 25          | 5,647  | 1,201   | 202     |
|                 | Forest      | 13,278          | 246         | 2,171  | 140,535 | 64      |
|                 | Wetland     | 1,012           | 32          | 179    | 51      | 88,594  |

**Table 2a. Transition Table for Entire Study Area Between 1995 and 2006.**

### 3. Impervious Surface

Impervious surface refers to roadways, rooftops, parking lots or any surface that water cannot penetrate through. Increasing impervious surface can be used as an indicator of both the intensity of anthropogenic development and the impact that this development has on the environment. Impervious surface is especially important within both the Mullica River Watershed and the Barnegat Bay watershed, as these watersheds are dominated by sandy pineland soils. The porous soils of the pinelands allow water to infiltrate into underground aquifers, lowering the amount and speed of surface runoff into streams and ultimately into the estuary system. Scientific studies have shown the larger the percent of the total surface covered by impervious surface the greater the resulting environmental impact. In general, watersheds that have less than 10% impervious surface are considered non-impacted, greater than 10% and less than 20% are considered impacted and greater than 30% are considered degraded.

Impervious surface within the Barnegat Bay watershed was summarized for 1986, 1995, 2002, and predicted in the future at buildout. Future predictions on impervious surface were accomplished by matching existing land cover categories with an average impervious surface value and extrapolating these values to a future predicted land cover layer. To determine the percentage of impervious surface the impervious area was divided by the upland area of the watershed (387,738 acres for the Barnegat Bay Watershed and 379,537 acres for the Mullica River Watershed). Estuary and ocean waters areas were not included.

In 1986, the Barnegat Bay watershed was covered by 7% percent impervious surface, or approximately 27,000 acres. This increased in 1995 to approximately 8% impervious surface or approximately 30,000 acres of impervious surface. In 2002, the impervious surface covered approximately 34,000 acres or 9% of the total surface area of the watershed. While this is below the 10% cutoff for impacted watersheds, 32% of the sub-watersheds within the larger Barnegat Bay watershed were over 10% impervious surface in 1995. At buildout, the Barnegat Bay watershed is predicted to have 12% impervious surface or approximately 46,500 acres of impervious surface.

Impervious surface for the Mullica River Watershed in 1986 was 1.3% or 5,100 acres. Between 1986 and 1995 impervious surface increased to 1.5% or 5,750 acres. In 2002, the impervious surface covered around 6,550 acres or 1.7% of the total surface area of the watershed. Both values are substantially less than the 10% threshold. The build-out analysis aggregated across the entire Mullica River basin, predicted a range of impervious surface between 2.5% and 2.8%. These values are also well below the 10% threshold for impacted areas.

### **III. JC NERR Vision, Mission, Goals, Objectives and Strategies**



### **III. JC NERR Vision, Mission, Goals, Objectives and Strategies**

#### **III. JC NERR VISION, MISSION, GOALS, OBJECTIVES AND STRATEGIES**

This section of the Management Plan identifies the vision and mission of the Reserve and outlines the four overarching goals and the related objectives and strategies which provide the underlining basis for all work plans. Goals, objectives and strategies are highlighted in detail within the Research, Coastal Training, Education and Stewardship sections.

##### **A. Vision**

A center of expertise for the protection and preservation of estuaries and coastal watersheds through science-based management and informed public stewardship.

##### **B. Mission**

To improve management of New Jersey coastal environments through science, education and stewardship.

##### **C. Goals, Objectives and Strategies**

The JC NERR mission drives reserve goals, objectives and strategies aimed at addressing the key coastal management issues in the Mullica River-Great Bay watershed and throughout the New Jersey coastal zone.

A broad suite of environmental issues bears on the quality of life and economic vitality of the New Jersey coastal zone. These include watershed management, sediment and water contamination, fishery management, nutrient enrichment, declines in natural resources, habitat loss, beach erosion, and harmful algal blooms. Given the importance of the coastal environment to the sustained economic development of the state, JC NERR research, teaching, and service programs that bear on coastal management issues can be used to help inform environmental planning and decision-making. Issues such as these are the subject of constant debate by the public, the media, and coastal decision-makers. A common feature of these debates is the need for better information and training about the coastal environment.

During the past three decades, land use patterns in New Jersey have shifted from “The Garden State” to a more urbanized landscape. Nowhere is this more apparent than in the majority of the state’s coastal zone which features a highly developed shoreline and coastal communities subject to human impacts and the emerging effects of climate change. As the most densely populated state in the nation, New Jersey is projected to be the first state to reach full buildout status. Development and associated human activities are affecting water and habitat quality throughout the state. Proposals to develop remaining open space and to tap into the Kirkwood-Cohansey aquifer pose threats to the ecological integrity and character of the state’s estuaries and coastal watersheds. As a result, programs at the JC NERR focus on three key management issues:

- Nutrient inputs into coastal waters
- Human alteration of habitat and water quality
- Effects of climate change on coastal and estuarine systems

Research, education, and outreach programs of the JC NERR will address these issues in a manner that links management information with science, and enriches educational programs

## JC NERR Management Plan 2009 - 2014

across all grade levels with real-world experiences and training. Responding to needs in its home location in Ocean County, the JC NERR will continue to deliver many of its nationally renowned programs in this region, but also will scale up education and training programs for delivery throughout New Jersey with key partners at two satellite reserve facilities.

### Goal 1. Research

**Key management information needs, especially with respect to eutrophication, habitat loss and alteration, effects of climate change and sea level rise on coastal communities and resources, and resource conservation are supported with advanced coastal and estuarine research and observing capabilities at relevant time and space scales.**

#### Objectives

- Track and predict short-term variability and long-term change in the integrity and biodiversity of estuarine ecosystems and coastal watersheds.
- Disseminate research results and other pertinent information to local and regional decision-makers.
- Promote the reserve as a long-term study site for use by federal, state, local, private and academic organizations.

#### Strategies

- Capitalize on innovative remote sensing and observation technologies to track change in ecosystem processes, land use and land cover.
- Maintain a data repository that is easily accessed by coastal stakeholders.
- Partner with CICEET and other organizations to focus research and observing opportunities in the JC NERR.
- Communicate results of research through publicly accessible media.
- Collaborate with coastal training and education staff to translate research findings to target audiences.

### Goal 2. Coastal Training

**Coastal decision-makers use science-based information to manage New Jersey's natural resources.**

#### Objectives

- Coastal decision-makers will use decision support tools and reserve products to address local and regional management needs.
- Coastal decision makers will recognize the CTP as a resource for scientific information relevant to watershed management issues.
- Coastal decision makers will understand the impacts their management decisions have on NJ's natural resources.
- Coastal decision-makers will increasingly implement science based decision-making.

### III. JC NERR Vision, Mission, Goals, Objectives and Strategies

- Identify and preserve significant unprotected estuarine areas within the Mullica River-Great Bay system.
- Natural resource managers will consider regional approaches to adaptive coastal ecosystem management.

#### Strategies

- Develop decision support tools to inform management land and acquisition activities of the coastal management community.
- Assist partners to identify ecologically sensitive lands, and assist in acquiring funds for land acquisition and protection.
- Coordinate programs and activities through the emerging seamless network initiative with protected area networks such as the U.S. Fish and Wildlife Service, National Park Service, Pinelands Commission, and the New Jersey Department of Environmental Protection.
- Conduct coastal training workshops in response to local and regional information needs.
- Implement performance measures and program evaluations to evaluate and guide JC NERR products, programs and services.

#### **Goal 3. Education and Outreach**

**The K-12 community and the general public possess increased awareness and understanding of estuaries and coastal watersheds and how they are affected by human behavior and natural change.**

#### Objectives

- Coastal watershed communities will understand the environmental and economic value of estuaries and coastal watersheds.
- Coastal watershed communities will recognize the JC NERR as a provider of science-based information and resources.
- K-12 teachers will incorporate lessons and hands-on experiences which demonstrate the value and function of estuarine and coastal habitats
- Coastal watershed residents will understand the importance of their role as environmental stewards.

#### Strategies

- Provide training opportunities for the next generation of coastal managers.
- Heighten visibility of the JC NERR by participating in public events, communication and marketing activities.
- Provide educational and recreational activities for the general public
- Deliver professional development programs to K-12 educators.
- Promote awareness of the value of estuaries through diverse media such as the Life on the Edge exhibit, the reserve website, newsletter, brochures, and interaction with community groups.

## JC NERR Management Plan 2009 - 2014

### Goal 4. Stewardship

**Resource managers use reserve science to protect, conserve and restore estuarine habitat, resources and water quality.**

#### Objectives

- Resource managers will increasingly use GIS data layers to support coastal management decisions and set priorities for land acquisition.
- Coastal communities will recognize the ecological, economic, historical and cultural importance and value of estuaries.
- Protect, conserve and restore estuarine habitat and water quality.
- Coastal communities will adapt to and mitigate the effects of climate change and sea level rise.

#### Strategies

- Identify the best available information, tools and technology for environmental decision-making.
- Train resource managers in the use of GIS technologies
- Track land use/land cover change in the Mullica River-Great Bay estuary and surrounding watershed.
- Establish JC NERR as a sentinel site for demonstrating approaches to respond to effects of climate change and sea level rise.

# IV. Summary of Accomplishments



## IV. SUMMARY OF ACCOMPLISHMENTS

### A. Introduction

The JC NERR staff has developed a broad array of research, education and coastal training programs and services that benefited diverse audiences. These achievements are a tribute to an outstanding staff dedicated to excellence in coastal management. Moreover, the staff has made strong contributions to the reserve system. Each staff member has devoted considerable time, energy and talent to develop and advance system-wide initiatives to elevate the NERRS as a national leader in coastal research, education and training. Key program accomplishments at the site level and system-wide level are provided below. A more complete list of past accomplishments may be found at Appendix I and Appendix J.

#### 1. Site Profile

*Characterization of the Jacques Cousteau National Estuarine Research Reserve* is a comprehensive profile report on the 22<sup>nd</sup> program site of the National Estuarine Research Reserve System. This 494-page document is the culmination of an intensive three-year effort to synthesize the voluminous information base that exists on the terrestrial and aquatic ecosystem components that comprise the JC NERR including the Mullica River-Great Bay and the Barnegat Bay-Little Egg Harbor estuaries. It also details the extensive outreach and education programs linked to community involvement in reserve programs. Major elements covered in the report include a description of the physical-chemical conditions, water quality, habitats, and biotic communities of the watershed and estuarine systems. It also discusses the significance of the system-wide monitoring program and the importance of ongoing research projects in the Reserve. In addition, endangered and threatened species are compiled for the region, as well as recreational and commercial species found within the reserve boundaries. The JC NERR site-profile is posted to the website at [http://www.jcnerr.org/pdf/JCNERR\\_FINAL\\_PROFILE\\_1-7-09.pdf](http://www.jcnerr.org/pdf/JCNERR_FINAL_PROFILE_1-7-09.pdf).

#### 2. Journal of Coastal Research

The Research Coordinator served as the editor of Special Issue 55 of the *Journal of Coastal Research* devoted to research and monitoring of NERRS program sites. This comprehensive compendium volume, published in July 2008, consists of 19 articles dealing with specific research and monitoring projects at reserve sites that investigated linkages between physical and biological components of estuarine ecosystems. It includes articles based on NERRS monitoring data alone, as well as investigations that pair NERRS research data with data collected by other entities. The latter type of studies demonstrate the value of concurrently using data from multiple monitoring and research programs in NERRS to more fully understand patterns and processes in NERRS estuarine systems.

#### 3. System-Wide Monitoring Program/Integrated Ocean Observing System (SWMP/IOOS) Real-Time Data in K-12 Classrooms

A front-end assessment was conducted to evaluate the ways in which K-12 teachers and students can use real-time data and associated education products to understand and appreciate the role of the environment in general, and the ocean in particular, plays in their daily lives. This project is aimed to identify the gap between SWMP/IOOS scientific data (current and projected) and the needs and capabilities of K-12 teachers and students to use those data, and to determine and

## IV. Summary of Accomplishments

recommend ways to bridge that gap via data visualization/ presentation and educational products/services. During the spring and summer of 2006, data was gathered from 54 stakeholders and 92 teachers from across the U.S. through:

- literature review.
- interviews and an online survey of stakeholders.
- focus groups (7 at 5 sites nationwide) with K-12.
- prioritizing activity with teachers and stakeholders during Centers for Ocean Science Education Excellence-Mid-Atlantic and Monterey Bay Aquarium Research Institute's Education and Research: Test Hypotheses teacher workshops.

This study was very successful and has impacted the design and development of the NERRS national education program, and other IOOS education initiatives.

### 4. Impacts to Coastal Systems Symposium

“The Impacts to Coastal Systems” symposium, sponsored by the JC NERR and the Barnegat Bay National Estuary Program was held at Rutgers University in April 2004. Approximately forty-five scientists and managers from throughout the mid-Atlantic and southeast Atlantic regions participated. The symposium aimed to evaluate existing knowledge and data gaps on nutrient dynamics and nutrient enrichment in the Barnegat Bay-Little Egg Harbor Estuary (BB-LEH).

Technical and management aspects of nutrient problems in the BB-LEH estuary and comparable systems nationwide were featured. Specific topics included nonpoint source nutrient inputs, eutrophication assessment, water quality and biotic indicators of eutrophication stress, algal blooms, impacted habitats, altered trophic organization, development of coastal nutrient standards, management options to remediate nitrogen loadings and other management controls.

A special issue of *Ecological Applications* on the topic of eutrophication was published. (Kennish, M. J. (Editor). 2007. Eutrophication of Estuarine and Shallow Coastal Marine Systems. *Ecological Applications*, Special Issue, Volume 17, Number 5. 196 p.)

### 5. Effects of Climate Change on Our Local Estuaries

“Effects of Climate Change on Our Local Estuaries” was the topic of a workshop held on June 9, 2007. The program informed participants about the effects of climate change on local estuarine environments by providing them with local and global science-based information. The workshop included a viewing of the “Inconvenient Truth” movie, a presentation by Dr. Mike Kennish about the local effects of climate change, and wrapped up with a facilitated discussion on climate change issues led by Steve Miller of the Great Bay NERR.

### 6. The Changing Landscape of the Barnegat Bay

Scientists from Rutgers University have been very engaged in assessing the ways in which the water quality, land use patterns and benthic habitats have changed in the Barnegat Bay watershed. This symposium featured research conducted by Dr. Mike Kennish and Dr. Rick Lathrop from Rutgers University. The symposium opened with a historical perspective regarding the changes from the late 1800's until mid-1900. Dr. Kennish spoke about the changes in the benthic communities, namely the eelgrass beds, shellfish resources and other estuarine indicators of change. Discussion centered on the ways in which land use alterations have

## **JC NERR Management Plan 2009 - 2014**

affected the amount of runoff that makes its way into the Bay. Data indicating the effects of build out on the watershed was highlighted.

### **7. Bay and River Shoreline Stabilization**

In May 2005 a workshop focusing on Bay and River Shoreline Stabilization was held in Monmouth County. Speakers included experts in the field from Rutgers University, Stevens Institute of Technology, the NJ DEP, and the U.S. Army Corps of Engineers. Topics were selected based on a previous needs assessment and included background on processes, current regulations, stabilization alternatives, and the status of current local stabilization projects.

### **8. Riparian Assessment**

Assessment of Land Use Change and Riparian Zone Status in the Barnegat Bay and Little Egg Harbor Watershed: 1995-2002-2006. The BB-LEH estuary is suffering from eutrophication issues due to nutrient, most importantly nitrogen, loading from both atmospheric as well as watershed sources (Kennish et al, 2007). Urban and agricultural land uses can be an important source of nitrogen loading. As part of our ongoing monitoring efforts, the Grant F. Walton Center for Remote Sensing & Spatial Analysis, with funding provided by the BBNEP, undertook to map and assess recent land use change in the BB-LEH watershed. Updated mapping reveals that urban land use increased from approximately 25% in 1995 to approximately 30% of the BB-LEH watershed in 2006. Including all altered land uses (i.e., agriculture and barren lands) puts the percentage of altered land in the BB-LEH watershed at over 33% in 2006. The BB-LEH estuary system is continuing to experience a significant conversion of forested and wetland habitats to urban land cover and thereby exacerbating nutrient loading to the BB-LEH estuary.

### **9. LiDAR Conference**

A LiDAR (light detection and ranging) conference was held in partnership with the JC NERR, Rutgers University and US Geological Survey in October 2007. This video conference based at the JC NERR Coastal Center focused on the process to collect analysis and use LiDAR data. LiDAR is extremely useful in coastal areas to map shoreline change, dune loss, effects of sea level rise, model storm surge, model storm water runoff, and model flood zones. This conference featured a wide variety of speakers from South Dakota and Montana using video conferencing and webex technologies. A diverse group of attendees at the JC NERR Coastal Center included representatives from Burlington, Atlantic, and Gloucester counties, NJDEP staff, Stockton College, the Delaware Valley Regional Planning Commission, Camden and Gloucester Soil Conservation District, The US Fish and Wildlife Service, the Delaware River Basin Commission, and the NAVAL Air Station. A second audience was housed in the Alampi Room at the Institute of Marine and Coastal Sciences (IMCS) at Rutgers University.

### **10. NJDEP Chlorophyll Monitoring Website**

The JC NERR has been working in cooperation with The Marine Water Monitoring Bureau, the NJ Forest Fire Service, Rutgers University, and United State Environmental Protection Agency (USEPA) Region 2 to implement aircraft remote sensing for estimating chlorophyll levels in NJ's coastal waters. Since chlorophyll is a plant pigment, high levels in the water are typically associated with an algal bloom. A plane flies 6 times a week, weather depending, over the coastal waters New Jersey to monitor the chlorophyll levels. This aerial monitoring provides a valuable perspective on water conditions and trends and enables targeted boat sampling in

#### **IV. Summary of Accomplishments**

locations where algal blooms may be occurring. This data is then mapped using Google maps to show high or low chlorophyll values over the New Jersey coastal ocean. Additional information can be found at <http://www.state.nj.us/dep/bmw/remotesensing.htm>.

## V. Administration Plan



V. ADMINISTRATION PLAN

A. Agencies Roles / Responsibilities

1. Lead State Agency Role/Responsibility

The JC NERR serves as the umbrella for an integrated approach to managing the Mullica River-Great Bay watershed among Reserve landholders (Figure 7). The lands that comprise the JC NERR are managed as a partnership of state and federal landholders, with Rutgers-Institute of Marine and Coastal Sciences as the managing institution for the Reserve. Each landholder has provided Rutgers with a written commitment to the Reserve program through a Memorandum of Understanding (MOU) (Appendix D). Rutgers-IMCS receives the federal financial assistance and has overall responsibility for Reserve management. Primary staff members are employed by Rutgers-IMCS and include a Manager, Executive Administrative Assistant, Education Coordinator, Public Programs Coordinator, CTP Coordinator, Watershed Coordinator/North, Watershed Coordinator/South, Research Coordinator, Field Researcher/SWMP Technician, Field Researcher-Technology/GIS Coordinator, Volunteer Coordinator, Communications and Budget Coordinator, and Interpretation Coordinator.

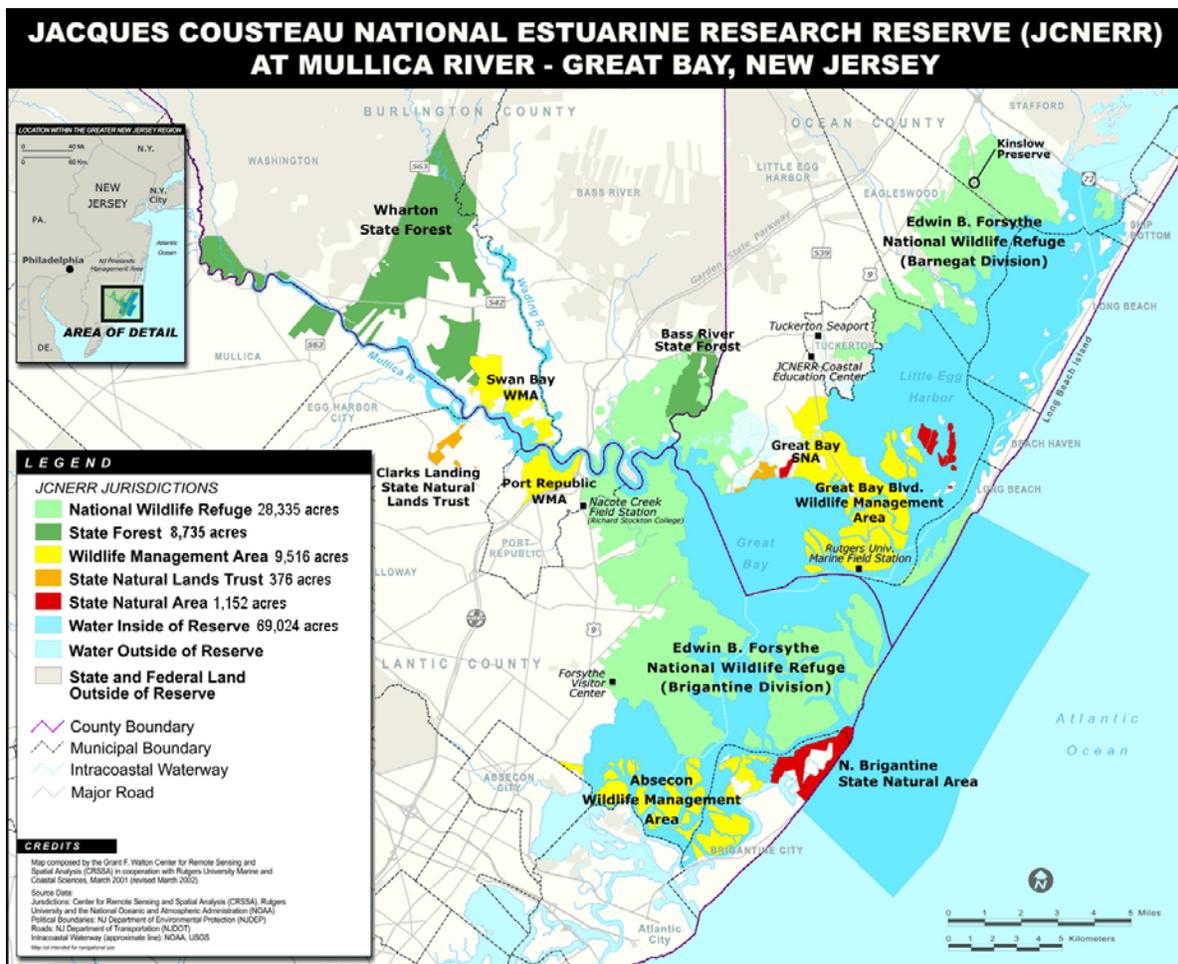


Figure 7. Land Owners/Managers within the JC NERR.

**2. Federal Agencies**

**a. U.S. Department of Interior, U.S. Fish & Wildlife Service**

The U.S. Fish and Wildlife Service manages the Edwin B. Forsythe National Wildlife Refuge. The Barnegat component of the Forsythe Refuge lies within the boundary of the JC NERR, an area that is managed in support of migratory waterfowl and includes environmental manipulations to provide habitat and food for this natural resource. The Forsythe Refuge maintains a field office, impoundments, nature trails and a Coastal Center. The Refuge Manager sits on the JC NERR advisory board.

**3. State Agencies**

**a. N. J. Department of Environmental Protection**

The NJ DEP is the designated state agency to administer programs under the CZMA. The NJ DEP implements state coastal programs and enforces regulations. The NJ DEP collaborates on CTP and outreach programs with the JC NERR, and coordinates management of state lands associated with the Reserve (eg. state run natural land trusts and natural areas). Rutgers-IMCS, together with the NJ DEP and the USFWS have signed a memorandum of understanding (see Appendix D) to advance the long-term management goals and objectives of the Reserve. These institutions jointly coordinate and collaborate on research initiatives and education programs within the Reserve, targeting those coastal and management issues of importance to coastal decision-makers. This partnership network promotes exchange of research findings and educational programs, and helps to integrate delivery of NJ DEP and JC NERR programs.

**b. Pinelands Commission**

The mission of the Pinelands Commission is to preserve, protect, and enhance the natural and cultural resources of the Pinelands National Reserve, and to encourage compatible economic and other human activities consistent with that purpose.

The Pinelands is a unique ecosystem of historic villages and berry farms amid a vast oak forest, extensive wetlands, and diverse species of plants and animals. It is protected by state and federal legislation through management by local, state, and federal governments and the private sector. The reserve contains Wharton State Forest, and Bass River State Forest, which provide public recreation facilities.

The Pinelands Commission has pioneered many smart growth planning concepts, such as watershed management, transfer of development rights, timed growth and conservation planning. The JC NERR collaborates primarily on education and outreach programs with the Pinelands Commission. This may be expanded to include demonstration products and development of tools to mitigate nonpoint source pollution.

**4. Local agencies**

**a. Barnegat Bay National Estuary Program**

The JC NERR features overlapping boundaries with the BBNEP. JC NERR Reserve staff was very involved in designation of this program and remain involved in the implementation phase of the BBNEP. The Reserve Manager chairs the BBNEP Science and Technical Advisory

## V. Administration Plan

Committee and is a member of the BBNEP Advisory Committee. The JC NERR Research Coordinator, Watershed/CTP Coordinator and GIS Coordinator also participate on BBNEP committees. Through these committees, the research, education and stewardship goals of the JC NERR were integrated into the Comprehensive Conservation and Management Plan and the Program Monitoring Plan for the Barnegat Bay Estuary Program. The BBNEP supports Reserve programs by increasing awareness of related local and adjoining watershed management issues and by providing opportunities for county, municipal, and state governments to conserve resources in Barnegat Bay and the adjacent JC NERR and by providing funding opportunities for research within the Reserve.

### **b. Tuckerton Seaport**

Tuckerton Seaport oversees 40 acres of coastal lands within the JC NERR. The Borough of Tuckerton, Little Egg Harbor Township, and Ocean County jointly acquired the land through the States' Green Acres Program (N.J.S.A. 13:8A-13(a)). The Green Acres legislation requires that land be used for recreational or conservation purposes and specifies that changes in the designated use of the lands must be approved by the Commissioner of the NJ DEP and the State House Commission of the State of New Jersey. The Tuckerton Seaport was also required to pay an amount equal to 50 percent of the current value of the land, as determined by the commission. The overall objective of the Seaport includes the establishment and maintenance of a center for the preservation and interpretation of the history of the New Jersey Shore and its Baymen. "Life on the Edge", a public exhibit administered by the JC NERR at the Seaport, has been established to (1) interpret and promote environmental awareness and the appreciation of coastal resources, (2) deliver a range of education and training services in support of basic education, school tours, and continuing education, and (3) act as a venue for the public to learn more about the Reserve, including education, research and CTP activities and services. The mission of the Seaport, to support public education on Bay culture and human interaction with the natural environment complements JC NERR programs and services.

### **c. Partnership for the Delaware Estuary**

The Partnership for the Delaware Estuary, a private nonprofit organization, administers the Delaware Estuary Program and is one of 20 National Estuary Programs in the nation. This program fosters research and education programs on behalf of the Delaware Estuary and its tributaries. Much effort is devoted to oyster restoration, stormwater management, wetlands restoration, and public environmental education. The Manager of the JC NERR serves on the governing board of this organization, and is developing joint program opportunities, especially with respect to oyster restoration, wetlands restoration, fish restoration and public education that will be conducted via the Sheppard House in Bridgeton.

### **d. New Jersey Conservation Foundation**

The mission of New Jersey Conservation Foundation (NJCF) is to preserve New Jersey's land and natural resources for the benefit of all. They are a private, not-for-profit organization which relies on philanthropic support and grants from a variety of public and private organizations and individual donors.

Through acquisition and stewardship NJCF protects strategic lands, promotes strong land use policies, and forges partnerships to achieve conservation goals. Since 1960, NJCF has protected

## JC NERR Management Plan 2009 - 2014

over 100,000 acres of natural areas and farmland in New Jersey – from the Highlands to the Pine Barrens to the Delaware Bay, from farms to forests to urban and suburban parks.

NJCF is JC NERR's newest land management partner. In 2009 NJCF will partner with the reserve to acquire the Lee property in Burlington County. This property along with three other NJCF properties has been identified as core properties and has been added to the JC NERR boundary (see VI. Boundary and Acquisition Plan).

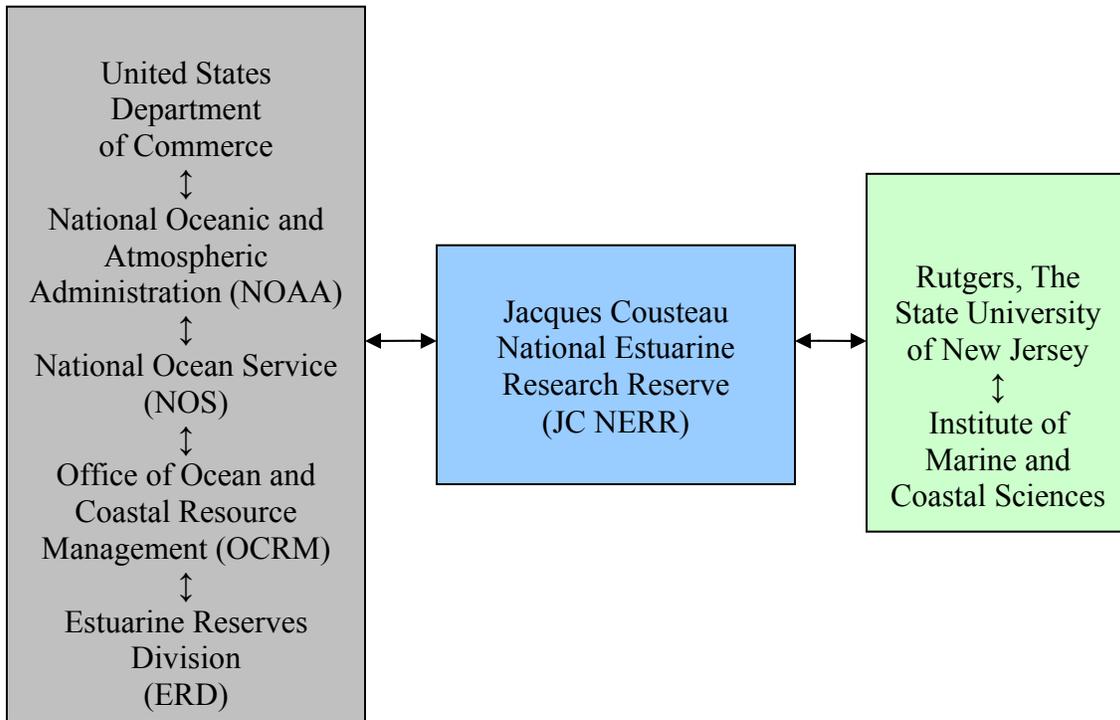
### 5. Universities

#### a. Rutgers University, IMCS

Rutgers-IMCS is composed of interdisciplinary teams of broadly-trained scientists dedicated to estuarine and ocean research and education. Rutgers has been conducting research and data collection in the Great Bay area since 1972, and serves as the focal point for the state's research efforts in estuarine, marine and coastal environments and assists in the development of New Jersey's environmental and educational assets. Rutgers-IMCS is located in New Brunswick, NJ, on the Cook campus of Rutgers University, approximately 75 minutes from the Reserve's Coastal Center. Staff of the Rutgers-IMCS includes more than thirty-two full time faculty members with expertise in many disciplines including undersea research, coastal processes, Pinelands ecology, aquaculture, and coastal physical oceanography. External funding is strong and provides a good measure of the research and education activities at Rutgers-IMCS, and opportunities to support JC NERR programs and activities.

Rutgers-IMCS maintains a Marine Field Station (approximately 14.6 acres) and fleet of research boats at the mouth of Great Bay with wet labs, a large running seawater system, special purpose laboratory rooms and a large dormitory facility on the upland adjacent to Coastal Center on Great Bay Boulevard. In addition, Rutgers-IMCS maintains an offshore research site known as LEO-15 which is located 3 miles offshore from Little Egg Inlet. LEO-15 features a suite of advanced samplers and sensors that enable the Institute to collect and transmit real time data on coastal ocean processes via the Internet for use by recreational ocean goers, coastal managers and the K-12 classroom audience.

Because Rutgers-IMCS is involved in management, education, and research within the Reserve's boundary, the Reserve can capitalize on the wealth of University resources and personnel including research technicians, computer technicians, administrative support, and education student interns (Figure 8). These resources are used to support JC NERR research and education programs.



**Figure 8. Management Structure for NOAA, JC NERR and Institute of Marine and Coastal Sciences at Rutgers, The State University of New Jersey.**

**b. Richard Stockton College of New Jersey**

The RSC Field Station maintains and operates a research and education facility within the Reserve at Nacote Creek. The facility houses computer and environmental science labs and a fleet of small boats. RSC assists in preserving the research, education, and stewardship goals and objectives of the NERRS program through its undergraduate education program (conducted at the Nacote Creek Field Station) and research program. They also maintain the Reserve’s weather station, which provides real-time information to the JC NERR system-wide monitoring program.

**c. New Jersey Sea Grant**

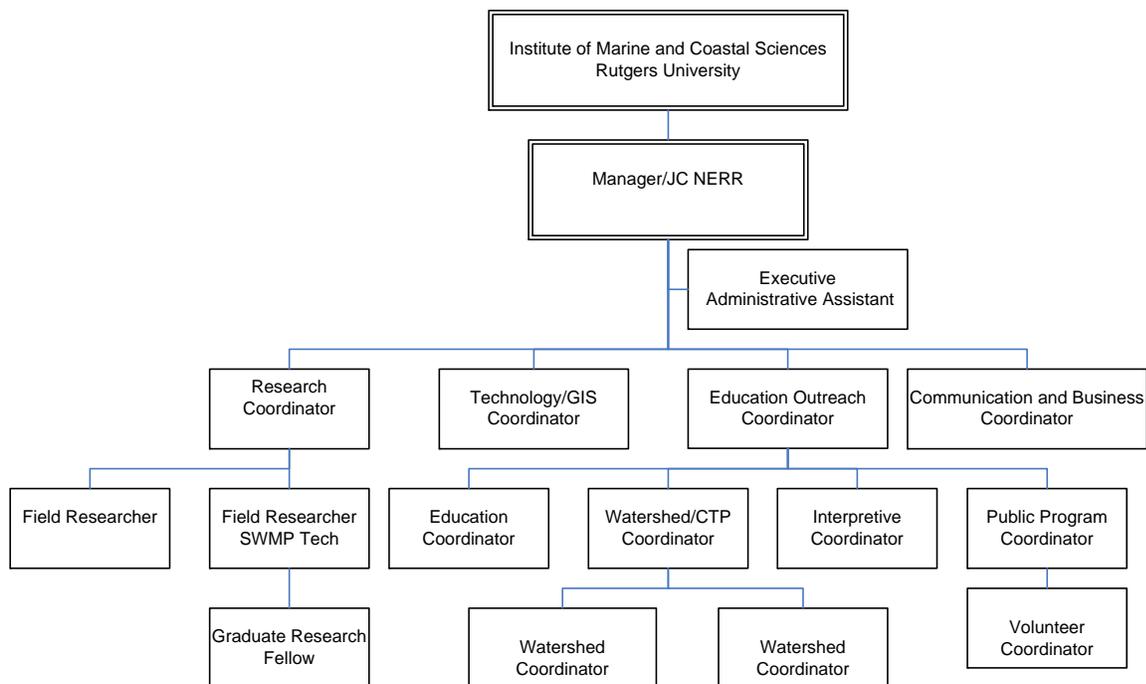
The New Jersey Sea Grant College Program is administered by a private, nonprofit group, the New Jersey Marine Sciences Consortium located at Sandy Hook. The JC NERR Manager is a member of the governing board of the NJ Marine Sciences Consortium. Efforts to collaborate have focused primarily on public events such as Coast Day, and K-12 education including joint sponsorship of the Shore Bowl, one of the regional competitions that comprise the National Ocean Science Bowl. More recently, Reserve staff members have sought research funding from NJ Sea Grant to develop information products for fishery managers and fish harvesters. Future efforts will be aimed at promoting collaboration on coastal training opportunities, and joint programs delivered from the JC NERR satellite facilities at Sandy Hook and Bridgeton.

**B. JC NERR Staffing Roles / Responsibilities**

Support for core staff is essential for meeting the mission, goals, and objectives of the JC NERR. The core staff consists of a Manager, the Communications-Business, Education, Research, GIS, Watershed and Volunteer Coordinators who manage the education, coastal training, stewardship and research programs on behalf of the Reserve. Rutgers-IMCS has the lead responsibility for administering these core positions (Figure 9).

Reserve staff members are employees of Rutgers-IMCS. Because of limited NERRS funding, some of the Reserve staff positions are partially or fully supported by Rutgers-IMCS. The Manager, Research Coordinator and Communications/Business Coordinator have offices at the main IMCS facility in New Brunswick and at the Coastal Center at Tuckerton. The Reserve Manager position is the Senior Associate Director at Rutgers-IMCS and has full responsibility for JC NERR management. The Watershed/CTP Coordinator, Volunteer Coordinator, Education Coordinator, Field Researcher/SWMP Technician are stationed at the JC NERR Coastal Center. The commute time between the Tuckerton facility and the office in New Brunswick is approximately 75 minutes.

Jacques Cousteau National Estuarine Research Reserve  
Organizational Chart



**Figure 9. Organizational Chart for the JC NERR.**

### 1. Manager

The Reserve Manager is the principal administrator of the Reserve and is responsible for ensuring all policies, regulations, and program activities are conducted in accordance with the Reserve Management Plan. The Reserve Manager has the qualifications of a resource Manager, and is employed and supervised by the Director of Rutgers-IMCS. Specific duties of the Manager are to:

- Manage the Reserve operations on a daily basis, prepare state and Federal grant applications, proposals, budgets, reports and maintain necessary records.
- Represent the Reserve and its policies at public meetings and hearings.
- Advise and coordinate government agencies on particular issues, questions, or projects, and their effects on or relationship to the Reserve.
- Oversee all special studies and research activities within or related to the Reserve and interpret and apply research results to produce benefits.
- Oversee the research and education programs for the Reserve.
- Coordinate with other program Managers on activities that might affect the Reserve.
- Monitor day-to-day operation of the Reserve and progress of research and education plans.
- Direct and coordinate with NOAA any changes in the management plan.
- Supervise Reserve staff members.
- Oversee facilities development, site selection and changes in the Reserve boundaries with consent from NOAA.
- Prepare required reports and work plans for NOAA and other funding agencies.

### 2. Executive Administrative Assistant

The Executive Administrative Assistant provided by the Institute of Marine and Coastal Sciences is responsible for facilities maintenance, grantsmanship assistance, website support, cultivation of friends of the Reserve, special events organization and management, and overall administrative support for the JC NERR.

### 3. Communications and Business Coordinator

This partially funded Coordinator is responsible for organizing and providing communications and financial management support for stewardship, research and education programs associated with the JC NERR/IMCS. In addition, this staff person coordinates production of a periodic newsletter, special publications, grant and budget accounting and tracking, preparation of progress reports, and assists with development of proposals including the annual operations grant. Specific duties are to:

- Develop publications and marketing tools.
- Establish outreach contacts (outlets) for marketing and advertising of programs/products and maintain database, running queries.
- Assist in the conduct of programs and development of educational materials.
- Assist with administration of JC NERR and related meetings, coordination of activities of Reserve advisory groups, special events, volunteer coordination, and preparation of periodic progress reports.
- Assist with fundraising efforts to support Reserve programs including preparation of proposals.

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### **4. Research Coordinator**

The Research Coordinator (33% grant-funded) implements and oversees all research and monitoring activities for the Reserve. The Research Coordinator maintains regular and direct communication with the research community and executes research activities in the Reserve. The Research Coordinator will report to the Reserve Manager and will be located at IMCS-Rutgers, the JC NERR Coastal Center or Rutgers Marine Field Station in Tuckerton, depending on assignments and projects. The Research Coordinator's responsibilities are to:

- Provide staff support for research and monitoring initiatives in the JC NERR.
- Coordinate all special studies and research activities within or related to the Reserve
- Assist the Reserve Manager and participating agencies in preparing and updating a list of priorities for research and monitoring at the JC NERR.
- Implement the research program for the Reserve.
- Interpret and apply research results.
- Recommend locations for research and monitoring stations within the Reserve and provide technical advice and assistance to scientists in conducting research and monitoring as available.
- Serve as the Reserve's liaison with the scientific community, promote data utilization, and act as primary contact for scientists performing research within the Reserve.
- Represent the Reserve at public and scientific meetings.
- Create a site profile.
- Implement the National NERRS Research (Fellowship) program at the Reserve.

### **5. Education Outreach/Watershed/Coastal Training Program Coordinator**

The CTP Coordinator (75% grant funded) works closely with Reserve partners and target audiences. Responsibilities include management of the CTP, land acquisition and outreach activities. Specific duties are:

- Design and conduct outreach programs, seminars and workshops on environmental issues of importance to coastal stakeholders.
- Develop ecosystem-scale management efforts in coordination with Reserve partners including the U.S. Fish and Wildlife Service, Pinelands Commission, NJ DEP and the EPA.
- Manage a CTP, including the preparation of a market analysis and needs assessment for technical training, development, organization, and conduct of Coastal Decision Maker workshops, and the establishment of a coastal repository.
- Enhance funding and support for the JC NERR.
- Develop public education programs and materials to complement the Life on the Edge exhibit at the Tuckerton Seaport.
- Coordinate training activities of the watershed coordinators.

### **6. Education Coordinator**

The Education Coordinator (100% grant funded) implements and coordinates education and interpretation elements of the management plan. Specific duties include:

- Assist in preparing and updating an annual list of priorities for education, interpretation, and visitor use programs.

## V. Administration Plan

- Coordinate education, interpretation, and visitor use activities within the Reserve and communicate with other Reserve management areas, especially research and volunteer programs.
- Advise and coordinate government agencies on education issues, questions, or projects, and their impacts on or relationship to the Reserve.
- Serve as a liaison with the academic community and act as primary contact for educators bringing groups to the Reserve.
- Provide technical advice and assistance, as available, for education and interpretation programs.
- Coordinate with NOAA National Education programs.
- Provide public outreach to area schools, colleges, universities, civic groups, professional societies, and other environmental education organizations.
- Coordinate educational activities of the watershed coordinators.

### 7. Watershed Coordinator

The part-time (40% grant funded) Watershed Coordinator will be stationed primarily at the Sheppard House. Emphasis will be placed on delivery and enhancement of CTP and education programs including programs on oyster and sturgeon restoration, as well as development of a volunteer program. Tasks associated with this position are to:

- Provide outreach and educational opportunities to the citizens of Bridgeton and the southern New Jersey area to increase an awareness of marine and estuarine issues within the region.
- Coordinate Project PORTS: Promoting Oyster Restoration through Schools K-12 enrichment and restoration programs; develop additional funding to sustain program; promote program among local schools and expand network of Project PORTS partner schools; and conduct biological assessments of restored oyster habitats.
- Develop collaborative programs with other regional environmental and research organizations to promote the protection and sustainability of important resources through research and education. In the near term this will include providing support in planning and conducting a regional symposium focusing on Atlantic sturgeon.
- Assess program interests and needs of local policy makers and the general public.
- Integrate regional programs with JC NERR programs and staff where appropriate.
- Develop relevant grant opportunities on behalf of the JC NERR.
- Assist in delivery of the MARE program.

### 8. Watershed Coordinator

This part-time (20% grant funded) coordinator will be primarily stationed at Sandy Hook to oversee the Seamless Network Initiative with the National Park Service, develop CTP programs with partners such as the National Park Service, National Marine Fisheries Service, and local officials in the northern New Jersey region. This staff person will assist in delivery of CTP workshops, especially those related to shoreline protection and coastal erosion-primary issues for this region of New Jersey, deliver training programs for park service personnel, foster activities and programs in support of science-based management of marine protected areas, and offer training programs for the next generation of resource managers.

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### **9. Field Researcher-Technology/GIS Coordinator**

This staff position (50% grant funded) monitors changing land use patterns within the JC NERR boundaries, assists the Research Coordinator in the design and completion of research projects, creates cartographic products, and collaborates with the Watershed Coordinator on CTP outreach efforts. Within each of these major job functions (research, outreach, and monitoring) are several job duties including:

- GIS and Remote Sensing data incorporation from Reserve partners.
- Designing Remote Sensing data collection missions. (Aerial Photograph, REMUS, LiDAR)
- Website creation and maintenance.
- Research project design and implementation.
- CTP workshops.
- GIS data creation and guidance for local municipalities.
- Cartographic and Graphics Design for technical reports, PowerPoint presentations, and web sites design.

This individual also assists the Research Coordinator with ecological investigations, including biomonitoring projects and other estuarine research efforts to characterize the Reserve:

- Obtain and process field data, including water quality, nutrient, biomonitoring, and other environmental data from JC NERR estuaries and watershed areas.
- Record physical-chemical parameters (temperature, salinity, dissolved oxygen, pH, turbidity, depth, and nutrients) of estuarine waters through the monitoring of field recording devices.
- Provides technical support for the JC NERR on remote sensing, spatial analysis, and applications.
- Collaborate with the JC NERR Research Coordinator on the preparation of technical reports and manuscripts for publication in peer-reviewed journals and other media.

### **10. Field Researcher/System Wide Monitoring Program Technician**

The Field Research/SWMP Technician (100% grant funded) is the lead technical coordinator of SWMP water quality monitoring, telemetry, and IOOS applications at the JC NERR. This staff person oversees all field and laboratory aspects of the program including calibration, deployment, retrieval, and maintenance of dataloggers, the sampling and analysis of nutrients and other water quality parameters and the preparation of SWMP water quality reports for the NERRS program.

Field Researcher/SWMP Technician also:

- Maintains comprehensive and accurate SWMP records.
- Maintains telemetered water quality stations and instrumentation.
- Updates and maintains internal data base.
- Prepares metadata reports for submission.
- Provides support for JC NERR Education programs.
- Collaborate with the JC NERR Research Coordinator on the preparation of technical reports and manuscripts for publication in peer-reviewed journals and other media.

### 11. Diving / Field Support

Field support for research and monitoring at the JC NERR is provided by the Mid-Atlantic Bight National Undersea Research Program. Two individuals, the Technical Director and Dive Safety Officer devote time and effort to deploy, maintain and troubleshoot the dataloggers, provide AUV support, and general dive support on behalf of JC NERR projects.

### 12. Volunteer Coordinator

A Volunteer Coordinator (part-time hourly) trains and organizes volunteers and docents to support JC NERR programs including public programs and festivals, field programs, administrative assistance, data entry, library work and mass mailings. The Volunteer Coordinator:

- Prepares and plan volunteer programs in coordination with the Reserve staff.
- Recruits, trains and supervises volunteers.
- Evaluates volunteer programs.
- Develops an incentive/reward program for volunteers.

### 13. Interpretation Coordinator

An Interpretation Coordinator (part time hourly) contributes to audience understanding at the Life on the Edge Exhibit at the Tuckerton Seaport. The docent's responsibility is to increase awareness of research and education programs conducted at the Reserve and to act as a spokesperson on coastal decision-making issues and inform the public of recreational access to MRGB. Specific duties are to:

- Develop a Steward Training program with reserve partners and in collaboration with the Education Coordinator to improve public involvement in the Reserve.
- Coordinate with the Volunteer Coordinator in the training of docents for interpretation related activities.
- Provide context and interpretive messages that relates the Life in the Edge Exhibit as the gateway to the Reserve.

### 14. Public Program Coordinator

The Public Program Coordinator (part time hourly) is responsible for the oversight and execution of all aspects of the Shore Bowl regional academic competition for high school students. The Public Program Coordinator is the JC NERR liaison working closely with the National Ocean Science Bowl Office in the delivery of this regional competition. Responsibilities include all team registrations and correspondence, recruiting and training all volunteers, solicitation of prizes, media relations, and all logistics for the event.

The Public Program Coordinator assists the Education Coordinator with the delivery and coordination of the Lunch n' Learn programs, and the recreation and public education programs offered by the JC NERR. This staff person also works collaboratively with the CTP Coordinator in planning and delivering CTP programs and represents the JC NERR a local festivals.

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### 15. Facility Maintenance - Tuckerton

Rutgers University provides facilities maintenance both to the administrative offices in New Brunswick and to the Coastal Center in Tuckerton, NJ. This support includes the grounds, interior and exterior building maintenance and structural building maintenance. Rutgers employs two full-time maintenance persons to oversee all the facilities in Tuckerton.

### C. JC NERR Advisory Committee

This committee, originally organized with subcommittees for each function area, has been restructured and streamlined to provide senior level advice and guidance on Reserve priorities to the Reserve Manager and staff. The committee meets twice annually to help develop opportunities for collaboration among Reserve partners, define key areas for future investment, and to provide advice on programs, products and services.

Committee members are specifically charged with helping to advance the Reserve mission of science-based management through partnerships, leveraging resources, and providing guidance on emerging trends for protected area networks. (See Appendix H.) JC NERR staff will communicate regularly with committee members, especially to exchange information on results of reserve programs.

Reserve staff may establish informal ad hoc committees to help guide their respective efforts as necessary.

| Committee Members                              | Affiliation   |
|--|---|
| Assistant Commissioner for Land Use Management | New Jersey Department of Environmental Protection                                   |
| Steve Atzert, Project Leader                   | Edwin B. Forsythe National Wildlife Refuge  |
| Rick Lathrop, Director                         | Center for Remote Sensing and Spatial Analysis – Rutgers University                 |
| John Stokes, Executive Director                | Pinelands Commission  |
| Dave McKeon, Planning Director                 | Ocean County Planning   |
| Mike Mangum, Director                          | Ocean County Department of Parks and Recreation                                     |
| Bob Connell, Chief                             | New Jersey Department of Environmental Protection Bureau of Marine Water Monitoring |
| Carleton Montgomery, Executive Director        | Pinelands Preservation Alliance   |
| Stanton Hales, Program Director                | Barneget Bay National Estuary Program   |

**Table 3. JC NERR Advisory Committee Members.**

### D. Memoranda of Understanding and Other Inter-Agency Arrangements for Coordination

Memoranda of Understanding (MOU) have been developed with key Reserve partners to define roles and responsibilities for Reserve programs, products and services. Agreements exist with NOAA, the New Jersey Department of Environmental Protection, U.S. Fish and Wildlife Service, New Jersey Pinelands Commission, Rutgers University, and the Tuckerton Seaport. These agreements were initially developed when the Reserve was designated in 1997 and have been updated and revised and are included in Appendix D. A Land Management Agreement has

## V. Administration Plan

been developed with the New Jersey Conservation Foundation. This agreement established a framework for coordination, cooperation and communication between the NJCF and the JC NERR for purposes of acquiring and managing lands within the boundaries of the JC NERR. This agreement is included in Appendix E.

### **E. Coastal Zone Management Program Consistency Certification**

While the JC NERR has not received formal consistency certification from the New Jersey Department of Environmental Protection other methods are in place to insure this management plan is consistent with the State of New Jersey's Coastal Zone Management Plan. Several senior level NJ DEP employees have been appointed to the JC NERR Advisory Committee and have been charged with helping to advance the Reserve mission of science-based management while staying within CZMA compliance. Each Advisory Committee member has been given copies of the management plan to review. They have provided advice and guidance on Reserve priorities in order to establish CZMA consistency.

# VI. Boundary and Acquisition Plan



### VI. BOUNDARY AND ACQUISITION PLAN

#### A. Introduction

Presently, the Jacques Cousteau National Estuarine Research Reserve (JC NERR) consists entirely of public lands managed primarily by state, federal, or local government agencies. A high level of protection and management exists for designated core and buffer regions that help to unify federal and state conservation efforts in the area. Current protection practices and land management ethics of the NERRS program also will be used to unify other conservation efforts in the area such as that of the Barnegat Bay National Estuary Program (BBNEP). Any land interest purchased by or donated to the Reserve will be managed by the requisite federal, state, or local landholders and subject to all the management provisions of the landholders. No condemnation procedures will be used for the addition of property.

Acquisition policy of the JC NERR states that lands may be added as a result of (1) continuing efforts by the federal government to acquire land for the Forsythe Refuge; (2) state efforts to increase its holdings of natural areas; (3) private donations; and/or (4) acquisitions made through the Coastal and Estuarine Land Conservation Program and the NERRS Construction/Acquisition program. Future acquisitions may also be needed to accommodate ecological or geomorphological changes in the Reserve including lands that enable adaptation to effects of climate change. Furthermore, acquisitions of land parcels in the region will certainly be welcomed to strengthen the current level of resource protection goals of the Reserve. More than 99 % (114,833 acres) of the JC NERR is composed of state and federal public lands. A total of 40 acres of the JC NERR are overseen by the Tuckerton Seaport, a local non-profit organization dedicated to the preservation and interpretation of the history of the New Jersey Baymen culture. The town of Tuckerton, Little Egg Harbor Township, and Ocean County jointly acquired the land through the N.J. Green Acres Program (N.J.S.A. 13:8A-13(a)). Green Acres legislation requires that the land be used for recreational or conservation purposes and specifies that changes in the designated use of the lands must be approved by the Commissioner of the New Jersey Department of Environmental Protection (NJ DEP) and the State House Commission of the State of New Jersey following a public hearing. As per N.J.S.A. 54:4-3.63 et seq. P.L. 1974, Chapter 167, the Legislature hereby finds and declare that natural open space areas for public recreation and conservation purposes are rapidly diminishing; that public funds for the acquisition and maintenance of public open space should be supplemented by private individuals and conservation organizations; and that it is therefore in the public interest to encourage the dedication of privately-owned open space to public use and enjoyment and provided for in this act. The Green Acres Legislation and a list of the comprehensive deed restrictions are included in Appendix C.

Historically, private landowners adjacent to the public land holdings of the Reserve have practiced good stewardship and have maintained a strong conservation ethic in management of these properties. Public education and awareness will be used to foster continued stewardship of properties neighboring (i.e., buffering) the Reserve. Public participation in the Reserve has and will continue to promote compatible uses of lands within the Reserve region.

### **B. Ecologically Key Land and Water Areas of the Reserve**

All regulatory agencies with jurisdiction in the Reserve boundaries have committed to enforcing an appropriate level of state or Federal regulation necessary to uphold the long term resource protection objectives of the NERRs program. These agencies, including the Pinelands Commission, United States Fish and Wildlife Service (USFWS), and NJ DEP (under the CZMA), are empowered to manage the public lands comprising the Reserve and are committed to upholding the resource protection goals of the NERRS program through a Memorandum of Understanding between all parties (see Appendix D). All land acquisitions are in accordance with Federal laws and regulations for real estate acquisition, including independent appraisals. Property is acquired only from private landowners willing to participate in the Reserve program. Boundaries for the JC NERR include "an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure an effective conservation" (15 C.F.R. 921.11). These areas are discrete enough to be effectively managed, but large enough to make long term research possible. To organize management efforts, site boundaries include two regions: key land and water areas (core area) and a buffer zone.

Regulations (C.F.R. 921.11) define core areas as areas that contain "critical estuarine ecological units for research purposes, encompassing a full range of significant physical, biological, and chemical factors contributing to the diversity of fauna, flora, and natural processes occurring within the estuary." The term "key land and water areas" in the regulations refers to that core area that is so vital to the function of the estuarine ecosystem that it must be under state control sufficient to ensure the long-term viability of the Reserve for research on natural estuarine processes. The determinations of which land and water areas are "key" to a particular Reserve are based upon specific scientific knowledge of the area. Key land and water areas also encompass resources that are representative of the total ecosystem and which, if compromised, could endanger the research objectives of the Reserve.

A buffer zone is described as an area adjacent to or surrounding the core and on which the integrity of the core area depends. Buffer zones protect the core and provide additional protection for estuarine-dependent species, including those that are threatened or endangered. Where determined appropriate and approved by the state and NOAA, the buffer zone also may include an area best-suited for facilities required for research and interpretation. Additionally, buffer zones should encompass an area sufficient to accommodate the shift of the core in case of biological, ecological, or geomorphologic change.

#### **1. Proposed Boundary Delineation Criteria**

The following criteria were used in the selection of the JC NERR boundaries:

- a. Minimum amount of development and population in upland watershed and coastal/estuarine area.
- b. Maximum amount of watershed protection in the form of public open space and multilevel state regulatory programs for private lands (e.g., Pinelands Commission regulation).
- c. Maximum amount of coastal/estuarine wetlands protection in the form of public open space (e.g., fish and wildlife management areas, park and forest lands, refuge space).

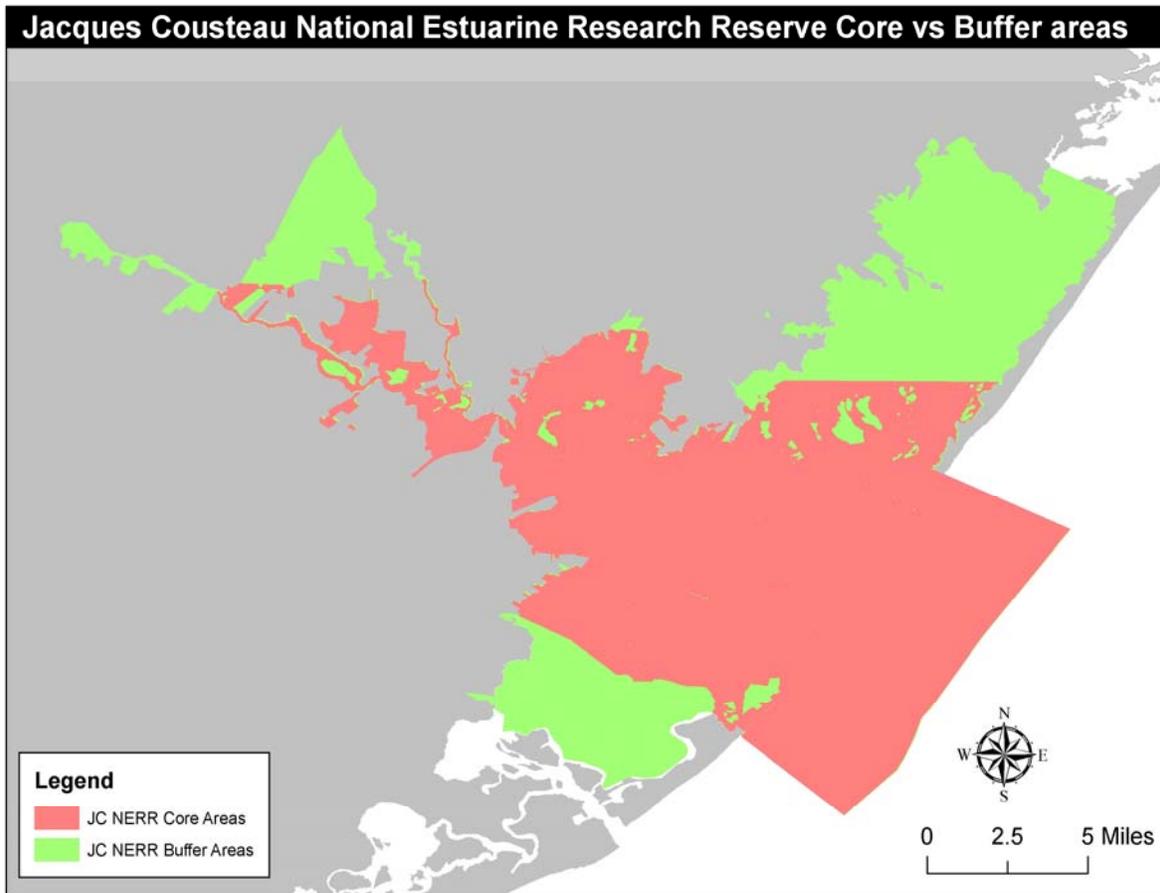
## VI. Boundary and Acquisition Plan

- d. Maximum amount of diversity in rare plants, animals and natural communities which interact with the estuarine zone. Diversity provides for contact with all representative trophic levels within the integrated ecosystem. The inclusion of many habitat types allows for a full range of comparative research and education activities.

### 2. Core and Buffer Delineation Criteria

The core and buffer zones were defined using the following criteria:

- a. The core area of the NERR are a contiguous area of minimally to virtually undisturbed lands and waters that span the gradient from upland/ freshwater wetland interface through the estuary and out to the near-shore continental shelf. The core area contains primarily water and adjacent wetlands (including both emergent and forested wetlands).
- b. The buffer zone of the NERR include upland forested areas adjacent to wetlands, whenever possible, to serve as a protective buffer. Areas from adjacent or fringing estuaries are included within the buffer zone boundary to include missing coastal habitats and/or allow greater comparative analysis of adjacent habitats.
- c. The jurisdictional boundaries for both the core and buffer zones, to the greatest extent possible, are coincident with existing municipal/county boundaries. Buffer zones will be identified as appropriate ecological units for research and monitoring purposes, and for long term planning purposes, as areas identified for future acquisitions.



**Figure 10. Core and Buffer Areas of the JC NERR and Its Resulting Boundaries.**

### 3. Resulting JC NERR Boundaries

The JC NERR boundary was delineated to incorporate the Mullica River upriver to the head of tidal influence and down river to include all of Great Bay (Figure 10). The JC NERR boundary extends north to include the adjacent waters and marshes of Little Egg Harbor to include submerged aquatic vegetation habitats (i.e., extensive beds of eelgrass, *Zostera marina*) that are largely absent from Great Bay proper. The boundary extends south to the important migratory waterfowl habitats contained in the Brigantine portion of the Forsythe National Wildlife Refuge and adjacent State Fish & Game Management lands. The tributaries of the Mullica River including Bull Creek, Wading River, Bass River, Landing Creek, and the Nacote Creek are included to the limit of tidal influence. The boundaries for the JC NERR are designed to comprise a natural ecological unit to the greatest extent possible. JC NERR boundaries encompass a core area of contiguous wetlands, riparian habitats, and portions of open water in Great Bay. These boundaries contain a highly productive system supporting a rich diversity of activities including recreation such as fishing and boating, as well as research studies by Rutgers University (since 1972), Richard Stockton College of NJ, the Pinelands Commission, and other institutions.

## VI. Boundary and Acquisition Plan

Because estuaries receive inputs from the adjacent oceanic margin, the boundaries of the JC NERR extend seaward into the Atlantic Ocean approximately 3 miles to include the LEO-15 observatory on the inner continental shelf. One obvious reason for considering this oceanic area is the importance of organic and inorganic exchanges within the water column and at the sediment interface, and opportunities to evaluate the significance of the oceanic contributions to the maintenance of the estuarine system. The LEO-15 site is designated as a 2.79 km offshore research area and is listed on all navigation charts and notices to mariners.

In Great Bay proper, with the exception of the small communities (i.e., small population size) of Mystic Island and Tuckerton extending for less than 3,000 m along the margin of the Bay, the aquatic boundary is in a near pristine state. A handful of marinas occur outside of Mystic Island, but their spatial impact is small within the overall scale of the JC NERR. This characteristic is particularly beneficial to compare the long-term processes related to estuarine quality in other nearby locations. For example, the adjacent waters and shoreline of Little Egg Harbor have experienced greater human pressure with the lagoonal development of Beach Haven West and the developed portions of Long Beach Island. Thus, the MRGB estuary can provide baseline data for evaluating modification and recovery programs at other sites.

### a. Core Areas

The core area, totaling 96,943 acres, was delineated to extend from the head of saltwater influence in the Mullica River downstream to include all of Great Bay and adjacent inlet areas and out into continental shelf waters to the LEO-15 site. In addition to the above water bodies, the core area includes the emergent wetlands and contiguous forested wetlands of adjacent estuaries. The core area is composed of three distinct areas: (1) Great Bay Blvd. Wildlife Management Area, a state owned and managed salt marsh area (4,670 acres) at the end of a peninsula extending south from Little Egg Harbor which forms the northern and eastern shore of Great Bay, (2) a Federally -owned complex of salt marsh and undeveloped barrier islands (40,000 acres) forming the southern boundary of Great Bay with eastern frontage on Beach Haven Inlet and the Atlantic Ocean, and (3) a coastal ocean area offshore at the mouth of Beach Haven Inlet. These areas along with the barrier islands incorporate the natural conditions of beach, dune features, overwash fans, abandoned inlets, and extensive back marsh virtually unknown throughout most of the East Coast. Certain heavily populated areas were specifically excluded to minimize conflicts with existing incompatible uses (e.g., Mystic Isles Development to the south).

Within the core region there are four major state and federal facilities including RUMFS, the RSC - Field Station (at Nacote Creek), the NJ DEP Fisheries Laboratory at Nacote Creek, and the Edwin B. Forsythe (USFWS) Visitors Center. All state regulatory agencies with jurisdiction in the proposed Reserve boundary have committed to enforcing the level of state regulation necessary to uphold the long term resource protection objectives of the NERRs program. Existing regulatory agencies (see section V. Administration Plan) including the Pinelands Commission, USFWS, and NJ DEP (under the CZMA) are empowered to manage the public lands comprising the proposed Reserve and are committed to upholding the resource protection goals of the NERRS program under the Memorandum of Understanding Agreement between all parties (see Appendix D). The Administrative Plan also provides for an advisory committee of all landowners and interested parties with educational, research, and resource management

## JC NERR Management Plan 2009 - 2014

objectives in the Reserve region. This committee acts as an advisory body for ensuring that the long-term natural resource protection objectives of the NERRS program are continually met.

Historically, private landowners surrounding the public land holdings included in the Reserve have practiced good stewardship and maintained a strong conservation ethic in management of these properties. Manipulations conducted by public landholders in the core area which are required to meet mandated responsibilities will continue. Specifically, the Forsythe National Wildlife Refuge will maintain the wetland habitats (i.e., East and West Pools) created by diking and water management strategies. Refuge staff also will conduct controlled burning to reduce the buildup of plant debris and maintain diversity in the upland (Pinelands) portion of the Refuge. These practices are a long-term preexisting management uses and are allowed to continue under 15 C.R.F. 921.1(d).

The coastal ocean portion of the JC NERR comprises more than one half of the core area. The Intracoastal Waterway is included in the boundary of the Reserve buffer region. Two primary management considerations exist in the coastal ocean portion of the core area: (1) dredging of navigational channels and (2) commercial and recreational fishing. Permits for coastal ocean dredging are controlled through the Tidelands Resource Council. Dredging in NJ navigable tidal waters require a Waterfront Development Permit and a Water Quality Certificate (pursuant to Section 401 of the Federal Clean Water Act) from the NJ DEP. Any discharge of dredged material also will require a permit from the U.S. Army Corps of Engineers pursuant to Section 404 of the Federal Clean Water Act. Dredging operations are regulated by the Federal government pursuant to Section 10 of the Rivers and Harbors Act of 1899. Federally-conducted, funded, or permitted activities which have an impact on any land or water use or natural resource of the NJ Coastal Zone will, in addition, require a Federal consistency determination from the NJ DEP, pursuant to the Coastal Zone Management Act.

The NJ DEP anticipates no problems with future, small scale dredge operations or disposal of dredge materials. Dredging may cause short-term changes in the benthic community structure. These changes are generally temporary in nature and do not represent a significant threat to the ecosystem. Dredge materials are either used as beach fill or cast back into the system. The dredged material in the MRGB system has a large sand content and is generally not considered contaminated or hazardous to the system.

In addition, Rutgers-IMCS has placed lighted guard buoys for recreational and commercial fishermen in the region, alerting them to the presence of the LEO-15 oceanographic equipment. The location of the buoys is explained on the Rutgers-IMCS home page (<http://marine.rutgers.edu/nurp/facilities>). Rutgers-IMCS also enjoys an excellent working relationship with the Cape May Seafood Association and has frequently met with the clambers in the region to explain the LEO-15 research site. LEO-15 is the site of a 1970's proposal to build a floating nuclear power plant. This site is consequently marked on navigational charts as a research site. Based on these navigational restrictions, this area receives moderate fishing traffic. Lastly, the Tidelands Council granted Rutgers-IMCS a revocable license/lease for the electro-optic cable that connects LEO-15 to RUMFS. NJ DEP will maintain adequate state control of dredging and fishing in the core region. Each of these controls has been in place for quite some time during which we have not experienced any conflicts between coastal user groups and operations of LEO-15 research and education programs.

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### b. Buffer Areas

Upland forest areas were included in the buffer area to capture the full ecological gradient from uplands to wetlands (e.g., soil catena) and to serve as a protective buffer. Adjacent areas were included within the boundary of the buffer to include missing coastal habitats and/or allow greater comparative analysis of adjacent habitats. The JC NERR boundary extends north to the adjacent waters and marshes of Little Egg Harbor to include submerged aquatic vegetation habitats (i.e., extensive beds of eelgrass, *Zostera marina*) that are largely absent from Great Bay proper. The proposed boundary extends south to include the important migratory waterfowl habitats contained in the Brigantine portion of the Forsythe National Wildlife Refuge and adjacent State Fish & Game Management lands.

The Reserve's buffer comprises approximately 17,930 acres of public lands and includes the Intracoastal Waterway, within the estuarine portion of the JC NERR. Management issues associated with the Intracoastal Waterway in the buffer area include commercial/recreational fishing and periodic dredging. In addition, the Tuckerton Seaport oversees 40 acres of public lands, purchased under the state's Green Acres program.

Private use of adjacent nonpublic lands surrounding the Reserve buffer area has been compatible with regulated land practices of the state and Federal lands for many years. The privately owned upland forested areas adjacent to the Reserve wetlands are important to migrating and nesting songbirds and other species. Residential and commercial uses of these adjacent public areas could present a threat to water quality of the estuary.

### C. Methods/Strategies for Acquisition

Donation of property and or purchase of lands from willing sellers will be the primary mechanisms for land acquisition in the JC NERR. Rutgers-IMCS will work with landholders, the JC NERR Advisory Committee, the Trust for Public Land and local land trusts to acquire high priority lands including lands identified through the Coastal and Estuarine Land Conservation Program. Particular emphasis will be placed on developing criteria to identify properties for acquisition to adapt to the effects of climate change.

### D. Recent Boundary Expansion

Through an agreement with the New Jersey Conservation Foundation (NJCF), the JC NERR has expanded the core boundary to include four additional properties (Figure 11). These properties are currently owned and managed by the NJCF. Addition of these parcels through agreement rather than by acquisition provides additional buffer areas for key land and water areas, with the responsibility for stewardship remaining with NJCF. The Foundation benefits by having the lands included in future research and monitoring programs. For example, physical control of invasives such as Phragmites will support habitat for desired species and biodiversity. Natural water flow will be preserved to sustain ecosystem function.

The Foundation will continue to manage these properties using accepted stewardship methods and best management practices on behalf of the JC NERR. The New Jersey Conservation Foundation's (NJCF) mission is to preserve and protect land for the benefit of all. Over the past fifty years, NJCF has been responsible for the preservation of more than 125,000 acres of land all across the State. During that time, NJCF has retained approximately 20,000 acres of preserves. The philosophy that guides the stewardship of NJCF preserves is driven by the protection and

## **JC NERR Management Plan 2009 - 2014**

enhancement of native habitats and ecosystem functions. This includes wetland restoration, forest management, invasive species control, rare species habitat creation, and coordination with adjacent landowners. Public access is granted to all of NJCF's preserves but is limited to passive recreational activities and is not directed toward areas of sensitive plant or animal populations. Finally, NJCF's stewardship staff goes to great lengths to protect our preserves from off-road vehicle use, illegal dumping and the poaching of rare species.

NJCF will support the long-term management of the lands and waters that comprise the JC NERR, in compliance with regulations of the National Estuarine Research Reserve Program contained in 15 CFR Part 921. Through cooperative efforts the landholders will support and complement on going educational, stewardship and research programs of the JC NERR. The NJCF agrees to manage their land holdings in the JC NERR according to the primary goals of the JC NERR as noted in this management plan. The JC NERR does not own or directly manage large tracts of land, therefore this agreement will allow for the inclusion of conservation lands within the Reserve boundary. The letter of agreement between JC NERR and the NJCF can be found at Appendix E.

### **1. Bear Creek Preserve (100 acres)**

Bear Creek Preserve offers a rare chance to view water and wading birds up close in various wetland habitats. This 100-acre preserve is located where the Bear Creek flows into the lower Mullica River. The Mullica River in this area is close enough to the ocean that its waters rise and fall with the tides. The water is also brackish, meaning it is a mix of fresh and seawater.

A sandy dike road starts at the access point on Lower Bank Road, just north of the Mullica River Bridge. After traversing Atlantic white cedar swamp, the road runs along a dike that dams the water of the Bear Creek, creating a fresh water pond and wetland habitat on one side, and a brackish water wetland on the other. This mix of habitat types attracts a wide diversity of wildlife species. Coupled with views of the Mullica River and mudflats that are exposed at low tide, the property is a great location for watching birds and other wildlife. The dike offers great views of the lower Mullica River Bald Eagle nest, located just across the river.

The property was donated to NJCF in 1986 by the Bear Creek Conservancy, a group of duck hunters and conservationists who wanted to ensure that the property was always protected.

### **2. Hanselman Preserve (57 Acres)**

The Hanselman Preserve is comprised of two units along North Manheim Avenue in Galloway Township, Atlantic County. The property captures the gradient of coastal forest habitats from pitch pine lowland and Atlantic white cedar forest to deciduous shrub-scrub wetlands to salt marsh flats. It is adjacent to land conserved by the New Jersey Natural Lands Trust as part of their Clark's Landing Preserve project area.

### **3. Rudolph Property (31 acres)**

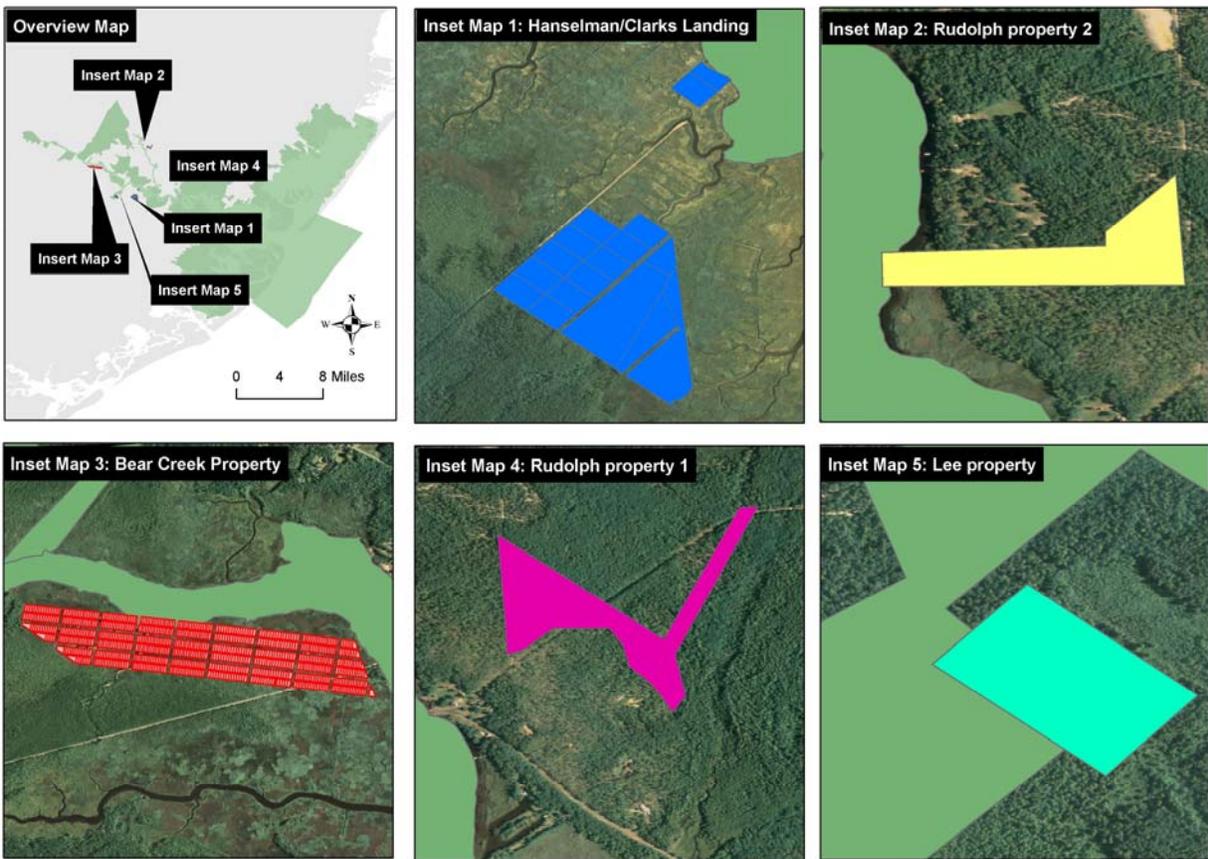
The Rudolph property is dominated by a mixed pitch pine – scrub oak upland. It is adjacent to several out-parcels of the Bass River State Forest. One portion of the property extends to the east and has frontage on the Wading River.

**4. Lee Property (20 acres)**

JC NERR has partnered with the NJCF to acquire approximately 20 acres of pitch pine and Atlantic white cedar forest in southern New Jersey. This acquisition represents the first parcel acquired through the Mullica River Conservation Initiative, a new land conservation project the JC NERR is facilitating with conservation agencies throughout the Mullica and Wading River watersheds.

The property is dominated by pitch pine lowlands with a few scattered Atlantic white-cedars. The under story is a typical mix of low bush blueberry and huckleberry. The habitat is suitable for Pine Barrens tree frogs and other threatened and endangered species. Nearby properties are being used as logging sites, making this site susceptible to similar activities.

**JC NERR Recent Boundary Expansion**



**Figure 11. Map Showing Recent Boundary Expansion of the JC NERR.**

### **E. Future Planned or Proposed Acquisitions**

Although the JC NERR is composed of public lands, Rutgers-IMCS recognizes the importance of long range planning for the acquisition of unique lands that possess critical habitat within the MRGB watershed. Rutgers-IMCS and Center for Remote Sensing and Spatial Analysis have been working with the Trust for Public Land to complete a study and gap analysis of property within the watershed that would be of conservation or public access value. Rutgers-IMCS acknowledges the work of USFWS and non-profit organizations such as the Trust for Public Land in the identification of unique conservation and public access sites. In collaboration with these partners, the following is a list of priority acquisitions sought during the next five years (Figure 12).

#### **1. Pocket Marsh (10.55 acres)**

Acquisition of the Pocket Marsh is ranked as top priority by the JC NERR. The purchase of this tract would allow the preservation of the wetland area on the eastern boundary of the JC NERR Coastal Center in Tuckerton, New Jersey. This small pocket of wetlands and marsh habitat (10.55 acres) adjacent to Tuckers Creek resides within one of our core areas, the Great Bay Boulevard Wildlife Management Area; a state owned and managed saltmarsh area (4,670 acres) at the end of a peninsula extending from Little Egg Harbor that forms the northern and eastern shore of Great Bay. This land is privately owned and is currently under consideration for development.

The JC NERR will continue to work with our land partners to acquire this highest priority parcel using the most cost effective means possible. In the past, the Little Egg Harbor Open Space Committee, the Ocean County Natural Lands Trust, Green Acres and Trust for Public Lands have all been unsuccessful in purchasing the property. The current private owner is unwilling to sell for the fair market value which was assessed at \$208,700 in 2004. Until the current owner is willing to accept fair market value the property will be at a selling impasse.

If acquired, an educational boardwalk trail will loop through the current JC NERR property and connect to this adjacent property. Stewardship concepts, plant identification and the changes in vegetation from upland habitats to wetland areas would be demonstrated throughout the trail.

#### **2. Osborn Island (46 Acres)**

Osborn Island is a parcel in Little Egg Harbor Township, immediately adjacent to Great Bay. The “island” is an area of uplands surrounded by both residential development and thousands of acres of protected tidal wetlands. Nearby conserved lands include the Edwin B. Forsythe National Wildlife Refuge, which protects more than 1,700 acres to the west of the site, and several thousand acres largely owned by the state to the east, which is within the JC NERR boundary.

Osborn Island is the site of a former golf course that was closed in the 1960s. Vegetation has since regenerated with mostly native species. The property contains freshwater wetlands and maritime forest including stands of red cedar, American holly, oak and pine trees. The state recently confirmed nesting black-crowned night herons, a state-threatened species since 1999, but only a ten acre area has been reserved as a rookery. The destruction of coastal maritime dune forests, due to development along the Atlantic shore, has greatly reduced habitat for black-crowned night-herons. The property is frequented by many other species including osprey, fox

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and diamond back terrapins which also nest on the site. The property is also thought to contain a Native American burial ground, a site of potentially significant archeological value.

Osborn Island ranks second in importance of acquisition because it is most threatened for development. Presently, this land is in the process of being acquired by the Ocean County Natural Lands Trust in partnership with the Trust for Public Land. The asking price for this parcel is 4.2 million and is considered fair market value. Negotiations have begun between Ocean County Natural Lands Trust and the private land owner. Once acquired the JC NERR will partner with these agencies to ensure the property is slated for preservation in order to protect the integrity of the Reserve for research purposes.

### **3. West Creek Dock Road Property (26 acres)**

The third property is a 26-acre parcel of wetland/marsh exists at the end of West Creek Dock Road, a rural, residential area in West Creek, New Jersey. This parcel is surrounded by JC NERR property that is managed in partnership with the Edwin B. Forsythe National Wildlife Refuge on two sides, Dock Road on one side and opens to Great Bay on the remaining side. As this land was previously a dredge spoil site, it has the potential to be used by the Reserve for restoration science efforts, education and stewardship programs. This piece of land is the only point of access for local hunters accessing the designated hunting grounds of Edwin B. Forsythe Refuge. It also is the only piece of land in the area that does not fall within the boundaries of the Reserve, as it has historically been privately owned. It does fall within the buffer area, as indicated by this management plan. As such, the property encompasses a full ecological gradient including wetlands and uplands, and provides a protective barrier to human disturbance.

Presently, the State of New Jersey is looking to purchase the land to use as a dredged materials disposal site. There has been much local opposition to this proposed land usage. Therefore, the JC NERR will work with its land partners to obtain the land. The Forsythe Wildlife Refuge has land adjacent to this parcel and may be interested in acquiring it. The Trust for Public Land has also express interest. The Green Acres Program, the Ocean County Natural Lands Trust and the New Jersey Conservation Foundation are additional agencies the JC NERR can partner with to acquire this land. In 2003 the asking price for this property was 1.2 million which was fair market value.

### **4. Wading River and Mullica River Wetland (4,192 Acres)**

.Lastly, the JC NERR looks to acquire the tidal lands along the Wading and the Mullica River. This parcel is pristine waterfowl and duck habitat especially due to the extensive wild rice stand which represents the last major stand in New Jersey. The rice was extensive beyond the Wading River Bridge into the freshwater stream of the Bass River State Forest in small patches. This extension of the wild rice is a relatively new growth. Wild rice was also noted growing in patches above the Green Bank Bridge (along both sides of the river). These wetlands habitats are partially protected by state and federal forests and Wildlife Refuges. In order to preserve the reminder of the wetland habitat and a large portion of what is draining into the JC NERR, the remaining publicly owned tidal habitat should be acquired and placed into public ownership.

The current Mullica River Conservation Initiative boundary line only includes tidally flowed lands. Many of these properties are already afforded protection through Tidelands and coastal wetlands regulations. In order to include properties which may have more imminent

## JC NERR Management Plan 2009 - 2014

development pressure, the Mullica River Conservation Initiative partners are considering expanding the current conservation boundary line to include upland properties. This boundary expansion could potentially include a much more broad area and take into account lands adjacent to the Mullica and Wading River headwaters, including their respective sub-watersheds.

The JC NERR will partner with the New Jersey Conservation Foundation to acquire individual land parcels that make up the Mullica River Conservation Initiative either through purchase or donation. Currently, the NJCF owns a number of properties within this area. The going rate for coastal wetlands is approximately \$1000 per acre. Due to the abundant number parcels with in this area that are owned by many different private land owners in this area will take numerous years to acquire.

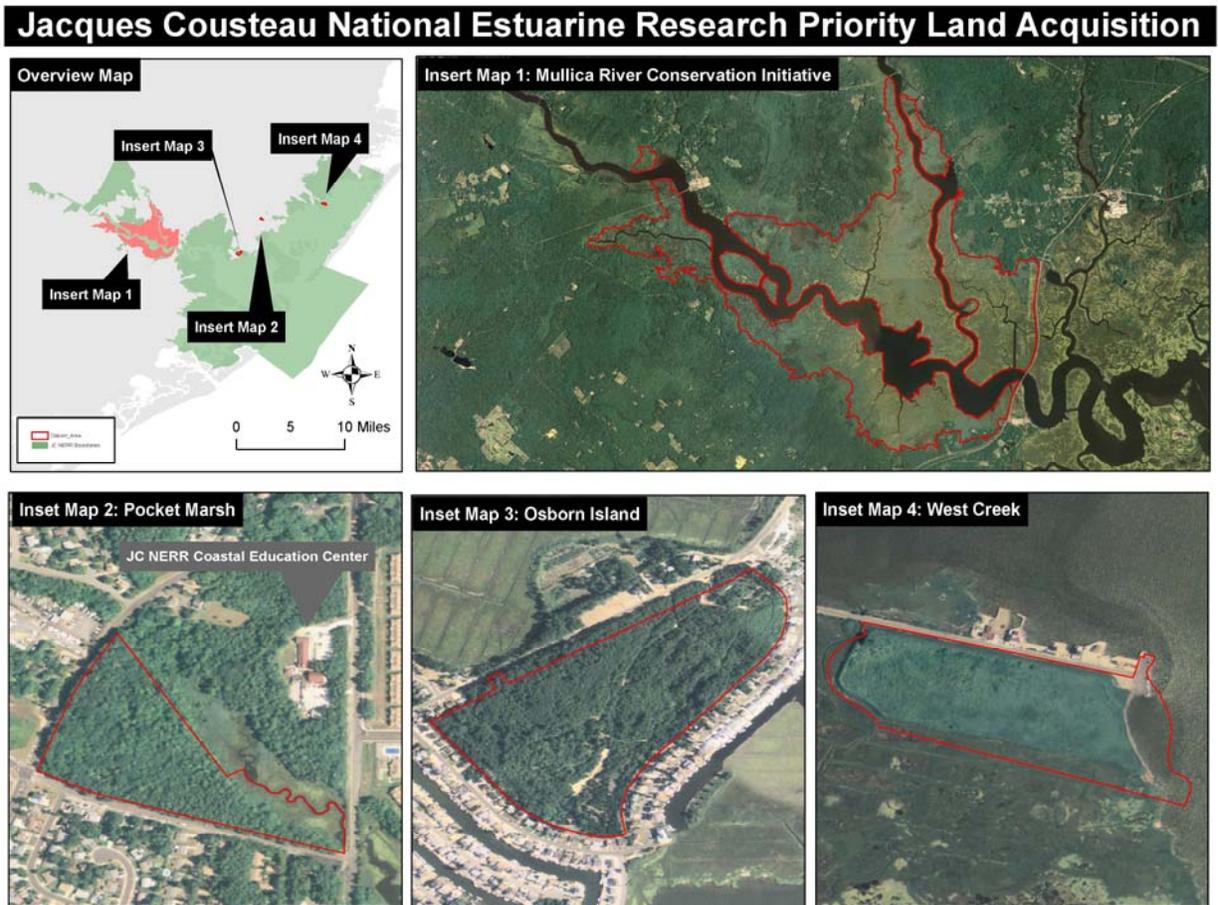


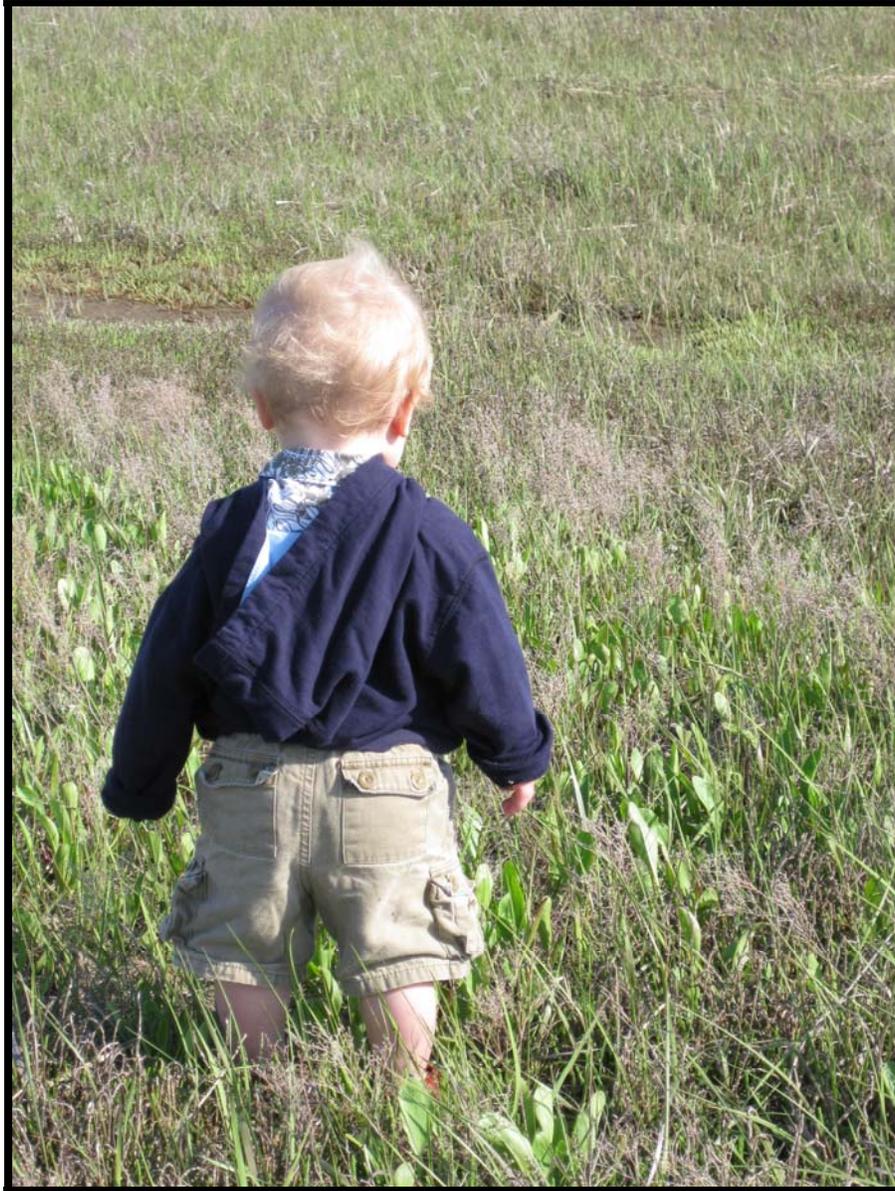
Figure 12. Map of Priority Land Acquisitions for the JC NERR.

## **VI. Boundary and Acquisition Plan**

Support to acquire the lands noted above will be sought via three primary avenues. Two of these are direct grant support available to the Reserve system from the Coastal and Estuarine Land Conservation Program and the NERR Construction and Land Acquisition Program. These opportunities will be pursued via established competitive grant procedures. The third avenue is to seek support in collaboration with Reserve partners including the U.S. Fish and Wildlife Service, Trust for Public Land, The Nature Conservancy and local land trusts.

Efforts also will be made to seek priority status for these land acquisitions on the state priority list, now being developed by the JC NERR in partnership with the NJ DEP. Any lands acquired by the JC NERR will ultimately be transferred to appropriate land management agencies for long-term stewardship and management. The JC NERR will work with its land management and conservation partners to develop acquisition criteria that improve resiliency of coastal communities, with an emphasis on identifying properties that can help mitigate effects of climate change.

## VII. Public Access Plan



### VII. PUBLIC ACCESS PLAN

#### A. Introduction

Waterfront property and public open space is at a premium in New Jersey and access to it is highly desirable. Understandably, the potential for conflict among users and resource protection is great. Conflict can be minimized through proper management. The success of well managed waterfront and public open space lie in approaches that combine long-term flexible public use with resource protection.

The Jacques Cousteau National Estuarine Research Reserve (JC NERR) will rely on public access plans enacted by the public agencies that manage the federal and state lands and waters comprising the Reserve. These plans maintain the integrity of the land for research, long-term resource protection and education while permitting traditional uses that do not conflict with Reserve goals. The plans foster strategic access to public lands and waters for municipal and recreational uses in a manner that mitigates broad human disturbance.

#### B. Existing Access Points

Access to resources of the JC NERR for recreational, research, education, and interpretive purposes is a major objective of the JC NERR program. The JC NERR maintains the public access policies enacted by the Reserve land management agencies. Public access to state waters for traditional uses such as boating, hunting and fishing are maintained under these policies. Existing allowable public land uses are detailed in Table 4. Continued and improved access is encouraged to the extent that Reserve resources are not adversely affected. Current statutes that exist for the land Managers in the Reserve continue to govern access within the Reserve. No new regulations will be developed with regard to access. The general public also can gain virtual access to the Reserve through the “Life on the Edge” Exhibit located within the Tuckerton Seaport. This facility has adequate parking and serves as a main point of public contact with the JC NERR.

The Forsythe Refuge provides access for more than 200,000 visitors annually through an 8-mile Wildlife Drive and foot trails. To ensure that the Refuge remains protected from human impact, visitors are asked to comply with simple guidelines and regulations. Access to the 6,000 acres of designated wilderness area, including Holgate and Little Beach (undeveloped barrier islands), is managed by the U.S. Fish and Wildlife Service which does restrict access through state and Federal programs. The Reserve does not impose any additional limitations on lands within the Reserve boundary.

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| <b>Public Access and Use</b>       | Wharton State Forest | Bass River State Park | Great Bay Natural Area | North Brigantine Natural Area | Port Republic Wildlife Management Area | Swan Bay Wildlife Management Area | Great Bay Blvd. Wildlife Management Area | Absecon Wildlife Management Area | Edwin B. Forsythe National Wildlife Refuge | Rutgers Marine Field Station | Coastal Research Center - RSC | Kislow Preserve Natural Lands Trust | Mystic Island Natural Lands Trust | Wading River Marsh Natural Land Trust | Clarks Landing Preserve Natural Land Trust |
|------------------------------------|----------------------|-----------------------|------------------------|-------------------------------|--|-----------------------------------|--|----------------------------------|--|------------------------------|-------------------------------|-------------------------------------|-----------------------------------|---------------------------------------|--|
| <b>Upland Hunting</b>              | x                    | x                     |                        |                               | x                                      | x                                 |  |                                  | x  |                              |                               |                                     |                                   |                                       |  |
| <b>Waterfowl Hunting</b>           | x                    | x                     |                        |                               | x                                      | x                                 | x  | x                                | x  |                              |                               |                                     |                                   |                                       |  |
| <b>Trapping</b>                    | x                    | x                     |                        |                               | x                                      | x                                 |  |                                  |  |                              |                               |                                     |                                   |                                       |  |
| <b>Fishing, Crabbing, Clamming</b> | x                    | x                     |                        |                               | x                                      | x                                 | x  | x                                | x  | x                            | x                             | x                                   | x                                 | x                                     | x  |
| <b>Birdwatching</b>                | x                    | x                     | x                      | x                             | x                                      | x                                 | x  | x                                | x  | x                            | x                             | x                                   | x                                 | x                                     | x  |
| <b>Camping</b>                     | x                    | x                     |                        |                               |  |                                   |  |                                  |  |                              |                               |                                     |                                   |                                       |  |
| <b>Picnic Area</b>                 | x                    | x                     |                        |                               |  |                                   |  |                                  | x  |                              |                               |                                     |                                   |                                       |  |
| <b>Playground</b>                  |                      | x                     |                        |                               |  |                                   |  |                                  |  |                              |                               |                                     |                                   |                                       |  |
| <b>Swimming</b>                    | x                    | x                     |                        |                               |  |                                   |  |                                  |  |                              |                               |                                     |                                   |                                       |  |
| <b>Natural Area</b>                | x                    | x                     | x                      | x                             |  |                                   |  |                                  | x  |                              |                               | x                                   | x                                 | x                                     | x  |
| <b>Boat Launch Area</b>            |                      | x                     |                        |                               |  | x                                 | x  | x                                | x  |                              |                               |                                     |                                   |                                       |  |
| <b>Hiking</b>                      | x                    | x                     |                        |                               | x                                      | x                                 |  |                                  | x  |                              |                               | x                                   | x                                 | x                                     | x  |
| <b>Canoeing</b>                    | x                    | x                     |                        |                               | x                                      | x                                 | x  | x                                |  |                              |                               | x                                   | x                                 | x                                     | x  |
| <b>Boating</b>                     | x                    | x                     |                        |                               | x                                      | x                                 | x  | x                                | x  |                              |                               | x                                   | x                                 | x                                     | x  |
| <b>Horseback Riding</b>            | x                    |                       |                        |                               |  |                                   |  |                                  |  |                              |                               | x                                   | x                                 | x                                     | x  |
| <b>Beach Buggy Use</b>             |                      |                       |                        | x                             |  |                                   |  |                                  |  |                              |                               |                                     |                                   |                                       |  |

**Table 4. Public land use activities permitted by federal and state agencies in the JC NERR.**

### **C. Traditional Uses**

Traditionally, the JC NERR has been used for hunting many game species. Recreational fishing in the rivers and creeks and commercial fishing and shell fishing in the estuary and bay also are recognized traditional uses. Each of these activities is currently subject to state regulation through required licenses, permits and other laws. The Reserve does not possess authority to enforce or implement existing laws and regulations concerning these or any other traditional uses of the JC NERR. These activities are permitted up to levels currently permitted under local and state laws unless these uses interfere with a research or educational activity that cannot avoid a conflict with these traditional uses.

### **D. Future Proposed or Planned Project**

The JC NERR plans to construct an interpretive and educational boardwalk to support professional development workshops for the public, teachers, coastal decision-maker training, and family and public programs. The boardwalk would be placed within the forest/marshland behind the JC NERR Coastal Center in Tuckerton, NJ. The trailhead would originate at the Coastal Center and pass through upland, wetland and creek habitats and loop back to the Coastal Center. The loop nature of the trail will expose program participants and visitors to the distinctive flora and fauna found within these habitats. The trail would include a 6-foot wide raised, wooden accessible boardwalk, fashioned like the wooden boardwalks used at the Edwin B. Forsythe National Wildlife Refuge. This looped walkway would include wooden benches and interpretive signage at various distances along the trail. The boardwalk and benches will be constructed from a recycled composite material to reduce long-term maintenance costs. Maintenance staff at Rutgers University, along with volunteers and educational staff at the JC NERR, will be responsible for maintenance of the interpretive trail.

This project will feature a self-guided, educational boardwalk that exposes the public to the various habitats which dominate southern Ocean County, NJ. Importantly, this boardwalk will describe living resources and discuss the importance of the transitional zones between the habitats. By offering this type of educational experience, visitors will be able to learn why it is important to protect such areas. Our boardwalk would be used by the public, K-12 educators, and by staff educators, who offer professional development opportunities for teachers and their students. The boardwalk will also be used during outreach workshops for local coastal Managers charged with land use planning decisions.

# VIII. Facilities Construction Plan



### VIII. FACILITIES CONSTRUCTION PLAN

#### A. Introduction

To date funds have been used to construct core facilities for the Jacques Cousteau National Estuarine Research Reserve (JC NERR). These include a primary complex that contains offices, a classroom, wet lab, and dormitory, facilities that house a public exhibit, and research space located at the Rutgers Marine Field Station.

Two efforts in progress will add satellite facilities to broaden delivery of Reserve programs and services to achieve the goals of the JC NERR. These are a renovated army barracks at historic Fort Hancock located at Sandy Hook, and the historic Sheppard House located on the bank of the Cohansy River in Bridgeton. Future plans require renovation of the Life on the Edge exhibit, and construction of an auditorium to support growing public programs.

Major construction projects (i.e., buildings) require the preparation of architectural and engineering plans and state approval of capital outlay proposals. Development of architectural and engineering plans for buildings must meet the goals and objectives of the Final Environmental Impact Statement. Funds for constructing buildings may come from Federal acquisition and development grants. All construction within the JC NERR boundary (core or buffer) will follow state and Federal regulations and guidelines. The construction and operation of a research and/or educational facilities will be thoroughly reviewed and examined by all landholders to ensure there are no negative impacts on the natural system. Pursuant to the National Environmental Policy Act, a categorical exclusion, environmental assessment, or supplemental environmental impact statement may be required prior to construction.

Minor construction activities such as nature trails, boardwalks, and boat ramps do not require architectural or engineering plans. Funding for planning and constructing nature trails, boardwalks, boat ramps, and other minor improvements also can be awarded under future acquisition and development grants.

#### B. Existing Facilities

##### 1. The Jacques Cousteau Coastal Center

Funds from the NERRS Construction and Acquisition Program were used to construct a Coastal Center in Tuckerton, NJ. The Coastal Center provides research, education and office space, and supports two types of programs: (1) coastal decision-maker workshops for resource and marine policy professionals and a variety of local/state government officials, environmental, civic, non-profit, and public interest groups, and (2) state-of-the-art professional development programs for K-12 educators seeking environmental classroom and field-based curricular programs. The Coastal Center is located in the buffer zone, next to the RUMFS dorm. This location has excellent access to a variety of Reserve habitats with minimal traffic impacts on sensitive areas.

Facilities within the Coastal Center include:

- **Main Entry Vestibule**
- **Distance Learning Classroom** - Used for formal classroom activities, lectures, and hands-on demonstrations, includes an audio-visual projection area and distance learning equipment

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- **Restrooms with showers**- Used by our class participants and overnight guests
- **Office space** - Office space for Reserve staff and volunteers
- **Library** - Small library for environmental science curricula and watershed management resources
- **Bedrooms** - Four bedrooms each with space for four people
- **Staff Dorms** - Used by staff or VIP guests that may be staying for multiple nights. Includes a small kitchen and laundry facilities
- **Wet Laboratory** – Used by education groups and researchers for further investigations of organisms collected in the field

### 2. “Life on the Edge Exhibit” at the Tuckerton Seaport

The exhibit opened to the public in July 2002, on the upper level of the Yacht Club Visitor Center. The project was collaboration between the Tuckerton Seaport, Rutgers-IMCS, and the JC NERR and was also funded through a NERRS Construction and Acquisition Program. The multi-media exhibit is presented through the context of water, with a unifying theme of “You Are Always Upstream or Downstream from Somewhere Else”. Simulated water streaming down the stairwell welcomes the visitor. After viewing an orientation video, the visitor is reintroduced to the water theme, repeated in sound, image, light and undulating fluid forms, shaping a natural pathway through Pinelands, the marshes and bay, barrier island and open ocean. A stopover at the mock-up of the RUMFS is also part of the journey. Throughout, layers of text, displays of satellite images, objects and “props”, present ideas and patterns of life. Interactive stations extend the reach of the exhibit with personal narratives that promote environmental literacy and scientific advancement, and help define community stakeholders and land use issues. Visitors leave the “virtual” experience to develop their own points of view. Further exploration at the Seaport reinforces the exhibit material, to further create a meaningful experience that forges a sense of place and stewardship of a region rich with culture, natural resources and maritime history.

### 3. Marine Field Station, IMCS, Rutgers University

The Rutgers University Marine Field Station (RUMFS) is a unit of the IMCS the primary manager of the JC NERR. At present, the buildings, causeway and grounds of RUMFS occupy seven acres on a peninsula close to Little Egg Inlet in southern New Jersey within the JC NERR. The facilities at this site consist of an office/laboratory building (7,388 sq. ft.), an adjoining seawater laboratory (1,736 sq. ft.), a third building consists of a partially renovated dry laboratories/office space (3,390 sq. ft.). The main building is also the terminus for the fiber optic cable from the Long-Term Ecosystem Observatory at 15 m outside Little Egg Inlet (<http://marine.rutgers.edu/mrs/LEO/LEO15.html>). A dormitory (5,828 sq. ft.), warehouse (2,068 sq. ft.), and the JC NERR Coastal Center (7,500 sq. ft.) are located in nearby Tuckerton. RUMFS resources also include the R/V CALETA a 28 ft. aluminum hull research vessel, equipped with an A-frame and winches and a 48 ft. research vessel, the R/V ARABELLA, equipped with an A-frame, GPS navigation system, lab facilities, and mast mounted wind sensors. The JC NERR boat, the Mullica Explorer, a 20 ft. Maritime Skiff is docked at RUMFS. Ready access to this boat enables JC NERR researchers to accomplish research programs and enhances support of field-based education programs.

Use of RUMFS has increased almost every year. During the last five years there were typically 25-30 individuals/day in the winter and filled our present capacity of 45-60 during the summer.

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These are comprised of faculty, postdocs, graduate students, staff, and undergraduate interns and technicians. Over the same period, there have been a large number of visiting scientists from U.S. (190), Canadian (8), European (4), Japanese (3) and other (7) foreign academic institutions. Visitors from elsewhere in the US include scientists from academic institutions, federal and state laboratories, private institutions and consulting companies.

The location of RUMFS near Little Egg Inlet provides immediate access to the adjacent Atlantic Ocean and a Long-Term Ecosystem Observatory at 15 m depth (LEO-15). This site is already the focus of multi-disciplinary studies that integrate physical, chemical, geological and biological approaches to the study to seasonal (e.g. upwellings and hypoxia), low-frequency (e.g. major storms), and other aperiodic events. The Science Dive Program complements this activity by support and conducting undersea research activities, primarily at the LEO-15 site. LEO is the first facility in the U.S. to be established as part of an electro-optical ocean sensing network, which provides the scientific community with the ability to monitor natural and anthropogenic changes in the marine environment in situ and in real time. A related sampling program that operates from RUMFS, both in the estuary and the ocean, is the Remote Environment Monitoring Unit (REMUS), an autonomous underwater vehicle that is designed to perform hydrographic reconnaissance in shallow water (3-20 m).

As a result of interest expressed by many investigators, and the development of NERRs objectives, RUMFS has become a focal point for estuarine and marine researchers and students from many other institutions. In addition, the IMCS research experience for undergraduates summer program sponsors students, from Rutgers and other institutions, who work and conduct research at RUMFS. In an attempt to encourage graduate student research at RUMFS there is an annual competition that provides support for students working in the JC NERR.

### C. Existing Partnerships

Two recent facilities, funded by NOAA and reserve partners, have been established to scale up delivery of coastal training, education and outreach programs. These facilities will be operated in partnership with a variety of stakeholders including government, academic and nonprofit organizations.

#### 1. Sandy Hook Building Renovation

Brookdale Community College, RU-IMCS and the JC NERR formed a partnership to combine the research, education, and service strengths of both institutions to serve the Bayshore and NY/NJ Harbor region. Grounded in nationally-acclaimed science and education programs (including a major Brookdale program presently housed at Sandy Hook), the partnership proposes to capitalize on the unique natural resources and reinvestment opportunities that exist at Sandy Hook to establish a coastal “campus” for the environment including a satellite facility to scale up delivery of CTP programs and services. Two priority themes will be addressed—identification of strategies for coastal communities to adapt to the effects of climate change and science-based efforts to mitigate shoreline erosion.

A broad suite of environmental issues bears on the quality of life and economic vitality of the Bayshore and NY/NJ Harbor region. These include watershed management, sediment and water contamination, fishery management, nutrient enrichment, declines in natural resources, habitat loss, beach erosion, and harmful algal blooms. Given the importance of the coastal environment

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to the sustained economic development of this region, research, teaching, and service programs that bear on coastal management issues can be used to help guide county planning. Issues such as these are the subject of constant debate by the public, the media, and coastal decision-makers. A common feature of these debates is the need for better information and training about the coastal environment. The existing research, education, and outreach expertise of Brookdale Community College offer unique opportunities to link science to the management needs of Monmouth County, and to enrich educational programs across all grade levels with real-world experiences and training.

Fort Hancock, built a century ago to guard the entrance to New York Harbor at the tip of Sandy Hook, was deactivated in 1974 and turned over to the National Park Service as part of the Gateway National Recreation Area. Among its many assets are a number of unique buildings that are being made available to educational, cultural, business, and non-profit groups. Several of these buildings are ideal to support the research, education, and service programs of Brookdale Community College. The Sandy Hook peninsula features diverse habitats ranging from beaches to wetlands, and offers easy accessibility to the metropolitan area. It also provides an excellent venue for addressing the environmental and economic challenges faced by the entire NY/NJ Harbor region, especially as identified by regional user groups (e.g., maritime industry, environmental Managers, pilots, County officials, and students).

A key feature of the partnership is to link information generated from field research programs to formal and informal training programs that prepare resource managers, visitors to the Bayshore and NY/NJ Harbor region, and our youth to be informed decision-makers.

Use of the facilities at Fort Hancock is designed to support a diverse range of research, education, and service programs. The teaching and academic core of the programs would be housed in an Enlisted Men's Barracks (Building 23). At over 17,000 square feet, Building 23 would be used to house classrooms, offices and a GIS laboratory.

The operating plan for Sandy Hook relies on several partnerships and the existing capacity of these partners. A Rutgers Professor Emeritus serves as the Director of Cooperative Research Programs at Sandy Hook on behalf of Rutgers University and as the Watershed Coordinator at Sandy Hook on behalf of the JC NERR. He also leads a Cooperative Ecosystem Studies Unit in partnership with the National Park Service, and will assist with development of the Seamless Network Initiative with the National Park Service. The Park Service plans to hire a full-time GIS Coordinator and a researcher on shore processes in the near future. Individuals stationed at this facility will work collaboratively on CTP programs for north Jersey, and are proposed to be housed at Sandy Hook. In addition, the National Park Service plans to develop a National Ocean Institute at Sandy Hook to deliver training programs for park service personnel, foster activities and programs in support of science-based management of marine protected areas, and offer training programs for the next generation of resource managers. These efforts will be conducted in collaboration with the JC NERR, and offer opportunities to leverage resources, share costs and facilities. CTP and education programs will focus primarily on the effects of climate change on coastal communities, and shoreline erosion and protection strategies.

Brookdale Community College plans to lease part of the Sandy Hook space for undergraduate training. This activity enables the partnership to incorporate science-based information into

## VIII. Facilities Construction Plan

undergraduate instruction. Brookdale Community College also conducts day programs for pre-college students. Again, this is an opportunity to incorporate results of JC NERR research, education and stewardship programs to a broad group of students, parents and educators. Two classrooms and several offices will be devoted to these efforts.

The New Jersey Sea Grant Program is located at Sandy Hook adjacent to Building 23 and administered through the New Jersey Marine Sciences Consortium. Sea Grant supports research, education and marine extension throughout New Jersey. Existing collaborations with the JC NERR focus on special events such as the Shore Bowl and Coast Day. Additional collaboration is planned in the complementary areas of marine extension and coastal training, as well as education programs for the general public.

The National Marine Fisheries Service operates the James J. Howard Laboratory at Sandy Hook. This agency sponsors research on commercial and recreational fisheries in the New York Bight region. Research conducted by this regional partner complements plans of the partnership to develop a fisheries CTP program with a relatively underserved audience—state, regional and federal fishery Managers. Development activities are underway to make this a future focal point for the partnership. These include acoustic tracking of finfish (conducted in the JC NERR for the past three years), a pilot project to apply SWMP data to inform fishery management decisions, and use of an AUV to characterize water masses such as slope water intrusions that influence stock assessments.

In summary, the constellation of relevant partners at Sandy Hook offer excellent partnering opportunities for the JC NERR to scale up and diversify delivery of CTP and education programs. Shared facilities, existing human and financial capacity, and existing partnerships combine to make this a practical investment for the JC NERR.

### **2. Bridgeton: The Cousteau Center at Bridgeton (Sheppard House)**

In Cumberland County, the JC NERR has partnered with the City of Bridgeton, the Bridgeton regional school district, local and regional government and the regional business community to establish a satellite Reserve effort. A Memorandum of Agreement is included in Appendix F. Support was received to establish a satellite facility in Cumberland County to expand access to and delivery of programs to all educators, coastal decision-makers, and interested participants in the southern New Jersey region. Expansion to this area also responds to demand for coastal programs and services identified in the CTP Needs Assessment for the JC NERR, and was stated as a priority in the September 2003 Sec. 312 evaluation of the JC NERR. An existing facility in Cumberland County is being renovated to support partnership programs. Renovation requires updating of the core infrastructure, improvements to existing space and the installation of advanced communications. Exterior work to the Sheppard House was completed with external funding from the City of Bridgeton and the New Jersey State Historic Preservation Office.

Bridgeton's history, location, current needs, and committed municipal government make it a perfect site for a satellite center. Established in the late 1600s as Cohansey Bridge, the City of Bridgeton has served as the Cumberland County seat since 1748. It is a longstanding regional center encompassing a wide array of financial, manufacturing, cultural and commercial enterprises. Rich in history, Bridgeton contains New Jersey's largest historic district with over 2,200 Colonial, Victorian and Federalist period homes and commercial buildings. However,

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since the second half of the twentieth century, the area has struggled with extensive unemployment and poverty. Clearly the population is underserved and underrepresented and particularly appropriate for this type of outreach initiative in keeping with the recommendations of the Commission on Ocean Policy. The demise of Cumberland County's oyster industry, which thrived along the Maurice River until the middle 1950's, is seen as one of the major historical and environmental factors affecting the county's later decline in prosperity. More recently, the City of Bridgeton began proactive redevelopment efforts to revitalize its waterfront area and stimulate commercial development. Since regional watershed management is of the utmost priority in the Bridgeton region, the expansion of partnership training and workshop programs meet a critical need in Cumberland County and southern New Jersey for science-based support.

Additionally, anchoring a coastal resource center in Bridgeton's Sheppard House will facilitate local implementation of the MARE initiative, so effective in other areas of the state. MARE (Marine Activities, Resources, and Education), is an interdisciplinary, whole school program that engages teachers, students, parents, administrators, and the community in transforming elementary and middle schools into dynamic laboratories for the study of the coast and ocean. The Institute of Marine and Coastal Sciences/Rutgers and its partners, have established MARE in over 50 New Jersey Schools, including programs in several Bridgeton schools including Indian Avenue and Quarter Mile Lane schools. Complementing the MARE program, the Sheppard House partnership program will offer Project PORTS: Promoting Oyster Restoration Through Schools, a community-based oyster restoration and education program for K-12 students. This program has been specifically developed for the Delaware Bayshore region and holds particular relevance for Cumberland County educators and students.

As with the satellite program based at Sandy Hook, programs and activities centered at the Sheppard house rely on existing partnerships and partner capabilities. Many local and regional organizations have committed to collaborating with the JC NERR and include: Director, Bridgeton Department of Development and Planning; President, Bridgeton Development Corporation; Director, Tri-County Community Development Corporation; Chair, Bridgeton Municipal Port Authority; President, Bridgeton Downtown Association; Chair, Bridgeton Church Council; President, Cumberland County College; Superintendent of Schools, Cumberland County; Director, Cumberland County Planning and Economic Development; Chair, Aquaculture Development Corporation; Executive Director, Cumberland County Utilities Authority; Executive Director, Cumberland County Development Corporation; Executive Director, Cumberland County Empowerment Zone; Director, Haskin Shellfish Research Laboratory; Director, Garden State Principals Center; Director, Environmental Affairs, Public Service Electric & Gas Company; and the Director, Walter Rand Institute for Public Policy at Rutgers-Camden.

These partners seek to develop a regional science enrichment and economic development program that capitalizes on the natural resources of the Bridgeton area and the research, education and stewardship capabilities of the JC NERR. Outreach is a key element critical to the success of the Program, especially for rapid dissemination of demonstration and research findings to the coastal user community in the Bridgeton region. Specific activities to be conducted include:

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1. Coastal Decision-Maker Workshops to enhance coastal decision-making and provide periodic scientific updates.
2. Field demonstrations of innovative techniques, methods, and practices to improve the capabilities of coastal planning efforts at the local level.
3. Educational programs that capitalize on the natural resources of the Bridgeton region to enrich basic and problem-solving skills of precollege students.
4. Opportunities for Bridgeton-area educators to participate in science enrichment programs such as MARE and Summer Research Experiences for educators.
5. Conservation of coastal resources.

Of particular importance are two emerging partnerships, one with The New Jersey Audubon Society and the other with the Freeholders of Cumberland County. The Nature Center of Cape May, an existing JC NERR partner that is administered by New Jersey Audubon, seeks to collaborate on public educational programs delivered via the Sheppard House. This group has expressed interest in locating staff and resources at the facility. In turn, this partnership will engage NJ Audubon in CTP efforts directed at information needs specific to south Jersey.

With respect to the County Freeholders, discussions have occurred to secure part-time support for a Watershed Coordinator at the Sheppard House. This also may be accomplished in cooperation with Rutgers Cooperative Extension.

Future discussions also will be held with New Jersey Sea Grant to identify opportunities to co-locate a marine extension agent at Sheppard House, especially to develop and deliver programs related to non point source pollution/stormwater management, climate change, and coastal development.

### **D. Maintenance**

The buildings and the grounds at the Coastal Center, the adjoining dorms and RUMFS are maintained by two full-time facilities staff members from Rutgers University. During the summer months when all facilities are being used to full capacity, additional part-time help may be enlisted to meet maintenance needs. Satellite facilities at Sandy Hook and Bridgeton will be maintained by Rutgers University and reserve partners.

### **E. Future Planned or Proposed Projects**

#### **1. Renovation of “Life on the Edge” Exhibit**

In 2002, the JC NERR opened the “Life on the Edge” public exhibit at the Tuckerton Seaport. This facility features interpretive exhibits that introduce visitors to the ecologic, economic and historical attributes of the MRGB system. Habitats, research activities and CTPs are presented in a manner that enables visitors to enhance their understanding of state and federal conservation and coastal management issues. Exhibits articulate differing perspectives from scientists, managers and people who use the estuary.

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The purpose for the exhibits was to educate visitors about the ecological, economical, and historical values of the Mullica River-Great Bay region and how they relate to state and national protection and management issues. The overwhelming message is positive – articulating the wonder of estuaries from the perspective of scientists, managers, and people who use the estuary (ie. Baymen).

Exhibits are nearing the end of their life expectancy, and some of the information is dated. Funds will be sought to update the exhibit, incorporate new communications and learning strategies, and deliver a dynamic experience for a general public audience.

Updates to the exhibit design require a process of place-making and narratives from a variety of perspectives. The exhibits will move beyond “edutainment” and will offer the visitor opportunities to “scaffold learning”, develop scientific inquiry skills, and enhance aesthetic appreciation of the natural world. The exhibit will be thematic and will express issues important to the JC NERR. The exhibit updates will provide non-formal education opportunities which will use a self inquiry approach to relevant topics. Inquiry based exhibits sustain the visitor’s interest and attention and leave them feeling satisfied that they have gained knowledge. Because people learn in different ways, interactive and learning options, such as text, sound, and touch will be employed to form a free choice learning environment. Exhibit updates for family learning will encourage intergenerational participation and interaction. Design updates will be made to develop a more engaging exhibit for school group visits to provide a link for children to connect with nature.

Life on the Edge topics and themes will aim to raise awareness of the ecological, economical and historical value of the Mullica River-Great Bay region, and to foster citizen stewardship efforts on behalf of preserving coastal and estuarine resources. We are always upstream or downstream of somewhere else.

Further enhancement will move toward the design of a greener exhibit to reduce operating costs such as motion sensor lighting, LED and fluorescent lighting. This is an opportunity to highlight sustainable strategies and advance the JC NERR stewardship mission.

The proposed construction schedule for this project will be broken down into the following construction phases: pre-design, schematic design, design development, construction documentation, construction administration, and construction/fabrication/installation. All renovations should be completed within a three year period.

The Pre-Design phase focuses on preparing a clear vision and solid foundation for all work that follows, insuring that the project is logically structured and its goals are understood and realistically attainable. Project team members and stakeholders are identified and their roles defined. In this phase we determine the project goals, interpretive objectives and the desired visitor experiences. Existing exhibits are evaluated as well as audience response to determine what works, where improvements can be made, or what should be added. Project parameters, such as the architectural space, budget, and timeline that will influence the overall design outcome are evaluated.

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Work accomplished during the Schematic Design Phase will be divided into two sub-phases: Schematic I and Schematic II. In Schematic I alternative schemes are explored for organizing both the interpretive content and physical layout of the exhibits and media. In Schematic II, a preferred alternative has been selected and major stories, exhibit elements and presentation techniques are illustrated and described. An early budget is developed for the overall project.

The work accomplished in the Design Development phase is divided into two sub-phases: Design Development and Final Design. Design development builds upon the plan approved in the Schematic Design phase. All major details of the design are confirmed. Content planning is fully developed in detail. Design and content are integrated into coherent presentations formats. Complex media elements requiring further development are fully described. The exhibit's physical structure and operational characteristics are established. The preliminary budget is now refined. In Final Design all content Development is completed: objects, images, and text.

During the Construction Documentation phase technical drawings and specifications are completed, communicating details necessary for potential exhibit fabricators to understand, price, and begin work on the project. These drawings communicate design intent. The exhibit fabricator is responsible for developing all shop drawings. Pre-Production planning and design tasks are initiated and coordinated with the exhibit fabrication schedule.

Construction Administration work includes creative and technical support during fabrication of the project, including Planning and Design Follow-ups required to complete development of specific exhibit elements, and Fabrication Support to insure adherence to the project's design intent.

During the Construction/Fabrication/Installation phase experienced craftsman will create an exact likeness of the JC NERR Reserve from the technical drawings and specifications paying attention to details and construction codes. Installation will be supervised with creative flexibility to allow for on site alternations and possible production changes and revisions.

Costs associated with the above phase work are estimated at \$72,000 for all phases excluding the Construction/Fabrication/Installation phase. Fabricators are currently quoting construction/fabrication/installation costs of \$500 sq. ft. for a highly interactive exhibit, \$250 sq. ft. for a moderately interactive exhibit and \$150 sq. ft. for a traditional more graphical exhibit. The total square footage of the Life on the Edge exhibit is 2400 sq. ft.

As with all JC NERR construction projects, Rutgers University will provide matching support through salaries for staff time for overall project management of the proposed project.

### **2. Renovation of Research and Education Facilities within the JC NERR**

To address a critical facilities need, the JC NERR plans to renovate two small dry laboratories and offices. On numerous occasions during the past five years, the JC NERR was either unable to provide laboratory space for visiting scientists or the space provided was marginal and failed to use researcher time in the JC NERR efficiently. This renovation will allow the continued development of the JC NERR as a significant facility for the study of complex and important issues confronting the ecology and management of the coastal zone.

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Numerous domestic and international scientists, teachers, legislators and students use JC NERR facilities each year. These facilities are uniquely located within international, national and state reserve systems. As a result, this protection provides an exceptional opportunity for estuarine and coastal inquiry across physical, geological, chemical and biological regimes that are largely protected from human disturbance. The intellectual contributions of JC NERR partners and investigators are innovative and substantial.

Because JC NERR facilities are used by a wide variety of individuals, renovations will be broadly available for a number of potentially very different lines of research as well as education. Further, insights gained through these improvements will be actively communicated to other scientists, resource managers, legislators and the general public through a variety of conventional approaches (publications, undergraduate and graduate classroom teaching) and state-of-the-art techniques (web-based learning and communication). The JC NERR has a history of productive, leading edge research, a broadly applicable setting and a commitment to building excellent infrastructure for science and training.

The requested renovations for two small dry laboratories and two offices are needed to improve our capacity to deliver quality research, education and training, especially for visiting scientists including faculty, postdoctoral fellows, graduate students and summer interns. This project will safeguard environmental quality in several ways. Rutgers University is required by state law to construct and renovate facilities to a LEED certifiable standard of a “Silver” rating and all University Design Standards are written and completed at that level. This includes optimizing energy performance using higher energy efficient equipment, lighting, motors, and use of renewable energy. These standards also include reduction of greenhouse gases, reduction of water usage, low VOC or no VOC in new construction materials, recycling of construction waste and use of paper with a minimum of 30% consumer fiber content, management of a recycling program at the faculty, and reducing the use of hazardous materials for research.

The laboratories (429 sq. ft) and offices (819 sq ft) will be renovated by improving insulation, electrical/lighting, and HVAC. Both laboratories will be outfitted with new cabinetry/casework, and one will have a new ventilation hood. The office space will be renovated by improving insulation, HVAC, electrical/lighting and providing moveable partitions to enhance the available space. The estimate of monies needed to complete the construction is \$624,000. This cost is based on estimates of \$556/sq.ft. for 1,248 sq. ft. by Rutgers University, Facilities and Maintenance Services. Matching support in the amount of \$267,430 for this project will be provided by Rutgers University School of Environmental and Biological Sciences (SEBS) to further equip the laboratories and offices for tracking fish in space (telemetry) and time (otolith analysis). This matching support will also include \$65,000 for research equipment and \$30,000 for minor equipment and lab supplies toward proposed research goals. In addition, other match support includes \$102,430 for personnel support for guiding the construction and \$70,000 for construction support from SEBS.

The proposed construction schedule for this project will be broken down into seven construction phases including pre-design, schematic design, design development, construction documentation, bidding and permits, construction phase and close-out and occupancy. Each phase will require anywhere from 40 to 154 days to complete. All renovations should be completed within a three year period.

## VIII. Facilities Construction Plan

### 3. Construct Public Auditorium/Meeting Space

The existing research, education, and outreach programs of the Jacques Cousteau National Estuarine Research Reserve offer unique vehicles to address coastal management. The JC NERR staff has developed a broad array of educational programs and services that benefit diverse audiences. These programs link management information with science, and enrich educational programs across all demographics with real-world experiences and training within the state of New Jersey.

A new auditorium/public meeting complex constructed at the JC NERR Coastal Center will provide valuable infrastructure to deliver programs that will raise the Cousteau profile in Ocean, Atlantic and Burlington counties within the Mullica River/Great Bay watershed in a state of the art setting.

Existing off-site venues used for current programs (such as Lunch n Learn) limit the number of participants and types of programs offered. Participation in the Marine Activities Resources and Education (MARE) program for K-12 teachers could significantly increase. The JC NERR has developed a mature volunteer program which can help administer public programs on site at the JC NERR Coastal Center. Also, there is a demonstrated need for a venue of this size and with these capabilities in this area. On numerous occasions the Cousteau Reserve has fielded requests by New Jersey Department of Environmental Protection, and other partners for such a facility.

The proposed auditorium will include a lobby area with freestanding displays that illustrate the four ecosystems encompassed in the reserve; Pinelands, wetlands/estuaries, barrier islands, and open oceans and work of the JC NERR. This space will also be used for queuing program participants and will include restrooms. The auditorium will accommodate 100 people on a gradual slope. The seats will include flip-up desks tops. The front of the room will include a stage area, a large screen, and distance learning equipment to ensure the ability to access learning opportunities off-site. The auditorium will be connected to the existing structure by a walkway.

Rutgers University is required by state law to construct facilities to a LEED certifiable standard of a "Silver" rating and all University Design Standards are written and completed at that level. This includes optimizing energy performance using higher energy efficient equipment, lighting, motors, and use of renewable energy. These standards also include reduction of greenhouse gases, reduction of water usage, low VOC or no VOC in new construction materials, recycling of construction waste and use of paper with a minimum of 30% consumer fiber content, and management of a recycling program at the faculty.

The proposed construction schedule for this project will be broken down into seven construction phases including pre-design, schematic design, design development, construction documentation, bidding and permits, construction phase and close-out and occupancy. Construction should take approximately three years.

The estimate of monies needed to complete the auditorium would range between 3.5 million to 4.5 million for a 7,000 to 8,000 sq. ft. auditorium and 4.5 to 5 million for a 10,000 sq. ft. auditorium. This cost is based on estimates of \$500 sq.ft. by Rutgers University, Facilities and Maintenance Services. Matching support will be provided by Rutgers, The State University of New Jersey through salaries for staff time for project management of the proposed project.

# IX. Research and Monitoring Plan



**IX. RESEARCH AND MONITORING PLAN**

**A. NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM**

**1. Reserve System Research**

The Reserve system provides a mechanism for addressing scientific and technical aspects of coastal management problems through a comprehensive, interdisciplinary, and coordinated approach. Research and monitoring programs, including the development of baseline information, form the basis of this approach. Reserve research and monitoring activities are guided by the Reserve system research and monitoring plan 2006-2011 which identifies goals, priorities, and implementation strategies. This approach, when used in combination with the education and outreach programs, will help ensure the availability of scientific information that has long-term, system-wide consistency and utility for managers and members of the public to use in protecting or improving natural processes in their estuaries. Research within the Reserves is designed to fulfill the Reserve system goals as defined in program regulations. These include:

- Address coastal management issues identified as significant through coordinated estuarine research within the System;
- Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
- Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

**2. Reserve System Research Funding Priorities**

Federal regulations, 15 C.F.R. Part 921.50 (a), specify the purposes for which research funds are to be used:

- Support management-related research that will enhance scientific understanding of the Reserve ecosystem,
- Provide information needed by Reserve managers and coastal ecosystem policy-makers, and
- Improve public awareness and understanding of estuarine ecosystems and estuarine management issues.

The Reserve system has identified the following five priority research areas to complement the funding priorities outlined above:

1. Habitat and ecosystem processes
2. Anthropogenic influences on estuaries
3. Habitat conservation and restoration
4. Species management
5. Social science and economics

**3. Reserve System Research Goal**

As stated in Goal 2 of the Reserve System Strategic Plan for 2005-2010, the NERRS aim is to research goal for the reserve system is to “Increase the use of Reserve science and sites to

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address priority coastal management issues.” This is also outlined in the 2006-2011 Reserve System Research and Monitoring Plan. Expected systemwide outcomes include:

- Biological, chemical, physical, and ecological conditions of Reserves are characterized and monitored to describe reference conditions and to quantify change.
- Scientists conduct research at Reserves that is relevant to coastal management needs and increases basic understanding of estuarine processes.
- Scientists have access to NERRS datasets, science products and results
- The scientific, coastal management and education communities, as well as the general public, use data, products tools, and techniques generated at the NERRS.

Currently, there are two Reserve system-wide efforts to fund estuarine research. The Graduate Research Fellowship Program (GRF) supports students to produce high quality research in the Reserves. The fellowship provides graduate students with funding for 1-3 years to conduct their research, as well as an opportunity to assist with the research and monitoring program at a Reserve. Projects must address coastal management issues identified as having regional or national significance; relate them to the Reserve system research focus areas; and be conducted at least partially within one or more designated Reserve sites. Proposals must focus on the following areas: 1) Eutrophication, effects of non-point source pollution and/or nutrient dynamics; 2) Habitat conservation and/or restoration; 3) Biodiversity and/or the effects of invasive species; 4) Mechanisms for sustaining resources within estuarine ecosystems; or 5) Economic, sociological, and/or anthropological research applicable to estuarine ecosystem management.

Students work with the research coordinator or manager at the host Reserve to develop a plan to participate in the Reserve’s research and/or monitoring program. Students are asked to provide up to 15 hours per week of research and/or monitoring assistance to the Reserve; this training may take place throughout the school year or may be concentrated during a specific season.

Secondly, research is funded through the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET), a partnership between NOAA and the University of New Hampshire (UNH). CICEET uses the capabilities of UNH, the private sector, academic and public research institutions throughout the U.S., as well as the 27 Reserves in the Reserve system, to develop and apply new environmental technologies and techniques.

### **4. System-wide Monitoring Program**

It is the policy of the Jacques Cousteau National Estuarine Research Reserve to implement each phase of the System-wide Monitoring Plan initiated by ERD in 1989, and as outlined in the Reserve system regulations and strategic plan:

- Phase I: Environmental Characterization, including studies necessary for inventory and comprehensive site descriptions;
- Phase II: Site Profile, to include a synthesis of data and information; and
- Phase III: Implementation of the System-wide Monitoring Program.

The System-wide Monitoring Program provides standardized data on national estuarine environmental trends while allowing the flexibility to assess coastal management issues of

## IX. Research and Monitoring Plan

regional or local concern. The principal mission of the monitoring program is to develop quantitative measurements of short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purposes of contributing to effective coastal zone management. The program is designed to enhance the value and vision of the Reserves as a system of national references sites. The program also takes a phased approach and focuses on three different ecosystem characteristics.

1. **Abiotic Variables:** The monitoring program currently measures pH, conductivity, salinity, temperature, dissolved oxygen, turbidity, water level and atmospheric conditions. In addition, the program collects monthly nutrient and chlorophyll a samples and monthly diel samples at one SWMP data logger station. Each Reserve uses a set of automated instruments and weather stations to collect these data for submission to a centralized data management office.
2. **Biotic Variables:** The Reserve system is focusing on monitoring biodiversity, habitat and population characteristics by monitoring organisms and habitats as funds are available.
3. **Watershed and Landuse Classifications:** This component attempts to identify changes in coastal ecological conditions with the goal of tracking and evaluating changes in coastal habitats and watershed land use/cover. The main objective of this element is to examine the links between watershed land use activities and coastal habitat quality.

These data are compiled electronically at a central data management “hub”, the CDMO at the Belle W. Baruch Institute for Marine Biology and Coastal Research of the University of South Carolina. They provide additional quality control for data and metadata and they compile and disseminate the data and summary statistics via the Web (<http://cdmo.baruch.sc.edu>) where researchers, coastal managers and educators readily access the information. The metadata meets the standards of the Federal Geographical Data Committee.

### B. JC NERR Program

#### 1. Goal, Objectives, and Strategies

The research goal of the JC NERR is to address **Key management information needs, especially with respect to eutrophication, habitat loss and alteration, effects of climate change and sea level rise on coastal communities and resources, and resource conservation are supported with advanced coastal and estuarine research and observing capabilities at relevant time and space scales.**

Key research objectives are to:

#### Objectives

- Track and predict short-term variability and long-term change in the integrity and biodiversity of estuarine ecosystems and coastal watersheds.
- Disseminate research results and other pertinent information to local and regional decision-makers.

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- Promote the reserve as a long-term study site for use by federal, state, local, private and academic organizations.

### Strategies

- Capitalize on innovative remote sensing and observation technologies to track change in ecosystem processes, land use and land cover.
- Maintain a data repository that is easily accessed by coastal stakeholders.
- Partner with CICEET and other organizations to focus research and observing opportunities in the JC NERR.
- Communicate results of research through publicly accessible media.
- Collaborate with coastal training and education staff to translate research findings to target audiences.

An integrated approach to research and monitoring will be used to characterize environmental conditions in the estuaries and adjoining coastal watershed areas of the Reserve. Baseline data will be regularly collected on water quality, habitat and biotic communities, and land use/land cover. These databases will be used to track the health and ecosystem function of estuarine systems in the Reserve through quantitative measurements of short-term variability and long-term changes in chemical and physical parameters as well as key biotic indicators. These data will provide decision-makers with vital information for devising solutions to coastal management problems.

All areas of the Reserve provide an opportunity to observe and explain basic functions of and changes in natural systems and apply this information to other estuarine systems along the mid-Atlantic coast. These areas, which are already managed in part to maintain their relatively undisturbed character, can be used as controls or benchmarks to compare with other areas. These areas may be modified or manipulated to accommodate research needs and to maximize their research utility in accordance with the Manipulation Plan.

JC NERR research will focus on ecosystem-based initiatives to help characterize or define physical, chemical, and biological processes controlling stability and change in the Reserve. To this end, priority research will emphasize the development of nutrient budgets for the estuarine systems in the Reserve, characterization of human alteration of habitat and water quality, and effects of climate change on coastal and estuarine systems. Research is also underway to describe more definitively the benthic habitats and water column processes influencing the species composition, diversity, and function of biotic communities in the estuaries. High priority research initiatives are targeting benthic, nektonic, and planktonic communities in the tidal creeks as well as the open waters of the Reserve estuaries. Critically important in this regard is the assessment of essential habitat, such as submerged aquatic vegetation (SAV), shellfish beds (hard clams), and salt marsh biotopes to the system.

## 2. Research and Monitoring Projects

### a. System-wide Monitoring Program (SWMP)

#### i. Nutrients

Research will continue on the collection of atmospheric nitrogen data and water column nutrient data to determine the degree that both nutrient sources may contribute to seasonal algal blooms in the Mullica River-Great Bay Estuary. An atmospheric sampling platform was constructed at the Rutgers University Marine Field Station (RUMFS) in March 2004, and data on atmospheric deposition of nitrogen have been collected. The long-term goal is to develop a nutrient budget for the Mullica River-Great Bay (MRGB) Estuary.

#### ii. Physical Parameters

The JC NERR currently will maintain five SWMP monitoring stations: four water-quality monitoring stations and one weather monitoring station. These include Lower Bank and Chestnut Neck in the Mullica River, and Buoys #126 and #139 in Great Bay (Figure 13). Monthly arrays of water quality and nutrient data will be collected at all of these sites using YSI datasondes, an ISCO sampler, and standard grab samplers. A meteorological station will be maintained at the Richard Stockton College Marine Field Station adjacent to the Mullica River. Two SWMP monitoring stations (Chestnut Neck and Buoy 126) have been equipped with telemetry equipment that broadcasts water quality data to a GOES satellite, which is then posted to the World Wide Web.

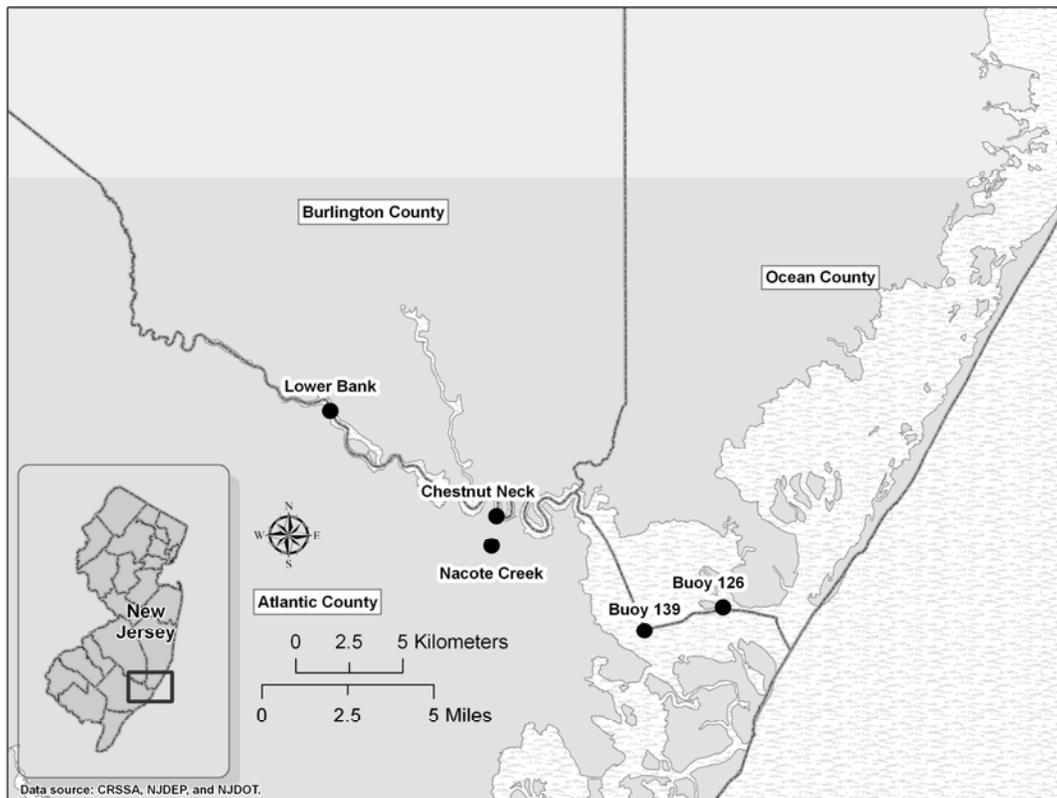


Figure 13. SWMP Monitoring Stations.

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The physical environment of the MRGB estuary will be monitored continuously with measurements of air and water temperature, wind speed and direction, and rainfall at nearby Atlantic City. JC NERR staff will use YSI data loggers to record salinity, turbidity, water temperature, dissolved oxygen, pH, and tidal variation. Data loggers will collect data in half-hour increments at three sites along a salinity gradient from fresh river waters to the open estuary. This information will be helpful in addressing short-term and long-term episodic events in the estuary, including patterns of circulation and the effects of upwelling events detected on the inner continental shelf by LEO equipment. These data will also be valuable in research on the results of upwelling on larval fish transport in the estuary and general patterns of species distribution within the estuary. Meteorological conditions including wind speed, direction and velocity, solar radiation, barometric pressure, and humidity will be recorded in one second intervals at the RSC Marine Field Station using a Campbell weather station. Monthly nutrient sampling will continue at the aforementioned SWMP sites, yielding a comprehensive database on ammonium, nitrate, ortho-phosphate, and chlorophyll *a*.

### **b. Phytoplankton**

Phytoplankton studies are ongoing in the Barnegat Bay-Little Egg Harbor Estuary as part of the assessment of escalating nutrient enrichment impacts from coastal watershed areas on this important coastal bay system. Chlorophyll *a* data are being collected estuary-wide as a measure of phytoplankton biomass. The occurrence and abundance of the toxic-bloom-forming species *Aureococcus anophagefferens* are being surveyed, particularly as they relate to alteration of vital seagrass habitat in the estuary. The development of *A. anophagefferens* blooms (HABs) are being investigated in respect to short-term nutrient loading and estuarine availability. Long-term field surveys will target phytoplankton communities and changes in species composition in response to climate variation and other environmental stress factors.

### **c. Benthic Research**

#### **i. Benthic Habitat Mapping**

Benthic Habitat Mapping within the JC NERR involves the inclusion of several research projects in a Geographics Information System to create a more complete picture of the benthic habitat. Analysis of side-scan sonar images of Great Bay has been conducted to characterize the seabed morphology and benthic habitats of a swath of estuarine floor near a long-term water quality monitoring station (Buoy #126 in Great Bay, New Jersey) of the JC NERR using high-frequency (600 kHz) side-scan sonar imaging. Acoustic backscatter records obtained with REMUS, an autonomous underwater vehicle, have been compared to the morphologic features of the seabed, bathymetry of the survey area, and the bottom sediment type. In addition, the array of bedforms delineated via side-scan imaging at the field site has been assessed for potential habitat of bottom-dwelling organisms.

Underwater camera systems have also been used to image bottom environments in the Reserve to augment benthic habitat mapping via side-scan sonar applications. Digital video camera and recording units are effective tools that provide high resolution images of the estuarine and coastal ocean floor useful for characterizing benthic communities and habitats in the JC NERR. The use of high resolution underwater camera systems coupled to GPS units in conjunction with remote sensing surveys conducted with aerial photographic and satellite imaging platforms are being employed in JC NERR research and monitoring initiatives over the near and long term. Continued application of these technologies will yield broad spatial coverage of estuarine

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systems as well as fine detailed benthic characterization in spatially restricted habitats of the Reserve.

- **Sediments Distribution and Composition**

Sediment composition and percent organic matter are being collected throughout the Reserve system to as part of an overall characterization of bottom habitats. In particular, bottom sediment characterization will be used to determine if and how sediments influence biotic communities in the Reserve estuaries. Benthic grab samplers and corers are being used to collect sediment in SAV beds, unvegetated bay bottom, and intertidal flats.

- ii. **Benthic Community Surveys**

Surveys will be conducted in estuarine waters of the JC NERR system to characterize the benthic faunal and floral communities. Biotic samples will be collected from both hard surfaces and soft bottom sediments to determine the species composition, abundance, diversity, and spatial distribution of the communities. Sampling will also be conducted to delineate spatial and temporal variation of constituent populations. This work will be augmented by videographic imaging and diver observations of the bay bottom to provide a more complete assessment of demographic characteristics of the communities as well as to provide additional information for benthic habitat characterization and mapping.

- **Submerged Aquatic Vegetation**

To assess the present condition of seagrass habitat in the BB-LEH Estuary, researchers working in the BB-LEH Estuary are conducting extensive investigations of seagrass beds. Both remote sensing and in situ surveys are being conducted to document the condition of SAV habitat in Reserve waters. Investigations will be ongoing to assess the effects of eutrophication on the SAV habitat.

CRSSA has mapped the areal extent and density of SAV within the BB-LEH Estuary as part of extensive monitoring for the BBNEP. Using advanced digital camera equipment flown in an airplane, the entire BB-LEH system was imaged on May 4 and 5, 2003. This color imagery was flown in the spring prior to increasingly turbid conditions in summer, enabling Rutgers researchers to observe the bay bottom and determine the location of seagrass beds. The aerial overflight was complemented with boat-based surveys to determine species type (i.e. eelgrass or widgeon grass), percent cover, blade height and sediment type. Periodic mapping will be conducted as funds permit to update the areal extent and diversity of SAV habitat.

*Periodic in situ* surveys of SAV beds will be conducted to assess vital population demographics of eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*). Three-pronged seagrass surveys will be completed which entail *in situ* quadrat, core, and hand sampling, as well as high-resolution underwater videographic imaging and comprehensive water quality sampling at 120 sampling stations estuary-wide. The main objective of these SAV investigations will be to determine the temporal and spatial habitat change of seagrass (*Zostera marina* and *Ruppia maritima*) over an annual growing period, as well as the potential impacts of benthic macroalgae and phytoplankton blooms on the seagrass beds. To accomplish this objective, seagrass beds in the estuary will be sampled bimonthly (June, August, and October). The following demographic data will be collected on seagrasses in the estuary: aboveground and belowground biomass, shoot density, blade length, percent epiphytic overgrowth, percent areal cover, and presence of

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bay scallops and other shellfish species. The abundance and percent cover of macroalgae will also be recorded. Diver observations will be made to determine the occurrence and areal cover of seagrass and macroalgae, epiphytic infestation, and presence of bay scallops. In addition, high resolution, underwater videographic imaging coupled to a differential global positioning system (GIS) will be used to validate diver observations. Sampling stations will be permanently located with a Differential Global Positioning System (Trimble®GeoXT™ handheld unit). Additional comprehensive SAV surveys will be conducted during the next five years using the same sampling protocols.

- **Biofouling on Hard Structures**

Epibenthic assemblages are collected on hard surfaces using three unique substrate materials: (1) aluminum panels oriented both vertically and horizontally; (2) plastic and PVC disks orientated horizontally; and (3) wood. Panels have been deployed and collected in summer and fall over the past five years; organisms are identified to the genus level, and when possible, to the species level. Typical fouling organisms include barnacles, calcareous worms, mussels, bryozoans, and algae. This study will help the NERR understand how SWMP data loggers are affected by fouling organisms during their 14-day deployment period. It will also provide information on the impact of fouling organisms on the degradation and integrity of human structures in estuarine environments of the Reserve.

### **d. Fisheries Resource Studies**

#### **i. Blue Crabs**

Research on the blue crab (*Callinectes sapidus*) entails assessment of its growth, reproduction, and mortality in both natural and altered habitats of the JC NERR. Investigations are being conducted by partners on the structure of blue crab populations in Great Bay and the BB-LEH Estuary and to determine their utilization of different habitat types. A major goal is to ascertain if human activities have a significant impact on abundance and mortality of blue crabs in estuarine waters of the Reserve.

#### **ii. Finfish**

Finfish research in the JC NERR is being conducted mainly by scientists at the Rutgers University Marine Field Station. Extensive and long-term datasets have been collected on the ichthyoplankton of the Mullica River-Great Bay Estuary. Other research has focused on habitat utilization by early life-history stages of species in estuarine and coastal marine environments. Habitat utilization by the mummichog, *Fundulus heteroclitus*, and the sheepshead minnow, *Cyprinodon variegates*, in the Mullica River-Great Bay Estuary provides an example. Species of recreational and commercial importance have also been targeted. For instance, studies have been conducted to track the distribution and movements of striped bass *Morone saxatilis*, summer flounder *Paralichthys dentatus*, and bluefish *Pomatomus saltatrix* in the MRGB Estuary and contiguous nearshore ocean waters using automated acoustic instrumentation. Other species are now being targeted for further research.

#### **e. Herpetofauna (Northern terrapins)**

The northern diamondback terrapin is listed as a "Species of Special Concern" in New Jersey. It is also an organism highly susceptible to road mortality by both residents and tourists frequenting wetlands habitat area along the estuary. Investigations have been conducted by RUMFS and JC NERR to (1) estimate the effect of road mortality due to traffic volume and speed on Great Bay

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Boulevard near Tuckerton, where terrapins are commonly observed; (2) identify any relationships between traffic volume/speed during the day/night or week/weekend that may correlate with increased/decreased road mortality; (3) determine the environmental factors that may increase the occurrence of diamondbacks on the road (e.g., temperature or creek location); and (4) evaluate the use and effectiveness of Passive Integrate Transponder tags to mark diamondback terrapins that encounter roadways. These studies have also been conducted to learn more about the population dynamics of the northern terrapin in the region.

### **f. Remote Sensing and Geographic Information Systems (GIS)**

The Grant F. Walton CRSSA, in cooperation with Rutgers –IMCS, has been utilizing Geographic Information Systems (GIS) technology for on-going research in the JC NERR system. As the primary source of GIS coordination for the Reserve, CRSSA has created and now maintains a web site to highlight produced maps, interactive mapping capabilities, and the JC NERR, Coastal Resource Repository. CRSSA is also involved with several research projects within the JC NERR boundaries including: buildout analysis of the Mullica River Watershed, buildout analysis of the Barnegat Bay Watershed, land cover of New Jersey in 2000 using spot / landsat satellite data, mapping of submerged aquatic vegetation in BB-LEH, and mapping brown tide in the the estuary. The 2003 SAV aerial distribution maps and GIS data/metadata downloads are available over the internet at <http://crssa.rutgers.edu/projects/runj/sav/index.htm>.

### **g. Coastal Change Research – Sandy Hook, Gateway National Recreation Area**

The dynamic interaction of the available sediment with the ambient waves and currents is a central focus of research along both the Oceanside and Bayside components of Sandy Hook. GPS survey units with sub-meter accuracy have been used to record shoreline position change, and to establish a protocol for position determination and monitoring in the North Atlantic region of the National Park Service. The utilization of Real-Time Kinematic GPS survey equipment is generating an extensive suite of coastal topographical data to measure sediment budget in a geotemporal context and to provide management with a quantitative evaluation of dimensions of change. Under the Seamless Network cooperative program initiated by JC NERR and the NPS, efforts are underway to integrate the use of the REMUS underwater vehicle with plans for a major estuarine research effort and new dock facility. Additional directions being pursued by the Seamless Network program to include local utilization of CODAR monitoring of nearshore waves and currents, and research directed toward impacts of climate change on the coastal system.

## **3. Research Opportunities**

Research priorities are driven by the national NERR goals and objectives and will be modified to address Reserve and site specific management needs. A number of research areas are currently being pursued within the JC NERR program. These include investigations on eutrophication, habitat loss and alteration, effects of climate change on coastal communities and resources, sea level rise, and resource conservation. These research initiatives involve integrative efforts of the research and monitoring, CTP, and education sectors of JC NERR.

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### **4. Cooperative Efforts Coordination with the NERR System**

The JC NERR works closely with NOAA-ERD staff, especially with the ERD Research Coordinator to develop and assess national research priorities. NOAA also is involved with the Reserve through research funding and proposal evaluation. The Reserve Manager and Research Coordinator communicate with other NERR Managers in other states, particularly the Mid-Atlantic States, and work with NOAA and other Reserve managers and researchers to exchange information.

Data from the JC NERR, and the other 26 reserves in the system, contribute to the Reserve network's long-term study to monitor the status and trends of estuarine ecosystems, substantively, to understand long-term ecological effects on estuaries and how we may better conserve and manage coastal resources. The coordinated research network aids greatly in understanding the theoretical and practical aspects of conservation and coastal resource management.

JC NERR Staff communicates with OCRM, other Reserves, National Marine Sanctuaries (NMS), the New Jersey Sea Grant Program, the New Jersey Department of Environmental Protection marine water quality monitoring, and other programs in the marine and estuarine science community via e-mail and meetings. Reserve staff also coordinates with NOAA's Office of Ocean Resources Conservation and Assessment (ORCA) Status and Trends Program, and the Environmental Protection Agency, where possible.

### **5. Funding opportunities**

Sources of external funding for the research program have included the BBNEP as well as state (NJ DEP) and federal government agencies such as the EPA and the US Department of Agriculture (USDA). The research and monitoring staff will continue to seek support from diverse sources including Rutgers University (Academic Excellence Awards) and external competitive grants programs, such as those of the National Science Foundation (NSF), EPA, and NOAA. Funding or in-kind support may also be sought from other partners who want to collaborate with the JC NERR research and monitoring scientists. Examples include Cooperative Extension and Sea Grant.

### **6. Information Dissemination of Results/Products**

Information gathered during JC NERR research and monitoring activities, and the management implications of this information, are made available to decision makers and the public in lay terms. Both NOAA and the JC NERR encourage the dissemination of research results to decision makers through the CTP.

Methods include:

- Journal articles in the peer-reviewed literature
- Research summaries at the proposed Reserve
- Presentations at professional societies
- Special symposia arranged by NOAA or Reserves, often in association with other meetings such as the biennial meetings of the Estuarine Research Federation or Coastal State Organization
- Annual reports to NOAA and the State of New Jersey

## **IX. Research and Monitoring Plan**

- Workshops, conferences and Roundtables at the Reserve
- JC NERR brochure, distributed with the annual call for proposals and at appropriate conferences and other events
- Press releases to local media
- Articles in journals of local organizations
- Through the Coastal Training Program
- Regular contact with representatives of other state and Federal agencies, local government agencies, and planning boards

### **7. Future Planned or Proposed Projects**

External sources of funding awarded to researchers in partner organizations are likely to continue to be the primary source of research support for the JC NERR. Therefore, research in JC NERR waters is largely conducted by academic scientists affiliated with Rutgers University (notably at the Institute of Marine Science in New Brunswick and at the Rutgers University Marine Field Station in Tuckerton) and scientists affiliated with other institutions. Future research at the JC NERR will be dependent on activities of these researchers, as well as researchers in the JC NERR who receive research grants from external sources. In addition, research of GRFs will be continued at the site.

# X. Coastal Training Plan



### X. COASTAL TRAINING PROGRAM

#### A. Reserve System Coastal Training Program

The CTP seeks to provide up-to-date scientific information and skill-building opportunities for coastal decision-makers. Through this program, National Estuarine Research Reserves can ensure that coastal decision-makers have the knowledge and tools needed to address critical resource management issues of concern to local communities.

CTPs offered by Reserves relate to coastal habitat conservation and restoration, biodiversity, water quality and sustainable resource management and integrate Reserve-based research, monitoring and stewardship activities. Programs target a range of audiences, such as land-use planners, elected officials, regulators, land developers, community groups, environmental non-profits, business and applied scientific groups. These training programs provide opportunities for professionals to network across disciplines, and develop new collaborative relationships to solve complex environmental problems. Additionally, the CTP provides a critical feedback loop to ensure that professional audiences inform local and regional science and research agendas. Programs are developed in a variety of formats ranging from seminars, hands-on skill training, participatory workshops, lectures, and technology demonstrations. Participants benefit from opportunities to share experiences and network in a multidisciplinary setting, often with a Reserve-based field activity.

Partnerships are important to the success of the program. Reserves work closely with State Coastal Programs, Sea Grant College extension and education staff, and a host of local partners in determining key coastal resource issues to address, as well as the identification of target audiences. Partnerships with local agencies and organizations are critical in the exchange and sharing of expertise and resources to deliver relevant and accessible training programs that meet the needs of specific groups.

The CTP requires a systematic program development process, involving periodic review of the Reserve niche in the training provider market, audience assessments, development of a three to five year program strategy, a marketing plan and the establishment of an advisory group for guidance, program review and perspective in program development. The CTP implements a performance monitoring system, wherein staff report data in operations progress reports according to a suite of performance indicators related to increases in participant understanding, applications of learning and enhanced networking with peers and experts to inform programs.

#### B. JC NERR Program

##### 1. Goal, Objectives, and Strategies

The goal of the coastal training efforts at the JC NERR is to ensure **Coastal decision-makers use science-based information to manage New Jersey's natural resources**. Science-based information will be transferred to audiences that can influence management of coastal resources. Often, science and technical experts are enlisted to share knowledge and help local decision-makers implement strategies to address coastal management issues.

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### Objectives

- Coastal decision-makers will use decision support tools and reserve products to address local and regional management needs.
- Coastal decision makers will recognize the CTP as a resource for scientific information relevant to watershed management issues.
- Coastal decision makers will understand the impacts their management decisions have on NJ's natural resources.
- Coastal decision-makers will increasingly implement science based decision-making.
- Identify and preserve significant unprotected estuarine areas within the Mullica River-Great Bay system.
- Natural resource managers will consider regional approaches to adaptive coastal ecosystem management.

### Strategies

- Develop decision support tools to inform management land and acquisition activities of the coastal management community.
- Assist partners to identify ecologically sensitive lands, and assist in acquiring funds for land acquisition and protection.
- Coordinate programs and activities through the emerging seamless network initiative with protected area networks such as the U.S. Fish and Wildlife Service, National Park Service, Pinelands Commission, and the New Jersey Department of Environmental Protection.
- Conduct coastal training workshops in response to local and regional information needs.
- Implement performance measures and program evaluations to evaluate and guide JC NERR products, programs and services.

The CTP seeks to provide decision support tools and to build capacity among coastal managers in New Jersey. Two additional, part-time staff will be employed to meet increasing demand for CTP programs and services. One will be located at Sandy Hook and the other at the Sheppard House in Bridgeton. Their activities will be conducted in partnership with regional and local partners.

### **2. Key Management Issues**

As the most densely populated state in the nation, NJ is projected to be the first state to reach full buildout status. Development and associated human activities are affecting water and habitat quality throughout the state. Proposals to develop remaining open space and to tap into the Kirkwood-Cohansey aquifer pose threats to the ecological integrity and character of the state's estuaries and coastal watersheds. As a result, many management issues relate to land use and human disturbance of the watershed. These are:

- Nutrient inputs into coastal waters
- Human alteration of habitat and water quality
- Effects of climate change on coastal and estuarine systems

## **X. Coastal Training Program**

The JC NERR is developing techniques and strategies for coastal managers to access, and interpret real-time and near real-time environmental data. This includes implementing a recommendation from the 2001 Workshop hosted by the JC NERR in which coastal Managers recommended that the NERRS program develop site level web sites that integrate the SWMP with other Reserve, state, and regional research data sources. Participants commented that a site that links all research activity and data products would be very valuable to local and state level decision-makers. The JC NERR will develop tools to facilitate access to this type of data. This will assist coastal managers in communicating the significance of the data to a general public and local community audience.

The JC NERR CTP will continue to target municipal leaders such as mayors, land use planners, zoning officials, environmental commissioners, planning board members and municipal, county and state staff for coastal training products and services. They are charged with, and have the power to make land use decisions. As a “Home Rule” state, individual municipalities are given primary authority for zoning, land use regulations and ordinances for their individual municipalities. Municipal officials present many challenges as a CTP audience. They are highly constrained by time and are subject to frequent turnover resulting from elections and changing appointments. In many cases, these officials are asked to make a decision on important land use issues and are expected to make informed judgments on public environmental issues.

The JC NERR CTP will meet these challenges by tailoring programs and outreach opportunities that can be delivered over short time periods and that can be easily repeated to engage and inform newly elected or appointed officials. It will be important for CTP staff to develop and maintain a strong rapport with land use decision-makers at the local level. Through targeted educational programs, web-sites and one-on-one interactions, the JC NERR plans to serve this audience by providing information resources, best available knowledge, management practices and technologies such as GIS and near real-time data to meet the needs of coastal decision-makers. In addition, the JC NERR will collaborate with partners to identify ecologically sensitive lands, and assist in acquiring funds for land acquisition and protection.

CTP participants will continue to be asked to evaluate each CTP in accordance with the CTP performance measures adopted by the Reserve system. The results of these evaluations will guide JC NERR programs, products and services.

### **3. CTP Programs, Workshops and Conferences**

Delivery of CTP information is tailored to specific audiences. For coastal decision-makers, information may be presented in the form of services such as coastal decision-maker workshops, technical training or products such as CD-ROMs, web-based learning modules, and brochures.

The JC NERR will continue to offer one-on-one training opportunities for coastal management officials. This type of training allows local land use officials access to the JC NERR GIS capabilities and assistance to use mapping software. These resources can be cost prohibitive and technologically challenging, but the face-to-face training enables users to work directly with the software and interact with CTP and GIS experts. While this type of training does not reach a large number of participants, it is effective when focused on key coastal Managers. One-on-one

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interactions were identified as a desired learning technique based on the JC NERR needs assessment.

### **a. Coastal Impacts of Global Climate Change Workshop**

In view of the current Global Climate Change scenario, and the widespread interest in the challenges the coastal zone is facing, the National Estuarine Research Reserve System is working collaboratively with the National Park Service and other agencies in order to understand the likely impacts on coastal resources, coastal systems, and coastal land use. A Seamless Network concept was created to bring together agencies that share a common goal of conserving sensitive coastal and marine resources, and ecosystems through the management of marine sanctuaries, national parks and coastal areas, estuarine research reserves, and national wildlife refuges. The National Park Service, U.S. Fish and Wildlife Service, the National Marine Sanctuary Program, and the National Estuarine Research Reserve System, are partners in this endeavor. To this end, a CTP will be organized and conducted to build upon the Seamless Network effort currently under way. It will incorporate the Climate Friendly Parks initiative to address Climate Change and its impacts on the National Parks. The National Park Service and the U.S. Environmental Protection Agency have created the Climate Friendly Parks program ([www.nps.gov/climatefriendlyparks/index.html](http://www.nps.gov/climatefriendlyparks/index.html)) and they are interested in extending its application. The JC NERRS Watershed Coordinator North is working towards interaction with the National Park Service and the NERRS program to produce a workshop involving a variety of Park and local community decision-makers in and around the Sandy Hook Unit of Gateway National Recreation Area.

Coastal decision maker workshops will continue as educational and technology transfer workshops, and represent a valuable mechanism to deliver science-based information to the coastal management community, especially through partnership and sponsorship activities. Through these workshops, the best scientific data can be presented in a context that is relevant to NJ's coastal management community and enables coastal managers an opportunity to receive, interpret and use scientific data that can be brought to bear on management decisions. In the needs assessment survey, workshops that featured disciplinary experts were identified as the most effective means to encourage attendance at a training/education/outreach session.

### **4. Website Development**

The JC NERR CTP launched a web-based professional development program for NJ coastal managers to build capacity for science-based decision-making. Maintenance and continued development of this web based program will enable the JC NERR to conveniently target a greater number of coastal managers, and assist them with natural resource decision making. A key component of the CTP website is the online training courses. Through a September 2006 needs assessment of municipal construction code officials the following key management issues were identified: Hazards (Floods, Fires and Storms, Land Use Regulations, Wetlands Protection, Septic System Issues).

Construction code officials indicated that they were very time-limited, but required continuing education through the Department of Community Affairs (DCA) to maintain their certifications. In partnership with the DCA and the NJ Division of Land Use Regulations, the JC NERR CTP developed web-based, online courses entitled "Understanding Land Use Regulations" and

## X. Coastal Training Program

“Understanding Floodplain and Flood hazards.” By providing this information online, the JC NERR CTP gained the opportunity to work with a new municipal audience. The JC NERR CTP will continue to partner with the DCA and offer online courses which met the needs of construction code officials.

### a. Geographical Information Systems (GIS) WebPages

Much of the data collected by the JC NERR research team has a spatial component and has direct relevance to a number of coastal issues. Decision makers are not experts in interpreting raw data or elucidating long term patterns of change. These web pages have been constructed to facilitate the understanding of scientific information and associated trends in spatial patterns. Web pages under development include a Stormwater Management Information System (SWMIS) and a Coastal Vulnerability Decision Support System (CV-DSS).

Existing web pages include:

- **Brown Tide Webpage**

The New Jersey Department of Environmental Protection / Division of Science Research and Technology in partnership with its collaborators at the New Jersey Marine Science Consortium, the Environmental Protection Agency (EPA) and the Rutgers University CRSSA have conducted a four-year study of potential contributing factors promoting brown tide blooms, caused by a minute alga, *Aureococcus anophagefferens* (*A. anophagefferens*), in New Jersey’s coastal estuaries. The maps and computer animations that accompany this study were developed into an interactive web site, by the JC NERR, to allow researchers and the public to access and view the information from a remote location. The website graphically displays the spatial patterns of bloom, salinity, and temperature by date, but does not include the mean, median, maximum, or minimum summary grid maps that were also created as part of this report. In addition during the summer of 2003 and 2004 the JC NERR, CRSSA, and the NJDEP provided Brown Tide Counts on a near real time basis. This information was provided so that coastal decision makers (clambers) could move seed clams based on brown tide counts. The webpage can be found at <http://www.crssa.rutgers.edu/projects/btide/>.

- **Submerged Aquatic Vegetation Mapping Webpage**

Submerged aquatic vegetation (SAV) is a key indicator of the environmental health of the Barnegat Bay ecosystem. The SAV of particular concern are the two species of seagrass, Eelgrass (*Zostera marina*) and Widgeon Grass (*Ruppia maritima*). In the summer of 2003, researchers from CRSSA mapped the extent and percent cover of SAV within the BB-LEH estuary systems. A coastal decision makers’ workshop was held in May 2001 and focused on SAV and mapping. As an outgrowth of this workshop, CRSSA developed and hosts a website that synthesizes available mapped surveys concerning SAV in the BB-LEH system. This website was updated in the summer of 2004 (June and July) using PHP web design by the JC NERR Technology/GIS Coordinator. The updated SAV boundary maps from 2003 were included. In addition, the GIS data (2003) and metadata were made available for download. Within New Jersey SAV habitat is protected by several statues by the NJ DEP Division of Land Use. Unfortunately, the NJ DEP Division of Land Use is using outdated SAV habitat map from the late 1970’s. This website was created to provide the NJDEP-DLU information on the current

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boundaries of the SAV habitat within the BB-LEH estuary system. The web link is <http://www.crssa.rutgers.edu/projects/runj/sav/index.htm>.

### **b. GIS Data**

GIS aids in the collection and analysis of spatial datasets. The main advantage of using GIS is the ability to integrate, query and synthesize geographic digital data. GIS has a wide range of potential applications in coastal resource management and land use planning. CRR contains a comprehensive GIS data bank incorporating data from a variety of sources (e.g., federal, state, local entities) that can be used by Coastal Decision Makers to identify trends in spatial patterns. GIS can be used to foster science-based management decisions that involve the principles of best management practices. Below is a list of data layers incorporated within the coastal resource repository:

- Aerial Photography
- Submerged Aquatic Vegetation
- Satellite Imagery
- Census
- Land Use Land Cover
- Elevation
- Wetlands
- Soils
- Place Names
- Sewer Service Areas
- Historical Imagery
- Zoning
- Boundaries: State, Municipal, Federal and Watershed
- USGS Digital Topographic Maps
- Streams, Lakes and Rivers

GIS data is broadly available as part of the coastal repository via the JC NERR website at [www.jcnerr.org](http://www.jcnerr.org). This information is also disseminated as part of stewardship efforts with local officials, planning board members and local land trusts including small group meetings and one-on-one training sessions.

### **5. Cooperative Efforts and Current Partnership**

The CTP advisory committee is comprised of the following organizations: Ocean County Soil Conservation District, NJ DEP, Ocean County Planning Department, Stafford Township, the Barnegat Bay National Estuary Program, Ocean County Health Department, the PMK Group and the Brick Township Utilities Authority. This committee acts to provide overall guidance, identify program opportunities and provide programmatic expertise. The CTP advisory committee meets on an as needed basis and communicates regularly through electronic means.

The JC NERR has an on-going relationship with the Coastal Zone Management Program at the NJ DEP. This partnership has led to training and educational opportunities to both NJ DEP staff members and statewide coastal managers. An example of a co-sponsored program includes a workshop to educate NJ DEP Land Use Regulation staff members about the value of submerged aquatic vegetation and the ways to use remote sensing and GIS to make informed decisions

## **X. Coastal Training Program**

regarding land use issues within SAV habitat areas. This represents a key partnership and audience for JC NERR programs and services.

JC NERR staff has worked closely with the Rutgers Center for Remote Sensing and Spatial Analysis. Through grants from the CICEET, the CTP and CRSSA will incorporate the needs of local decision makers in the development of GIS decision support tools. This partnership will result in spatially relevant planning tools for stormwater managers, floodplain managers, emergency management officials, town planners and township engineers.

An emerging relationship with the Ocean County Planning Department and the Barnegat Bay Estuary Program has been developed to deliver outreach, training, and technical assistance for county land use planning and zoning officials. These partnerships provide input into the content and value of the CTP, and also provide additional avenues for funding sources as well as program marketing and delivery.

### **6. Funding Opportunities**

Sources of external funding for the CTP have included CICEET, the BBNEP and the state Coastal Management Program. Reserve staff will continue to seek support from diverse sources via competitive grants programs. Funding or in-kind support may also be sought from other partners that work with Reserve audiences. Examples include Rutgers Cooperative Extension, and Sea Grant.

### **7. CTP Resources**

Rutgers-IMCS provides a variety of resources that benefit the CTP program. These include direct access to state of the art scientific and technical information, direct access to scientists and educators, and match funding for CTP grants.

Many of the members of the JC NERR Advisory committee frequently act as resources for CTP programs. These partners help deliver programs, act as resources for scientific and management information, help with funding needs, assist in advertising programs and serve as sponsors. Key partners include the CRSSA, Richard Stockton College of New Jersey, USFWS, NJ Division of Parks and Forestry, Ocean County government, the NJ DEP, Pinelands Commission, and the BBNEP.

### **8. Future Planned or Proposed Projects**

The JC NERR will continue to broaden the use of science-based information, products and decision support tools within the coastal community. The CTP will continue to offer workshops and training opportunities in conjunction with reserve partners such as the NJ DEP, Rutgers University, CRSSA, and BBNEP. The CTP will continue to develop a web-based professional program for NJ coastal managers to support science based decision-making. Through the CRSSA partnership, the CTP will broaden the online spatial information available to coastal decision makers. Finally, the CTP will continue to assess audience needs and respond with appropriate information, tools, resources and opportunities.

# XI. Education Plan



**XI. EDUCATION PLAN**

**A. The Reserve System**

**1. The Reserve System Overview**

The Reserve system provides a vehicle to increase understanding and awareness of estuarine systems and improve decision-making among key audiences to promote stewardship of the nation's coastal resources. Education and interpretation in the Reserves incorporates a range of programs and methodologies that are systematically tailored to key audiences around priority coastal resource issues and incorporate science-based content. Reserve staff members work with local communities and regional groups to address coastal resource management issues, such as non-point source pollution, habitat restoration and invasive species. Through integrated research and education programs, the Reserves help communities develop strategies to deal successfully with these coastal resource issues.

Formal and non-formal education and training programs in the NERRS target K-12 students, teachers, university and college students and faculty, as well as coastal decision-maker audiences such as environmental groups, professionals involved in coastal resource management, municipal and county zoning boards, planners, elected officials, landscapers, eco-tour operators and professional associations.

K-12 and professional development programs for teachers include the use of established coastal and estuarine science curricula aligned with state and national science education standards and frequently involves both on-site and in-school follow-up activity. Reserve education activities are guided by national plans that identify goals, priorities, and implementation strategies for these programs. Education and training programs, interpretive exhibits and community outreach programs integrate elements of NERRS science, research and monitoring activities and ensure a systematic, multi-faceted, and locally focused approach to fostering stewardship.

**2. Reserve System Education Goals**

The National Estuarine Research Reserve System's mission includes an emphasis on education, interpretation, and outreach. Education policy at the Jacques Cousteau National Estuarine Research Reserve is designed to fulfill the Reserve system goals as defined in the regulations (15 C.F.R Part 921(b).) Education goals include:

- Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation
- Conduct and coordinate estuarine research within the system, gathering and making available information necessary for improved understanding and management of estuarine areas

**3. Reserve System Education Objectives**

Education-related objectives in the Reserve System Strategic Plan 2005-2010 include:

1. People are aware of the ecological, economic, historical, and cultural importance of estuarine resources

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2. People understand how human choices and natural disturbances impact social, economic, and estuarine ecological systems
3. People apply science-based information when making decisions that could impact coastal and estuarine resources

### B. JC NERR Program

#### 1. Goal, Objectives, and Strategies

The education goal of the JC NERR is to ensure **The K-12 and community and the general public possess increased awareness and understanding of estuaries and coastal watersheds and how they are affected by human behavior and natural change.**

Education programs aim to provide on-site education opportunities for the community, teachers and other targeted audiences. Programs will include general information about the Reserve including its ecological, economical, and historical values, and how they relate to natural resource protection and management issues, and are designed to integrate with other relevant programs in the Reserve region.

Formal education programs will focus on elementary and secondary school teachers, enhancing their ability to present science in innovative ways to stimulate student interest. Hands-on field enrichment opportunities will be promoted such as immersion of educators in real-time scientific research conducted in the Reserve. In addition to field experiences, educators will work with the Education Coordinator to develop practical applications that bring their experiences into the classroom.

Habitats within the Reserve will serve as centers for general public education. Visitors to the Reserve will gain awareness and understanding of the estuarine system through our exhibits at the Seaport and through our public programs. These activities will explore ongoing research throughout the Reserve, as well as cultural, historical, and economic issues. Scientists will be invited to present their research through seminars and describe how their studies are relevant to community members. In coordination with our land management partners, we plan to offer these community-based programs throughout the JC NERR watershed.

#### Objectives

- Coastal watershed communities will understand the environmental and economic value of estuaries and coastal watersheds.
- Coastal watershed communities will recognize the JC NERR as a provider of science-based information and resources.
- K-12 teachers will incorporate lessons and hands-on experiences which demonstrate the value and function of estuarine and coastal habitats
- Coastal watershed residents will understand the importance of their role as environmental stewards.

### Strategies

- Provide training opportunities for the next generation of coastal managers.
- Heighten visibility of the JC NERR by participating in public events, communication and marketing activities.
- Provide educational and recreational activities for the general public.
- Deliver professional development programs to K-12 educators.
- Promote awareness of the value of estuaries through diverse media such as the Life on the Edge exhibit, the reserve website, newsletter, brochures, and interaction with community groups.

### **2. K-12 Professional Development Programs**

Many studies have shown that conventional approaches to teaching science are not effectively communicating science basics to students across the nation. In elementary school, students begin to lose interest in science with this trend continuing through high school. Only a small percentage of students graduate high school with the knowledge and motivation necessary to pursue science-related careers. Through environmental education, young people can be encouraged to explore their ability to develop theories, analyze evidence, and make a difference in their environment. The key to a changeover from conventional methods to an inquiry-based approach is a well trained, motivated educator.

In order to increase awareness and understanding of ecosystems such as an estuary, resources must be provided to the educators. The JC NERR education program will focus on elementary and secondary school teachers, enhancing their ability to present science in innovative ways to stimulate student interest. One means to achieve this is to provide educators with access to new technologies and research relevant to estuarine ecosystems. Hands-on field enrichment opportunities will be promoted and educators will be immersed in real-time scientific research being conducted in the Reserve. In addition to field experiences, educators will work with the Education Coordinator to develop practical applications that bring their experiences into the classroom. The JC NERR will accomplish this through the following programs.

#### **a. Marine Activities and Resources Education (MARE) Program**

The JC NERR selected the Marine Activities Resources & Education or MARE program to serve as a core professional development program. Developed by the Lawrence Hall of Science at the University of California - Berkeley, MARE is a dynamic, K-8, inquiry-based science program that transforms entire elementary schools into laboratories for the exploration of the ocean. The program has been supported since its inception in 1995 by the Geraldine R Dodge Foundation, the Institute of Marine & Coastal Sciences at Rutgers University, and Research for Better Schools (1997-2004). In addition to being designated a "Promising Practice in Mathematics and Science Education" in 1995, and an "Idea That Works in Science Professional Development" in 1999 by the Eisenhower Regional Consortia and National Clearinghouse in Mathematics and Science Education, through rigorous evaluation programs with Chris Parsons, (WordCraft) positive changes have been documented for schools that have implemented MARE. Examples of these performance metrics included: shifts to non-text book methods for teaching science, increases in parental involvement, and greater students interest in science as a result of MARE

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being used in their school. Evaluations results also suggest that MARE enhances teacher competence and confidence in facilitating science learning.

The future of MARE in the JC NERR will include: 1) grade level specific workshops focusing on habitats found within the reserve boundaries. These courses will commence in summer 2009. 2) Integrating Estuaries 101 curriculum materials where possible and where main concepts fit into MARE habitat lessons, and 3) Emphasizing watershed concepts through partnering with groups such as the Pinelands Preservation Alliance, and 4) Instilling concepts of environmental sustainability throughout all lessons.

Continued delivery of the MARE program depends on continued funding by organizations such as the Geraldine R. Dodge Foundation. This funding makes it possible to deliver high quality programs and offer teachers the materials and supplies needed to employ newly acquired skills and training. As funding continues to tighten at all levels, delivery of professional development may require novel approaches to program delivery. Two day workshops may have to replace week-long training programs. Other strategies may have to be adopted such as bringing professional development opportunities to the schools instead of relying on the schools to send teachers to the reserve. Integrating new partnerships may also allow the reserve to take a new look at the ways in which it delivers its materials to teachers. The JC NERR also plans to participate in the emerging KEEP program once the final elements and funding are in place. This will require a reassessment for future delivery of the MARE program through the JC NERR.

### **b. Promoting Oyster Restoration through Schools (Project PORTS)**

The presence of JC NERR in Cumberland County will support education and outreach efforts on critical watersheds in the southern New Jersey region. Project PORTS (Promoting Oyster Restoration Through Schools) is a community-based restoration and education program focusing on the importance of oyster populations in the Delaware Bay ecosystem. The education program utilizes the oyster as a vehicle to acquaint school children, grades K-12, with the Delaware Estuary and scientific concepts via enrichment programming in the school setting. The community-based restoration component engages students in oyster restoration activities, giving them an opportunity to experience environmental stewardship first hand, while at the same time enhancing critical oyster habitat in the Delaware Bay. In the last two years, 14 schools have participated in Project PORTS. The program offered nearly 3000 child-centered learning experiences. The focus through Sheppard House will be to expand opportunities for Project PORTS in Cumberland County Schools, particularly Bridgeton Schools.

### **c. K-12 Estuary Education Program**

The K-12 Estuary Education Program (KEEP) is a collection of resources for learning about estuaries for teachers and students in grades kindergarten through high school (K-12). Currently under development with national coordination, direction and standards, these resources will be available to all K-12 teachers and students in the country. Some aspects of KEEP will be delivered globally via the Internet, while others will be implemented at Reserves in the National Estuarine Research Reserve System (NERRS). As KEEP moves forward in the NERRS system the JC NERR plans on fully implementing the three components of the program and is working closely with our land management partners to discuss the development of site-based estuarine

education programs as well as the continued development of technology and web-based learning with a variety of local and NOAA partners.

### **d. The Life on the Edge Exhibit at the Tuckerton Seaport**

The “Life on the Edge” Interpretative exhibit serves as a gateway to the Reserve by promoting knowledge of the habitats within the Mullica River-Great Bay. It also communicates research occurring throughout the watershed and estuary and provides information and ideas about recreational access and opportunities throughout the Reserve. The exhibit is an educational tool that educates visitors about the stewardship of natural resources. It also fosters environmental awareness that puts special emphasis on helping visitors to develop their own opinions about natural resource protection. Housed at the Tuckerton Seaport the exhibit forges cooperative efforts between the JC NERR and the Tuckerton Seaport in a range of environmentally focused educational programs.

Additionally, the Interpretation Coordinator develops and delivers themed school group programs that reflect the commonality of both the Seaport and JC NERR missions. The programs promote and enhance a cohesive field trip experience and fulfill NJ Schools core curriculum standards.

Funding is being requested to revise the interpretive center. Updates would include new information about best management practices for coastal communities, our changing estuaries in the light of climate change and an updated review of reserve-based research. For additional information see the “Facilities Plan”.

### **3. Community Education and Outreach Programs**

Development and delivery of educational opportunities for the general public will receive renewed emphasis at the JC NERR. Community education programs and outreach events will be planned based on audience assessments such as surveys and feedback from visitors to the Life on the Edge Exhibit. The overall focus for these activities will be familiarizing the community with the variety of habitats within the Reserve, and ways in which the public can be informed stewards of these habitats. The Education Coordinator will work closely with the Research Coordinator to develop a series of outreach programs addressing current research being conducted at the Reserve and highlighting important topics within the NERRS such as climate change and sea level rise.

#### **a. Rutgers Marine Field Station Open House**

Coinciding with National Estuaries Day, the JC NERR and the RUMFS host an annual Open House at the Tuckerton-based field station. This annual event draws 500 to 700 people who are interested in learning more about the research projects occurring at the Field Station. The Open House runs from 10am until 3pm and is advertised through our websites, local papers, radio and television. Visitors are given a map and a short description of each of the featured “lecture stations”. With map in hand, visitors are invited to hear an overview of featured research projects conducted by technicians and research staff from throughout the Institute of Marine and Coastal Sciences. This annual event is one of the most anticipated throughout the area. Due to its popularity this event will be expanded in the future.

**b. You and Your Watershed Outreach Programs**

Many people that live and work within the boundaries of the JC NERR are unaware of the tremendous natural resource value of the Reserve. The JC NERR serves as the educational link between the community and the scientific research being conducted throughout the Reserve. Educational programs for the JC NERR are designed to raise public awareness about the structure and function of a watershed, research that occurs throughout the watershed and daily behavior that can lead to informed stewardship of the watershed. These outreach programs take various forms based on audience needs. Community education programs will continue to be offered and developed over the next few years and may include: Sea Level Rise in New Jersey, The Importance of Submerged Aquatic Vegetation and What You Can Do About Climate Change.

**c. Lunch n' Learn Series**

Through a partnership with the Tuckerton Seaport, the JC NERR has been hosting a successful series of Lunch n' Learn programs. Once a month, on the second Wednesday, a scheduled speaker talks to an audience of 30-50 people about their research, a culturally significant topic or a topic of historical importance. These programs were initiated in winter 2004 as a way to get more people involved in the Tuckerton Seaport during the off season. Due to their overwhelming success, Lunch n' Learn has been expanded to include fall, winter and spring programs. Future improvements to this program will include an emphasis on sustainability and examples of how to be more "green", as well as adjustments to program location and room set up to better facilitate audience integration.

**d. Family Science Programs**

In association with the Tuckerton Seaport, the JC NERR will be offering Family Science programs. The Life on the Edge exhibit will serve as the classroom for these programs which will highlight the importance of clean water, the water cycle, life in an estuary and the watershed concept. Short, inquiry-based science stations will be set up with each program so children can use their own creativity and intuition to investigate the watershed in which they live. Some programs will include short field excursions and sample collecting.

**e. Outdoor Recreation**

The JC NERR will develop outdoor recreational programs such as hiking, kayaking, and birding. These programs will provide the community with the hands-on experiences and a greater appreciation for sensitive habitats. These programs will be developed in cooperation with Ocean County Parks, a partner generally recognized in the region for their high caliber educational and recreational programs, and other land management partners.

**f. The Nature Center of Cape May**

The Nature Center of Cape May and the JC NERR have developed a collaborative effort to address coastal education and stewardship needs of the Cape May region as a component of a regional revitalization initiative. This partnership will expand delivery of an integrated program of research, education and stewardship that promotes informed coastal stewardship. Information generated from field research programs will be delivered in formal and informal education and training programs that prepare residents and visitors to the Cape May region, and especially area youth to be informed decision-makers. Of particular importance is the need to conduct and deliver programs related to the health of the coastal ecosystem and coastal processes as part of an

integrated program to meet the changing needs of coastal users in a manner that is compatible with environmental concerns.

### **g. Shore Bowl**

The Shore Bowl is a regional academic competition for high school students that focuses on ocean-related topics. Topics include the biology, chemistry, physics and geology of the oceans, as well as navigation, geography, and related history and literature. Teams of five students (four plus one alternate) compete in timed matches that include: 1) multiple choice and short answer oral questions, and 2) written team challenge questions. The competition is held each year at Rutgers University, and will be one of 25 regional competitions hosted around the nation. Winners travel to compete in the annual National Ocean Sciences Bowl. This program is funded through 2010.

### **4. Evaluation**

Evaluation is a key element of all JC NERR education and outreach programs. Front end evaluations guide initial program development. Formative assessments provide adaptive program feedback which shapes ongoing programs and informs the development of future programs. Summative evaluations provide results which feed into new educational programs and opportunities.

MARE is one of the JC NERR programs that has been well evaluated. In addition to yearly post-training evaluations, an extensive implementation evaluation was completed in 2005. Evaluation data was gathered from Rutgers MARE staff, MARE Master Trainers, MARE leadership teams (Rutgers-trained teachers), turnkey-trained teachers and others (district staff, curriculum supervisors, etc.) involved in implementing the MARE program at school sites.

In addition to identifying factors that help facilitate and hinder successful MARE implementation, recommendations were provided to Rutgers IMCS and the JC NERR for future program development. These recommendations included five overarching factors which were identified as “key” to the successful implementation and continuation of MARE: school recruitment & retention, training (turnkey and ongoing), teaching materials (the “binder”), communication (within schools and between Rutgers and schools), and support (administrative and financial). More detailed suggestions were provided under each key topic.

These results led to changes in the delivery of MARE over the past few years. In the summer of 2008 the MARE habitat-based lessons were reviewed and correlated with NJ educational standards. Key lessons were pulled from each habitat and highlighted in a “MARE Guide to the Golden Lessons”. These guides were distributed to each of the 2008 MARE Summer Institute teachers. The 2009 Dodge Foundation proposal requested funds to further publish and disseminate “Golden Guides” to additional MARE schools. Additionally, the MARE Summer Institute will focus on additional teacher cohorts from the schools represented in 2008. This program methodology follows the evaluation result which recommends MARE training be viewed as a two-year whole school training program.

The evaluation results also suggested that grade level specific materials, such as the MARE binders, were inspiring to the teachers. In an effort to support and enrich our existing MARE

## **JC NERR Management Plan 2009 - 2014**

community of schools, the JC NERR will be offering one-day habitat-themed workshops for educators across the MARE network. These workshops, which were successfully offered from 1997-2002, combine classroom and field experiences related to a specific marine habitats featured in the MARE curriculum. Participants will engage in inquiry-based activities, practice a variety of teaching strategies, receive high-quality materials, and receive orientation and training for the Golden Lesson Guides. Workshops will be offered for grades 3-5, focusing on wetlands, shallow bays and open oceans, respectively.

### **5. Cooperative Efforts**

Community outreach programs will continue to be developed and enhanced by working with our land management partners, while also acknowledging the need to continue strengthening education partnerships with other NOAA programs and partners. The Reserve continues to place high value on collaborative projects, therefore we developed a series of collaborative projects using Autonomous and Remotely Operated Underwater Vehicles. These programs are collaborative approaches to habitat mapping that include an educational component developed by Douglas R. Levin of the NOAA Chesapeake Bay Office, Krista Trono, NOAA Monitor National Marine Sanctuary and Christine Arrasate, of Nauticus. These cooperative outreach projects involve NOAA's Undersea Research Program Mid Atlantic Bight Center, Rutgers University, and NOAA's Chesapeake Bay Office, and have included NJ Sea Grant, and the NY/NJ Seamless Network group which includes but is not limited to the National Park Service, U.S. Fish and Wildlife Service, NERRS, and the National Marine Sanctuary Program. They also involve many of JC NERR's partners such as our MARE and Shore Bowl schools. These programs will be continued and expanded upon in the future.

### **6. Underrepresented Audiences**

The retirement population within our watershed is increasing each year. People are moving to southern New Jersey without much awareness of the watershed or their impacts on it. The JC NERR is developing an outreach program specifically targeted to this underrepresented audience specifically including senior citizen living communities within the Reserve boundaries. By providing these new residents with information about the natural resources and their role in the watershed the JC NERR will help them become better stewards of their new environment. Depending on evaluations of this program it may be expanded in the future.

Since a market analysis and needs assessment are needed for the incorporation of KEEP the JC NERR will be looking closely at our needs assessment for other underrepresented groups such as the Hispanic/Latino community and developing outreach programs that will raise estuarine and coastal awareness among these audiences.

### **7. Volunteer Program**

The volunteer program supports field programs and reserve administration with a corps of well-trained individuals, and generates public involvement in the stewardship of our coasts and estuaries. The Volunteer Coordinator oversees the implementation and operation of the program and continuously recruits volunteers through speaking engagements at senior citizen communities, and festivals and also through the media. It is the Volunteer Coordinator's responsibility to develop and maintain a Volunteer Manual. The manual includes short- and long-term responsibilities for all volunteers and orients individuals to the JC NERR and its volunteer program.

## **XI. Education Plan**

With the prevalence of 55+ senior developments in Ocean and Atlantic Counties, and the broad professional experience of retirees which ranges from engineering to library science, recruitment efforts have targeted this population. To date, volunteers have supported public programs and festivals, field work, administrative assistance, data entry, library work and mass mailings. Activities include fish painting, exhibit interpretation and distribution of literature.

Reserve staff often seeks help from the volunteers with the conduct of field research programs. Training programs are delivered to volunteers to familiarize them with a research program, after which they accompany investigators to the field to collect data. Field programs that involve volunteers include LEO-15 data collection, eel grass surveys, offshore otter trawling, bridge netting, and stripertracker. Volunteers also assist with small boat and equipment handling, and with interpretation of the Life on the Edge exhibit at the Tuckerton Seaport.

The JC NERR will continue to incorporate the continuous recruiting of quality volunteers to meet the net-manpower necessary to support the Education, Research and CTP Programs. The JC NERR will continue to expand learning opportunities and involvement of the volunteers by giving them additional responsibilities as they assume a greater role as docents and stewards. The JC NERR website will be updated to include a volunteer section. The annual Volunteer Recognition program will continue to be held to honor volunteers for their contributions to the JC NERR. Volunteers receive service pins, and a Volunteer of the Year is honored.

### **8. Marketing Materials and the JC NERR Website**

Marketing materials for the Reserve include brochures, the quarterly Life on the Edge newsletter, a stormwater newsletter, advertisements for upcoming programs, and special publications. The Reserve newsletter provides the public with current information on Reserve, education, CTP and outreach activities and events and updates on research activities. The newsletter also highlights partner activities. Print materials are distributed through a variety of venues including the Life on the Edge exhibit.

A future project will be to develop a map to support a watershed driving tour featuring unique areas throughout the Reserve. Stops along the tour would focus on land management partners including the Bass River State Forest, Batsto Village, Great Bay Blvd Wildlife Management Area and the Edwin B. Forsythe Refuge. The map would include historical and recreational information about each of the sites. The tour may also be made available on Google Maps.

The JC NERR Website provides information on the Reserve to a broad audience. Primary components of the website highlight Reserve research, education, and CTP programs and recreational opportunities. Current information is provided on upcoming programs, highlights of past programs, current descriptions of research projects and results, and links to recreational activities throughout the Reserve. The website allows for online program registration, provides contact information for Reserve staff and includes directions to the Coastal Center.

The Reserve plans to design and distribute a general information page about the JC NERR and its place within the Mullica River/ Great Bay watershed. This document will include information about land management partners, the JC NERR in relationship to the other Reserves around the

## JC NERR Management Plan 2009 - 2014

country, and our mission and core programs. These will be available at the Life on the Edge exhibit, at the RUMFS, and at public events.

### **9. Funding Opportunities**

Grant opportunities are available that could help supplement the outreach activities of the Reserve. Proposals will be crafted for teacher professional development programs and community education programs.

#### **a. The Geraldine R. Dodge Foundation**

The Geraldine R. Dodge Foundation has been a long time supporter of the work the JC NERR has done with the MARE program and other teacher professional development programs. Grant funding is focused on providing transformational experiences for pre-K-12 children who face conditions that limit opportunities for, and access to, educational excellence. Foundation support is focused on:

- Experiential learning opportunities that connect educators and students to the arts, to the natural world, and to the local and global community.
- Schools in their efforts to reinvent themselves by exploring alternatives to the traditional public school model. Special consideration will be given to alternatives that emerge from intentional collaborations, between schools and outside agencies, dedicated to fostering the emotional, physical, intellectual, and social development of the entire community.

#### **b. Trust for Public Land, Barnegat Bay Environmental Grant Fund**

Professional development and community education programs could benefit from the Barnegat Bay Environmental Grant Fund. Grants are generated from a portion of a fund established by a \$2.5 million donation to the NJ DEP from the former Ciba-Geigy Corporation. Under contract with the NJ DEP, The Trust for Public Land was designated as the administrator of the fund because of its long-term protection effort on behalf of the Barnegat Bay. Since the inception of the grants program, nearly \$350,000 has been awarded to support projects to protect the Barnegat Bay and its watershed.

#### **c. Barnegat Bay NEP Public Participation and Education Mini-Grant Program**

In order to supplement community education efforts throughout the watershed, the JC NERR could apply to the BBNEP under their education mini-grant program. In an effort to increase public awareness, the BBNEP solicits proposals for public education and participation activities focusing on major environmental problems facing the Barnegat and Little Egg Harbor Bays, including multiple users' needs and ecosystem health and sustainability. Proposed projects need to increase public awareness and education; emphasize that this ecosystem is a living environmental and social resource; demonstrate that the public can help to protect the estuary; motivate people to actively participate in its restoration; and utilize innovative activities which involve people and lead to local action.

### **10. Future Planned or Proposed Projects**

Education staff will continue to provide educational opportunities for the community, teachers and other targeted audiences. Programs will be tailored to audiences needs and will familiarize the participants with the variety of habitats within the Reserve, and ways in which they can be informed stewards of these habitats. The Education Coordinator will work with the Research Coordinator to develop a series of outreach programs to address priority coastal resource issues such as climate change and sea level rise. These science based programs will incorporate the current research being conducted at the JC NERR Reserve.

# XII. Stewardship Plan



### XII. STEWARDSHIP PLAN

#### A. Reserve-Wide Program

Stewardship within the National Estuarine Reserve System is a national program implemented differently by each Reserve based on the individual Reserve's structure and land management responsibilities. In the JC NERR, science-based stewardship is a principal goal integrated throughout the research, education, and coastal training program. The JC NERR does not own or directly manage large tracts of land and therefore lacks "on the ground" physical forms of stewardship. Rather, the JC NERR defines stewardship in the broader sense of providing relevant information, education, and training to achieve our mission. This stewardship role has been broken down into different themes, each corresponding to a different spatial area of our estuarine and watershed system. These themes present the JC NERR with a variety of training opportunities based on land management, human use and unique ecological conditions.

#### B. JC NERR Program

##### 1. Goal, Objectives, and Strategies

The stewardship goal is that **Resource managers use reserve science to protect, conserve and restore estuarine habitat, resources and water quality.**

Key objectives in support of this goal are:

##### Objectives

- Resource managers will increasingly use GIS data layers to support coastal management decisions and set priorities for land acquisition.
- Coastal communities will recognize the ecological, economic, historical and cultural importance and value of estuaries.
- Protect, conserve and restore estuarine habitat and water quality.
- Coastal communities will adapt to and mitigate the effects of climate change and sea level rise.

##### Strategies

- Identify the best available information, tools and technology for environmental decision-making.
- Train resource managers in the use of GIS technologies.
- Track land use/land cover change in the Mullica River-Great Bay estuary and surrounding watershed.
- Establish JC NERR as a sentinel site for demonstrating approaches to respond to effects of climate change and sea level rise.

#### C. Stewardship Activities

##### 1. Stewardship for Partner Managed Lands

The upland areas of the JC NERR are owned and managed by Reserve partners and include a National Wildlife Refuge, state forests, wildlife management areas, state natural areas, and state

## JC NERR Management Plan 2009 - 2014

natural lands trusts. Each of these designations is characterized by different management approaches with unique goals relating to human use and natural habitat function. The JC NERR will provide a range of stewardship programs and services in collaboration with reserve partners:

### **a. Provide Relevant Management Information**

The JC NERR staff will conduct research on land use and land cover change for the entire Reserve watershed including areas owned by land management partners. Analyses will be conducted using remote sensing technologies (aerial and satellite photography) and quantified within a Geographic Information System. These data will be made available for download at <http://www.crssa.rutgers.edu/data/download.shtml>. In addition, a buildout analysis (predicting future development) may periodically be used to predict future population numbers, land cover change, and impervious surface coverage. This data will generally be presented as a technical report available at <http://www.crssa.rutgers.edu/data/reports.shtm>.

JC NERR staff will collaborate with the Trust for Public Land to revise or periodically update the “Century Plan”. These reports will set new priorities for land acquisition and codify many diverse geo-spatial datasets to rank land acquisition priorities for the Barnegat Bay Watershed. As part of this project, private properties that are adjacent or surrounded by preserved lands will be designated priority sites.

### **b. Priority Land Acquisitions**

Even though the Reserve does not have land management responsibilities, we will work alongside land management partners to acquire priority lands that can be added to the JC NERR core boundaries. The JC NERR will compete for land acquisition funding by applying for Coastal and Estuarine Land Conservation Program and NERRS-specific land acquisition funds. The Reserve will continue to engage in priority land acquisition partnerships through the Mullica River Land Conservation Initiative (See Section VI).

### **c. Creating and Hosting Public Outreach Programs**

One of the objectives of the education program is to increase public outreach programs and opportunities. Public visits to the various lands managed by Reserve partners, such as the Edwin B. Forsythe Refuge, Bass River State Forest and Wharton State Forest, will be promoted as lands that are managed under the broad umbrella of the JC NERR.

### **d. Capacity Building for Partners**

JC NERR staff will provide partner organizations with opportunities to diversify skill sets and use of Reserve data layers. Examples of planned programs include the use of GIS and remote sensing technologies, the practical use of LiDAR data including data acquisition, storage, and processing, and skill-based training for staff and managers of land management agencies such as Project Design and Evaluation and Managing Visitor Use. Future courses will be offered based on the needs of land management agencies.

### **e. Signage**

Placing educational signage throughout the Reserve is another way in which the JC NERR encourages stewardship. Signs will be placed at partner facilities to educate visitors about the Reserve, notify them that they are within the boundaries of the JC NERR and to describe core

## **XII. Stewardship Plan**

programs - research, education and coastal training. The signage will also direct visitors to the JC NERR website to obtain additional information.

### **2. Stewardship for Privately Controlled Lands**

Privately owned lands make up the majority of the upstream watershed of the JC NERR. Stewardship activities will rely on both bottom up approaches (homeowner education) and top down approaches (regulatory and statutory).

#### **a. State Government**

The JC NERR will serve the stewardship information needs of several state agencies such as the NJDEP Division of Land Use Regulations. Web-based data and data layers will be developed in response to regulatory needs. As an example, JC NERR staff created a website illustrating the spatial distribution of rooted submerged aquatic vegetation habitats (seagrass) <http://www.crssa.rutgers.edu/projects/runj/sav/index.htm>. These habitats are protected by state regulation, but the regulations were based on maps from the late 1960's. A website was developed to provide the NJDEP with access to five different survey years of data from 1968 to 2003, and the ability to view a cumulative grid showing the number of times each area was mapped as seagrass habitat. Periodic needs assessments will be used to identify future information needs.

#### **b. Local Government**

JC NERR staff will train local government employees on the use of geographic information systems, global positioning systems, and remote sensing technologies. Training sessions will be conducted using both a classroom-style learning approach and hands-on training sessions. In addition staff will provide hardware (GPS units) and access to GIS software to facilitate the incorporation of geospatial technologies into local management decisions.

Workshops to be developed include an Introduction to Geographic Information System, the New Jersey LiDAR Remote Sensing Workshop, Marking and Mapping Storm Drain Inlets and an Introduction to Global Positioning Systems. Hands on training will include training on GIS to determine priorities for local land preservation, provide relevant GIS data from diverse sources, and the use of GIS to enhance local decision making.

#### **c. Homeowner Education**

Educating the local homeowner community is an important part of the stewardship program at the JC NERR. The Reserve initiated a municipal storm drain adoption program wherein the Reserve works with local municipalities and their residents to advance understanding of the complexities of non point source pollution and the ways in which non point impacts on estuaries can be reduced. The Reserve will also install and maintain a low maintenance rain garden with interpretive signage documenting the benefits of using native plants and reusing rainwater generated onsite. Future JC NERR programs will focus on climate change issues and what homeowners can do to live a more sustainable lifestyle.

#### **d. Scientific Data**

Science information collected on upland habitats has been designed primarily to provide partners with data on habitat, human land use, and future land use changes. These projects will continue to be supported with remote sensing technologies and geographic information systems. For

## JC NERR Management Plan 2009 - 2014

example the JC NERR staff plan to update maps of land use/land cover over a variety of temporal and spatial scales using both satellite imagery and aerial photography. In addition, buildout analyses will continue to be used to analyze changes in natural habitat, altered habitat, changes in riparian zones, percent impervious surface, and human population (See Section II.). The GIS datasets GIS and written reports will be available online at [www.jcnerr.org/coastal\\_training](http://www.jcnerr.org/coastal_training).

### 3. Stewardship for Estuary Systems

Stewardship of estuarine systems are governed by a suite of regulatory guidelines set forth by federal, state and local governments. JC NERR staff will provide data to these management agencies to inform estuarine management. Data sets will include *in situ* samples of water quality based on remote sensing using airplanes and an automated collection and processing system, and then routing the data stream through Google maps to provide near real time access to the data set which are located at [http://71.59.88.199/SondePages/Projects/ChloSensor/chloro\\_9.php](http://71.59.88.199/SondePages/Projects/ChloSensor/chloro_9.php). Other data to be provided includes riparian *in situ* seagrass habitat and 3-dimensional benthic mapping with the REMUS AUV.

### 4. Demonstration Stewardship Projects

JC NERR staff has plans to demonstrate science-based stewardship practices to the resource management and public communities. These are:

#### a. Rain Garden

In partnership with the Ocean County Soil Conservation District and the NJ Forest Resources Education, the JC NERR will install and maintain a low maintenance rain garden onsite at the Coastal Center. The garden will be used to demonstrate various ways in which homeowners, municipalities and schools can integrate native plants and water reuse on their own properties. The garden will include signage and handouts documenting the soil and sunlight requirements of each of the selected species. The Reserve plans on applying for a grant from the BBNEP to add a “mobile” native plants kiosk to the Life on the Edge exhibit. This will feature the JC NERR rain garden and the various ways in which homeowners can garden in a more sustainable way.

#### b. Boardwalk Trail

A boardwalk trail is proposed to demonstrate stewardship concepts and include signage and kiosks to teach visitors about plant identification and the changes in vegetation from upland habitats to wetland areas. The boardwalk will cross through areas dominated by *Phragmites sp.* Signage will describe issues associated with invasive species and ways in which restoration projects can be undertaken to control invasives. Additionally, the platform section of the boardwalk trail will be outfitted with sampling and monitoring gear, along with signage, to describe ways in which research staff conduct long term monitoring throughout the Reserve. Additional information regarding the trail can be found in the Facilities Plan. Construction of the trail will be contingent upon external funding.

### 5. Stewards Training Program

A new multi-session Stewards Education Module will be developed to train volunteers to be docents at the Life on the Edge Exhibit at the Tuckerton Seaport, and to serve as ambassadors at JC NERR events and other Reserve programs. The Stewards will expand their own horizons while serving the community and aiding the JC NERR in reaching its goals and objectives. This

## **XII. Stewardship Plan**

program will create an exchange of ideas, resources and information between scientists and JC NERR stewards in order to improve the environmental quality and community stewardship of the Mullica River-Great Bay eco-systems.

The training format will increase the Stewards' knowledge of eco-systems and scientific research by engaging their curiosity through consistent educational delivery methods (power-point lecture, hands-on activities, field trips and independent studies). These focused investigations will instill a deeper understanding of content and help Stewards consolidate how to communicate what they've learned to others. A framework of learning methodologies for informal educational settings which are appropriate for specific audience characteristics (age, experience, knowledge and skills) will be established. The JC NERR will educate, motivate and inspire volunteers toward environmental stewardship by integrating ideas and relationships into the training such as sense of place, interpretation methodologies, environmental values, cultural and artistic heritage.

### **6. NY/NJ Bight Seamless Networks**

On May 13-14, 2008, representatives of key federal and state agencies, nongovernmental organizations, and experts from relevant disciplinary partners met to identify collaborative approaches and programs to advance a New York/New Jersey Bight Seamless Network of Protected Shores. The workshop report may be found at Appendix G. Key objectives were to identify common interests in stewardship, research and monitoring responsibilities, and to explore strategies to develop a collaborative network on behalf of these common interests. Real world examples of seamless network collaboration were presented, along with specific challenges to sustaining networks at various scales.

The themes of global climate change and sea level rise were pervasive throughout all breakout group discussions. The research and monitoring group listed "climate change" as one of their monitoring priorities, along with related monitoring efforts such as shoreline geomorphology, sea level elevations and sediment elevation tables. The stewardship and natural resource management group recognized climate change in a number of their priority issues. Examples include characterizing intertidal and subtidal habitat loss and functional degradation, developing a regional sand and sediment management plan, alternative energy development, and coastal resilience including disaster response. The outreach and education group outlined two pilot projects, focusing on sea level rise messaging for various audiences.

Workshop participants agreed that developing pilot projects is one way to test the functionality of the seamless network. A variety of projects were identified, with two possessing near-term opportunities for implementation. One of these is to prepare a baseline map of submerged natural and cultural resources for use by multiple resource partners. Bathymetry, sediment type, and habitat maps accompanied by detailed inventories comprise critical information needed by park managers to design effective resource protection strategies, identify restoration needs, and to implement long-term monitoring programs. This pilot will aim to test and evaluate state-of-the-art and cost-effective methods for mapping submerged habitats and cultural resources within nearshore ocean and bay environments. Such information also can provide a mechanism for scientists, managers and educators to communicate and collaborate on education and outreach programs and services. This pilot was executed in November 2008. Next steps include the development of a CTP to disseminate the findings.

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The second project aims to engage the seamless network partners to develop a NY/NJ Bight online, GIS data repository. Creation of the repository will provide a one stop listing of partner GIS and Remote Sensing Datasets thus enabling partner agencies to assess data availability or gaps, solicit partners for technical assistance, and provide contact information for data distribution. This project is being spearheaded by the JC NERR currently under initial development.

### **7. Resource Manipulations**

A number of activities related to research and monitoring may alter or manipulate the estuarine environment for long-term research purposes. Likewise there are areas which have undergone disturbance from human activity in the past that could be restored to a natural function capacity for research and monitoring purposes. These include:

#### **a. Long-term Ecosystem Observatory (LEO-15) Cable Burial**

IMCS established a Long-term Ecosystem Observatory (LEO-15) 3 miles off the New Jersey coast (Figure 14). The observatory is designed to sample and sense the processes governing change and stability in the ocean not detectable with conventional oceanographic techniques. LEO-15, located on the continental shelf in 15 m of water just offshore from RUMFS, is included within the core boundaries of the JC NERR. The goal of LEO-15 is to continuously acquire long-term data to understand processes in the New York Bight and eventually to predict changes in the marine environment. LEO-15 consists of a fiber optic cable linked to an instrumented terminal at RUMFS equipped with sensors to measure standard oceanographic parameters (i.e, conductivity, temperature, pressure, dissolved oxygen, wave height, etc.). Lightweight remotely operated vehicles and autonomous undersea vehicles are used to track episodic events over larger geographic areas. This technology allows investigators to monitor experiments remotely, based on real-time events occurring in the field.

The cable was installed in August 1996 and has no long term effects on the biota of the region. These activities were overseen and monitored by the NJ DEP and have had negligible impact on the local marine environment. LEO-15 was a proof of concept project that faces uncertain funding in the near future. Partnering opportunities to sustain this capability will be explored including the potential for maintaining this asset as a core capability of an emerging Seamless Network of Marine Protected Areas.

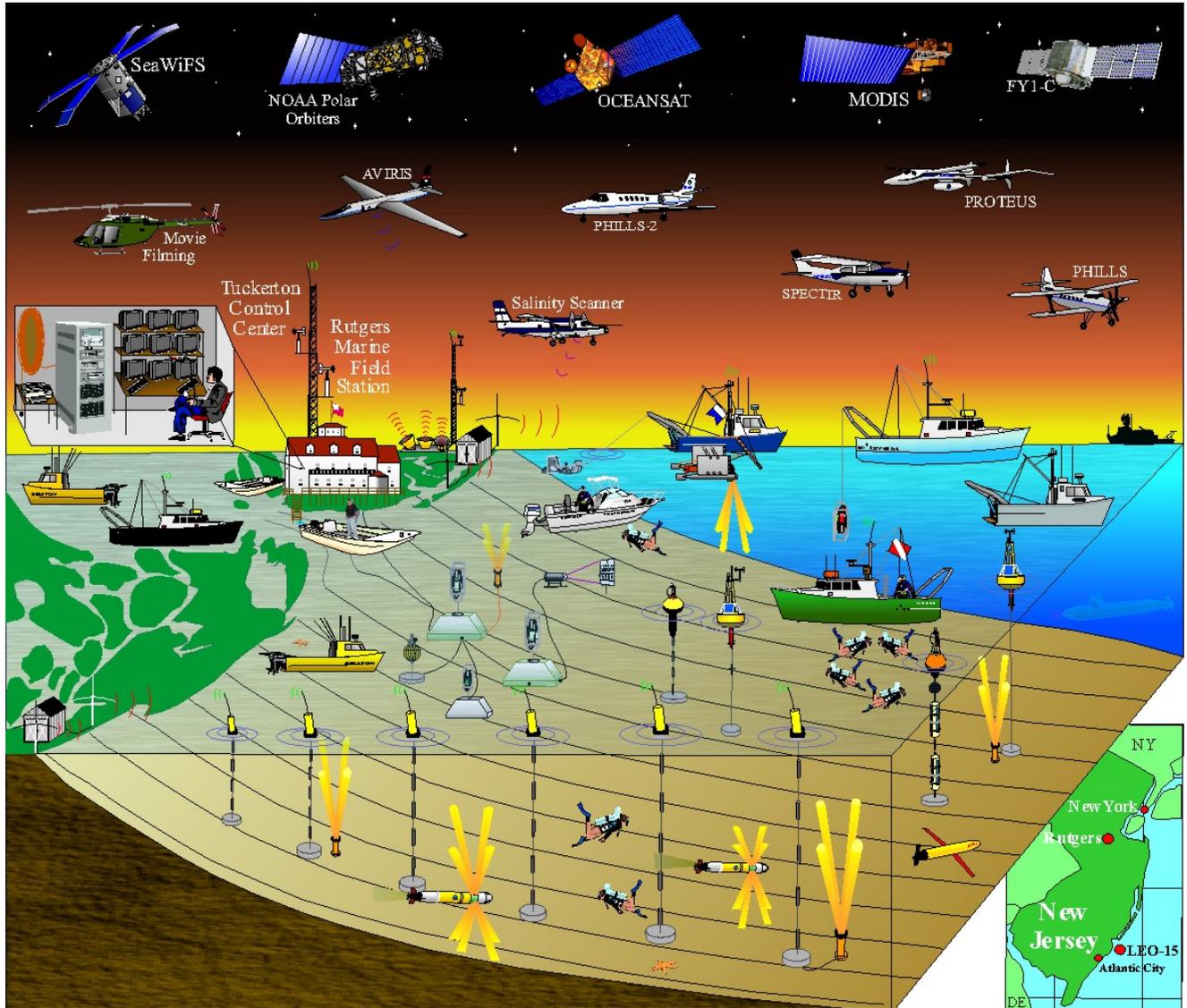


Figure 14. Long-term Ecosystem Observatory in 15 m Water in the Coastal Ocean Component of the JC NERR.

**b. RUMFS Salt Marsh Research Plots**

Reserve investigators have engaged in limited research manipulation of three to four salt marsh plots immediately around the Rutgers Marine Field Station where water levels are manipulated to determine its relationship to *Spartina* spp. distribution. These areas, approximately 2- 3 square meters in size, also are used as small tidal pools where cameras are set up to examine juvenile fish and their interaction with the natural environment. The plots are limited in size and number and do not significantly affect the larger system.

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### **c. Tuckerton Creek**

Rutgers, IMCS and the JC NERR must maintain water access to Great Bay to support field operations with research vessels. Periodically, it is necessary to dredge a boat basin. When dredged, sediments from the boat basin will be disposed of in an environmentally responsible manner in accordance with the management regulations issued by the NJ DEP.

### **d. Forsythe Impoundment**

The U.S. Fish and Wildlife Service maintains several impoundments to provide habitat for migratory waterfowl. Elevation of the impoundments is managed seasonally and in response to prevailing weather conditions. This manipulation is conducted in accordance with all rules and regulations of the Fish and Wildlife Service.

## **8. Future Planned or Proposed Projects**

JC NERR remains committed to providing relevant scientific information to resource managers within the JC NERR boundaries and associated watersheds. To facilitate data transfer, the JC NERR staff identified the following stewardship projects to disseminate vital information to protect, conserve and restore estuarine habitat, resources and water quality with the reserve.

### **a. LiDAR**

High resolution elevation data for Ocean and Atlantic County coastal areas has been identified as a priority data gap within the site boundary and watershed area of the JC NERR. JC NERR staff contacted federal, state, and local government partners to plan for the acquisition of digital elevation data. The Federal Emergency Management Agency (FEMA) will collect LiDAR data in the spring of 2009 for the CAFRA zones in both Ocean and Atlantic Counties. This data set and a three meter Digital Elevation Model (DEM) created by the U. S. Geological Survey (USGS) will be available in 2010. Combined with the LiDAR data for Burlington County collected in the spring of 2004, the entire JC NERR and most of the NJ CAFRA area should have LiDar data available within two years.

LiDAR data can be difficult to assimilate into decision making tools since they are complex to analyze. To help reserve partners better use this data for stewardship activities, JC NERR held a workshop on October 17th, 2008 to provide an overview on LiDAR and hands on software training as noted in section IV, "Summary of Accomplishments.". For an agenda and a list of presentations visit the following link at <http://www.crssa.rutgers.edu/rs07/>. The JC NERR continues to provide support to our stewardship partners on the use of high resolution elevation data for resource management issues. To this end, JC NERR staff has submitted a proposal to the Cooperative Institute for Coastal and Estuarine Environmental Technology (CICEET) to provide LiDAR analysis and training to JC NERR partners.

### **b. Cooperative Institute for Coastal and Estuarine Environmental Technology**

The rapid urbanization/suburbanization of coastal watersheds and barrier islands in New Jersey has led to alterations in groundwater recharge and surface runoff patterns, as well as the progressive eutrophication of freshwater tributaries and adjacent coastal waters (Valiela and Bowen, 2002). Effective and properly engineered storm water management systems (SWMS) represent one of the most important water resource protection strategies available to counter the

## XII. Stewardship Plan

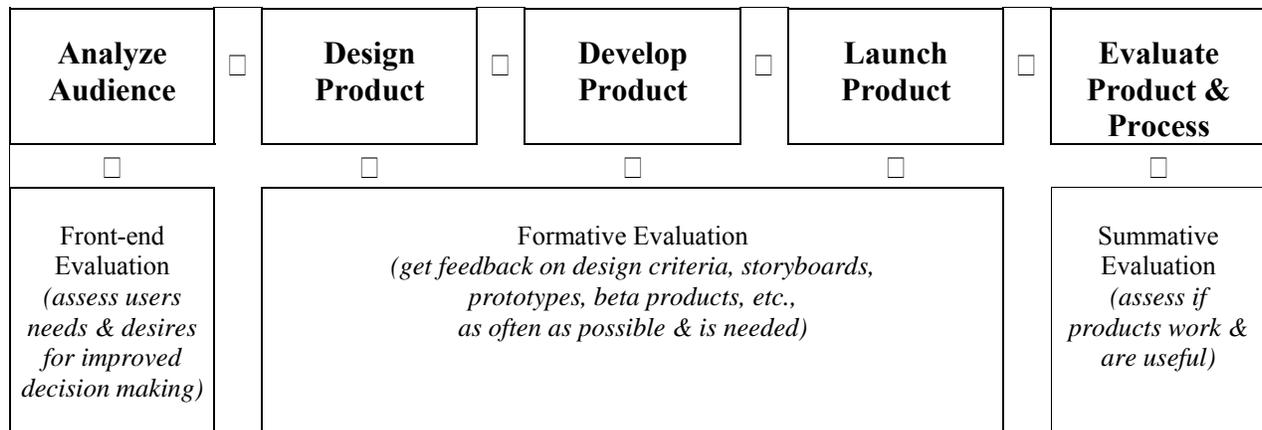
most deleterious impacts of nonpoint source pollution and surface runoff associated with development (Debo and Reese, 2003; USEPA 2004a).

Presently, coastal managers, professionals in the environmental protection and land use planning communities and private developers do not have a comprehensive database detailing the locations and attributes of retention/detention/infiltration basins and associated infrastructure. Due to this lack of information, projects are often evaluated in isolation with minimal consideration of cumulative impacts on the watershed.

To address this issue, the JC NERR and CRSSA are partnering with state and local authorities to develop a suite of innovative, internet-based geospatial tools coupled to a database management system, called the StormWater Management Information System (SWMIS). SWMIS will provide: 1) a geospatial inventory of existing stormwater management systems, 2) an internet accessible repository of stormwater management system GIS and attribute data, and 3) an on-line suite of GIS tools and models to evaluate development and/or mitigation projects.

A data base was created by extracting positional information from hard copy data sheets collected by the Ocean County Soil Conservation District prior to basin development. Historical basin positional information was obtained by either state plan coordinates or address matching block and lot information on the original scanned hard copy. Data is stored in a Geographic Information System (GIS). Future work on this project will focus on providing an internet based format for basin submittal to facilitate direct input into a GIS.

In response to needs of the end-user, a structured design and evaluation process will be used to gather input from a cross-section of the target audience. The instructional systems design (ISD) model is commonly used for the development of programs and products and employs a “systems approach” that matches the products and programs to users’ needs. This ensures that program/product development is effective and efficient. The steps are depicted below:



A sub-set of the potential users were surveyed to: (1) identify the parameters that are most important to their decision-making, (2) determine their level of comfort with online mapping tools (i.e. GOOGLE MAPS and other ESRI-based internet mapping servers), (3) determine the best structure for querying, inputting data to, and retrieving data from the SWMIS, and (4)

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determine what would enable or prevent them from using such a product. The results of this assessment guided the overall structure, functionality and display of the SWMIS.

Once a “beta” version of the SWMIS is developed, a sub-set of potential users will be asked to participate in a focus group to provide feedback on the initial design and usability of the SWMIS. The evaluation method of “quester testing” will be used. With this approach, potential users are introduced to the product, and then given a set of decisions they must make (quests) and asked to use the product to help them make the decisions. Each of the quests is a typical decision-making scenario. During quests, users engage with the product, find the information they need, note each decision on a quest sheet and then provide feedback on successes and/or frustrations. At the end of the session, users discuss their results with product developers and/or the evaluator.

Based on feedback from “quester testing”, the SWMIS will be improved. Once this new version of the SWMIS is completed, a second and third focus group will be held to gather additional feedback. This iterative process allows for on-going development of the SWMIS and ensures a product that is closely aligned to the needs and skill levels of the intended audiences. Once the formative evaluation stage has been completed, the SWMIS will be ready for dissemination to the previously identified audiences throughout the Barnegat Bay watershed.

### **c. Remote Sensing and *in situ* Survey of Submerged Aquatic Vegetation**

The JC NERR will employ high spatial resolution (<1 meter) ortho-rectified multi spectral (red, green, blue and infrared) aerial photography to map the extent of SAV in the Barnegat Bay-Little Egg Harbor Estuary. This mission will be flown with a number of temporal constraints including tidal, sun glint, wind and wave effects, and water turbidity. An array of *in situ* field points (N > 100) will be collected within the BB-LEH estuary to field-verify the imagery using both divers and a submerged video camera unit linked to a Global Positioning System (GPS). The imagery will be loaded into an object-orientated classification software package (e-cognition) to delineate SAV habitat boundaries. The plan is to accurately map SAV. Data created from this project will be added to the current CRSSA seagrass distribution web-site located at (<http://crssa.rutgers.edu/projects/runj/sav/>). In addition, we will collaborate with the education and outreach group of the JC NERR to deliver presentations and outreach materials on the project to the coastal and K-12 communities.

### **d. Developing a Nutrient Pollution Indicator**

Public awareness of the eutrophication of the Barnegat Bay ecosystem is growing in response to research and outreach efforts of the JC NERR. Local citizens, non-governmental organizations, and community groups are very interested in learning about research projects taking place through the watershed and estuary. To capitalize on this interest, the eutrophication issues affecting Barnegat Bay and the use of seagrass as a nutrient indicator will be featured in the JC NERR “Lunch-N-Learn” series. This program attracts visitors to the Tuckerton Seaport during the off season and draws an audience beyond the Barnegat Bay watershed including participants from Pennsylvania.

A fourth grade teacher worked alongside the research team and was involved in all aspects of the research project including water quality testing, collection of samples, preparation of samples, and the nutrient analysis. This teacher will develop three novel lesson plans to complement the

## **XII. Stewardship Plan**

Marine Activities and Resources Education (MARE) curriculum. The lesson plans will focus on the following topics:

1. Non-point Source Pollution and the Causes of Nutrient Over-Enrichment
2. The Impacts of Eutrophication on Estuarine Systems
3. Using Indicators to Assess Environmental Quality

The completed lesson plans will be added to the JC NERR fourth grade “Shallow Bays” curriculum.

### **e. Ocean Governance**

In April 2004, the U.S. Commission on Ocean Policy delivered its preliminary recommendations for a coordinated, comprehensive national ocean policy for the twenty-first century. The report stressed that effective policies must be based on unbiased, credible, and up-to-date scientific information. The report devotes an entire chapter to discussing the benefits of regional research approaches to ecosystem management (Ocean Commission, 2004), and calls for a reform of ocean and coastal governance.

Over the next 5 years, the JC NERR will pursue opportunities to coordinate and advance ecosystem management approaches at the federal, state and local levels to improve stewardship of coastal and estuarine resources. Activities will include participation in multi-institutional initiatives including establishment of Cooperative Institutes with NOAA (2 proposals pending), and participation in an emerging regional mechanism in the Mid-Atlantic aimed at fostering ecosystem-based management. The latter opportunity is being driven by the governors of the Mid-Atlantic States, and modeled after the successful Gulf of Mexico Alliance and West Coast Governor’s Agreement on Oceans and Human Health.

Among other features, the report calls for a strong role for the states and local entities requiring the active involvement of informed state and local policy makers and other stakeholders. Recognizing that an interested and engaged public is essential to addressing complex ocean and coastal issues, the report promotes high quality ocean education programs – programs that result in lifelong learning, an adequate and diverse workforce, informed decision makers, improved science literacy, and a sense of stewardship for ocean and coastal resources. These must include in particular, outreach to underrepresented and underserved communities. Effective programs at the K-12 level are needed, and undergraduate and graduate programs must be able to produce the next generation of ocean scientists, technicians, educators, and policy makers. Outside the classroom, informal education efforts must cultivate a sense of stewardship by helping all individuals recognize the value of the ocean to his/her own life and how the oceans affect the marine environment. JC NERR education and outreach programs will be positioned to address these education challenges

### **f. Atlantic Sturgeon**

Atlantic sturgeon represents a signature species of the Mid-Atlantic region. The JC NERR partnered with the Seaboard Fisheries Institute, a nonprofit organization dedicated to research and education relating to the sustainability of diadromous fish, to organize a symposium to foster collaborative regional approaches to restoring and protecting coastal Atlantic sturgeon populations and their associated essential habitats. The Symposium, A Regional Approach to

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Atlantic Sturgeon Recovery—The Seaboard Fisheries Institute 1<sup>st</sup> Symposium on Atlantic Sturgeon, was held in February 2009 and hosted scientists, resource managers, nonprofit organizations, and industry representatives. The specific objectives of the Symposium were: to provide a forum to facilitate information exchange and discussions between expert scientists and stakeholders; to ensure that decision makers are aware of the species' growing importance and provide them with information necessary to improve policy with regard to the species recovery; to promote a regional dialogue and to identify appropriate approaches for regional restoration strategies; to identify and prioritize actions that can accelerate the development and implementation of such strategies; and to develop and disseminate symposium proceedings, which summarize the meeting and outlines identified restoration strategies. The JC NERR co-sponsored this event. Future collaboration with the Seaboard Fisheries Institute will support Atlantic sturgeon restoration efforts in the Mullica River-Great Bay estuary and other Mid-Atlantic estuaries.

# **XIII. Resource Protection Plan**



### **XIII. RESOURCE PROTECTION PLAN**

#### **A. Introduction**

The JC NERR and surrounding watershed are primarily owned and managed by local, state and federal agencies. These include the New Jersey Department of Environmental Protection (NJ DEP), Pinelands Commission, and the U.S. Fish and Wildlife Service. These agencies share a common goal aimed at science-based management of the watershed. Public access and use within the core and buffer areas of the reserve are coordinated by the Reserve Manager with the public agencies that manage these areas. All uses within these areas are controlled by the public land owners and are subject to direct permitting or federal consistency control by the NJ DEP under the rules for New Jersey's Coastal Management Program. These regulations ensure that the reserve ecosystem and surrounding watershed will be protected for long-term research and education.

#### **B. State Regulations**

The reserve lies within two regulatory regions including 1) the area east of the Garden State Parkway is within the Coastal Area as defined by New Jersey's Coastal Management Program, and 2) the area upstream or west of the Garden State Parkway is within the Pinelands Protection Area. Both regulatory designations provide protection for the Reserve.

For state lands within the JC NERR, the DEP has responsibility and full authority to manage and enforce activities and uses. Responsibilities include permit review, planning, managing public tidelands real estate, monitoring and enforcing coastal permit and tidelands laws, undertaking coastal engineering projects, and providing financial and technical assistance to local governments. Legislative mandates for this authority include the Coastal Area Facilities review Act (CAFRA, N.J.S.A. 13:19-1), the Wetlands Act of 1970 (N.J.S.A. 13:9A-1) and the Waterfront Development Act (N.J.S.A. 12:5-3). Under these three statutes, any development proposed within estuarine waters, on wetlands, or on uplands within 150 feet of tidal waters, beaches, or dunes needs to receive a coastal permit from the NJ DEP. State regulated development is reviewed using a set of rules known as the Rules on Coastal Zone Management, N.J.A.C. 7:7E-1 et seq., The Mullica River-Great Bay estuarine system was chosen as the site for the JC NERR, in part, because these rules preserve and protect the key land and water areas of the reserve. More specifically, these rules define the land and water resources of the research reserve as Special Areas. These areas are defined as those with natural resource value, importance for human use, or sensitive to disturbance that they merit specific attention. Special Areas are defined and given special policies in Subchapter 3, and are grouped under four broad headings: Special Water Areas; Special Water's Edge Areas; Special Land Areas; and Special Coast Wide Areas. Special areas protected under these rules include:

### **XIII. Resource Protection Plan**

- Shellfish Beds Surf Clam Areas
- Prime Fishing Areas
- Finfish Migratory Areas
- Submerged Vegetation
- Navigation Channels
- Canals
- Inlets
- Marina Moorings
- Ports
- Submerged Infrastructure Routes
- Shipwrecks and Artificial Reefs
- Intertidal and Subtidal Shallows
- Dunes
- Overwash Areas
- Coastal High Hazard Areas
- Erosion Hazard Areas
- Barrier Island Corridors
- Bay Islands
- Beaches
- Flood Hazard Areas
- Alluvial Flood Margins
- Wetlands
- Wetlands Buffers
- Wet Borrow Pits
- Coastal Bluffs
- Intermittent Stream Corridors
- Critical Wildlife Habitat
- Public Open Space
- Special Hazard Areas
- Endangered or Threatened Wildlife or Vegetation Species Habitats

The estuarine resources of the JC NERR are protected by several state laws. State laws that protect the estuarine resources of the JC NERR are described briefly below. These laws form the core protective measures for estuaries from activities that occur within or adjacent to estuaries.

#### **1. Coastal Area Facility Review Act**

The Coastal Area Facility Review Act (CAFRA, N.J.S.A. 13:19-1 et seq.) authorizes DEP to regulate and approve the location, design, and construction of major facilities in a 1,376 square mile coastal region encompassing portions of Middlesex, Monmouth, Ocean, Burlington, Atlantic, Cape May, Cumberland and Salem Counties. The CAFRA area also includes coastal waters. Lying within the CAFRA area are New Jersey's coastal barrier beach islands, all of its coastal resort areas, portions of the Pinelands, large agricultural areas and New Jersey's fastest growing communities. Facilities regulated under CAFRA are relatively large in size, such as residential developments with 25 or more dwelling units, industrial facilities, roads and sewers greater than 1,200 feet in length and commercial facilities with 50 or more parking spaces. Any development, regardless of size, within 150 feet of dunes, beaches and tidal waterways is also subject to CAFRA review.

#### **2. Wetlands Act of 1970**

The Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.) authorizes DEP to regulate activities on coastal wetlands. The Act gives DEP broad discretion in regulating virtually any form of development or disturbance on mapped coastal wetlands, except for mosquito control and continued commercial production of salt hay or other agricultural crops or activities. All of the coastal wetlands within the proposed reserve are protected under the Wetlands Act of 1970. This Act does not affect inland or freshwater wetlands.

#### **3. Waterfront Development Law**

The Waterfront Development Law (N.J.S.A. 12:5-3) authorizes DEP to regulate the construction or alteration of a dock, wharf, pier, bulkhead, bridge, pipeline, cable, or other "similar or dissimilar development" on or adjacent to navigable waterways and streams throughout the State.

#### **4. Tidelands Management**

In New Jersey, "tide-flowed" lands (or tidelands) are publicly owned and held in trust by the State of New Jersey, except where already conveyed. The State acts as trustee for the public, and must administer their use in the public interest. The State exercises control over tidelands in two ways: through its proprietary role as owner and through its regulatory role under the Waterfront Development Law. The Tidelands Resource Council which is composed of twelve citizens appointed by the governor, with the advice and consent of the State Senate, has broad discretion concerning applications for tidelands conveyance. The DEP advises the Council on these applications relying on the Coastal Management Program as guidance. The DEP Commissioner has the authority to veto any Council action inconsistent with state policy.

#### **5. Regulation and Planning of Energy Facilities**

DEP has broad planning authority over energy-related matters, including the authority to participate in the decision making of other State agencies concerning the siting of energy facilities. The fact that energy generating and petroleum refining facilities often seek to locate in the coastal zone means that DEP energy authority is a significant element in the management system. DEP recognizes its dual jurisdiction over energy facilities sited in the coastal zone.

#### **6. Shore Protection Act**

The Shore Protection Act (N.J.S.A. 12:6A-I) governs activities related to beach erosion in New Jersey. Shoreline change due to natural and man-made causes is a major concern in New Jersey and DEP is authorized to undertake actions necessary to maintain a static shoreline. In 1977, New Jersey voters approved a \$30 million bond issue to fund state matching grants for shore protection projects (the Beaches and Harbors Bond Act of 1977, P.L. 77-208). The Act required DEP to prepare a comprehensive master plan that would serve as a guide to distribute these grants. This resulted in publication of the N.J. Shore Protection Master Plan, adopted in 1981 to ensure that shore protection funds were used for projects that served the public interest.

#### **7. Pinelands Protection Act**

The Pinelands Protection Act of 1979 (N.J.S.A 13:18-1 et seq.) delineates a Preservation Area where the Pinelands Commission shall "preserve an extensive and contiguous area of land in its natural state, thereby insuring the continuation of a pinelands environment..." The Pinelands Commission adopted a comprehensive management plan in 1980 that implements this mandate. The portion of the proposed reserve within the Pinelands is located entirely within the Preservation Area.

#### **8. New Jersey Coastal Management Program**

The New Jersey Coastal Management Program provides a sound foundation to protect the estuarine resources of the proposed JC NERR, and is comprised of three parts: a coastal boundary; a set of coastal policies; and an implementation plan. In order to receive federal approval and implementation funding under the Coastal Zone Management Act of 1972, states and territories had to demonstrate that they had programs with enforceable policies, that were sufficiently comprehensive and specific to regulate land uses, water uses, and coastal development, and enabled resolution of conflicts among competing uses. In addition, they had to have the authority to implement the enforceable policies. New Jersey is one of 29 States and Territories with such a federally approved program.

### **XIII. Resource Protection Plan**

The New Jersey Coastal Management Program was developed in the 1970s by the DEP and received federal approval from the U.S. Department of Commerce in two phases. The first approval, given in 1978, was for the Bay and Ocean Shore segment defined by the Coastal Area Facility Review Act (N.J.S.A 13:19-1 et seq.) (CAFRA). The second phase, for the remaining areas of the state with tide- flowing coastal waters, was approved in September, 1980. These two regions encompass the regulated coastal zone of New Jersey.

The New Jersey Coastal Management Program seeks to preserve the major land and water components that make up the reserve. The land and water characteristics of the JC NERR receive special attention under the state Coastal Management Program which ensures that the area will be managed in conformance with the goals of the National Estuarine Research Reserve legislation. For example, under New Jersey's CZM Program, a coastal permit issued by the DEP is required for any activity within a salt marsh or water area. In order to receive a permit the activity must be evaluated in accordance with a strict set of policies and regulations. Policies for coastal wetlands prohibit any alteration unless the activity is water dependent, no available alternate non-wetland site exists and produces a minimum disturbance to vegetation and tidal flow. Regulated activities include major disturbances such as dredging or filling, construction projects such as docks, piers, pilings and operation of all terrain vehicles. In water areas, activities are restricted based upon the environmental sensitivity of the water body (Table 5).

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| Special Area Rules                  | Filling/Disposal | Docks/Piers | New Dredging | Maintenance Dredging | Submarine Mining | Physical Barrier | Submerged Infrastructure | Land Development |
|-------------------------------------|------------------|-------------|--------------|----------------------|------------------|------------------|--------------------------|------------------|
| Shellfish Habitat                   | P                | P           | P            | C                    | P                |                  |                          |                  |
| Surf Clam Areas                     | P                | P           | P            | P                    | P                |                  |                          |                  |
| Prime Fishing Areas                 |                  |             |              |                      | P                |                  |                          |                  |
| Finfish Migratory Pathways          |                  |             |              |                      |                  | P                |                          |                  |
| Submerged Vegetation Habitat        | P                | C           | C            | C                    | P                |                  |                          |                  |
| Navigation Channels                 | P                | P           | C            | C                    |                  |                  |                          |                  |
| Canals                              |                  |             |              | C                    |                  |                  |                          |                  |
| Inlets                              | P                |             |              |                      |                  |                  | D                        |                  |
| Marina Moorings                     |                  |             | C            | C                    |                  |                  |                          |                  |
| Ports                               | P                | C           |              |                      |                  |                  |                          |                  |
| Submerged Infrastructure Routes     | C                | C           | C            | C                    | C                |                  |                          |                  |
| Shipwrecks and Artificial Reefs     | P                |             | P            | P                    | D                |                  |                          |                  |
| Wet Borrow Pits                     | D                | C           |              |                      | C                |                  |                          |                  |
| Intertidal and Subtidal Habitat     | D                | D           | D            | C                    | D                |                  |                          |                  |
| Dunes                               |                  |             |              |                      |                  |                  |                          | P                |
| Overwash Areas                      |                  |             |              |                      |                  |                  |                          | P                |
| Coastal High Hazard Areas           |                  |             |              |                      |                  |                  |                          | P                |
| Erosion Hazard Areas                |                  |             |              |                      |                  |                  |                          | P                |
| Barrier Island Corridors            |                  |             |              |                      |                  |                  |                          | C                |
| Bay Islands                         |                  |             |              |                      |                  |                  |                          | D                |
| Beaches                             |                  |             |              |                      |                  |                  |                          | P                |
| Flood Hazard Areas                  |                  |             |              |                      |                  |                  |                          | D                |
| Wetlands                            | P                | P           | P            | P                    | P                |                  |                          | P                |
| Wetlands Buffers                    |                  |             |              |                      |                  |                  |                          | P                |
| Coastal Bluffs                      |                  |             |              |                      |                  |                  |                          | P                |
| Intermittent Stream Corridors       | P                |             |              |                      |                  |                  |                          | P                |
| Endangered or Threatened Wildlife   | P                | P           | P            | P                    | P                | P                |                          | P                |
| Endangered or threatened Vegetation | P                | P           | P            | P                    | P                | P                |                          | P                |
| Critical Wildlife                   | D                | D           | D            | D                    | D                | D                |                          | D                |
| Public Open Space                   |                  |             |              |                      |                  |                  |                          | C                |
| Special Hazard Areas                |                  |             |              |                      |                  |                  |                          | D                |
|                                     |                  |             |              |                      |                  |                  |                          |                  |
|                                     |                  |             |              |                      |                  |                  |                          |                  |
| <b>C – Conditionally Acceptable</b> |                  |             |              |                      |                  |                  |                          |                  |
| <b>D – Discouraged</b>              |                  |             |              |                      |                  |                  |                          |                  |
| <b>P – Prohibited</b>               |                  |             |              |                      |                  |                  |                          |                  |

**Table 5. Regulatory Program State and Federal Laws**

In addition, both the federal Coastal Zone Management Act and the New Jersey Coastal Management Program require consistency of all activities directly affecting the coastal zone. Table 6 provides an overview of the activities controlled by state coastal laws and the state and federal activities subject to the Rules on Coastal Zone Management.

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| State and Federal Laws            | Land Regulation | Wetlands Regulation | Water Regulation | Education | Monitoring | Planning | Construction | Acquisition |
|-----------------------------------|-----------------|---------------------|------------------|-----------|------------|----------|--------------|-------------|
| Coastal Area Facility Review Act  | x               |                     | x                | x         | x          | x        |              |             |
| Wetlands Act of 1970              |                 | X                   | x                | x         | x          |          |              |             |
| Waterfront Development Law        |                 |                     | x                | x         | x          |          |              |             |
| Tidelands Management              |                 |                     | x                | x         | x          |          |              |             |
| Shore Protection                  |                 |                     |                  |           |            | x        | x            | x           |
| Sec 401-CWA                       |                 | X                   | x                |           |            |          |              |             |
| Sec 404-CWA                       |                 | X                   |                  |           |            |          |              |             |
| Sec 319-CWA                       |                 |                     |                  | x         |            |          |              |             |
| Sewage Infrastructure Improvement |                 |                     |                  |           | x          | x        | x            |             |
| New Jersey State Planning Act     |                 |                     |                  |           |            | x        |              |             |
| Barnegat Bay Study Act            |                 |                     |                  | x         |            | x        |              | x           |
| Green Acres Bond Funds            |                 |                     |                  |           |            | x        | x            | x           |

**Table 6. New Jersey Coastal Program Rules**

**C. Specific Uses for State Lands in the JC NERR**

In general, the uses allowed under the land owner management plans for the core and buffer areas are limited to recreational activities such as hunting, fishing, and nature study (Table 6). More specifically, the uses presently allowed within specific managed parcels are:

**1. New Jersey Division of Fish, Game & Wildlife**

Absecon Wildlife Management Area: The Absecon tract in Atlantic County comprises 3,688 acres. Absecon is almost entirely salt marsh and is primarily managed for waterfowl. The marshes are heavily utilized by waterfowl during the fall and winter months, and many shorebirds nest in the area. The area is managed for waterfowl hunting, saltwater fishing and crabbing and bird watching. In addition, many vacationers enjoy boating and water skiing in the area. Some launching ramps and boat liveries are available. The intracoastal waterway crosses this tract.

Great Bay Boulevard Wildlife Management Area: This area is located in Ocean County south of Tuckerton and includes 4,670 acres of salt marsh. Great Bay Boulevard runs through the middle of the area with boat launching ramps accessible from this road. Because the area is heavily utilized by waterfowl and nesting shorebirds, it is an excellent site for bird watching and waterfowl hunting, as well as fishing, crabbing and clamming.

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Port Republic Wildlife Management Area: The area contains 755 acres and is located north of Port Republic and west of the Garden State Parkway in Atlantic County on the south bank of the Mullica River. Three quarters of this tract consists of salt-marsh with the remaining area an upland-field habitat. The area is used for upland hunting including wild turkey, deer and waterfowl. The Mullica River is excellent for fishing and Collins Cove is used during winter for ice fishing for white perch.

Swan Bay: This tract is located on the north bank of the Mullica River west of the Wading River, and is comprised of 1,078 acres of upland and salt marsh managed primarily for waterfowl hunting.

### **2. New Jersey Division of Parks and Forestry**

Bass River State Forest: This area contains 18,284 acres and is located in part of the fringe area of the proposed reserve in Burlington and Ocean counties. The State Forest is managed for hunting, fishing, nature study, camping, swimming, hiking, canoeing and boating.

Wharton State Forest: This large tract contains 108,773 acres and is located in part of the fringe area of the proposed reserve in Burlington and Atlantic counties. The State Forest is managed for hunting, fishing, nature study, camping, swimming, hiking, canoeing, boating and horseback riding.

North Brigantine Natural Area-677 acres, Absegami Natural Area-146 acres, Great Bay Natural Area-395 acres: These areas are managed for environmental conservation and enhancement. Uses are limited.

### **D. Federal Regulations**

Federal lands within the JC NERR consist of those managed by the U.S. Fish and Wildlife Service and which comprise the Edwin B. Forsythe National Wildlife Refuge. This large federal wildlife refuge manages land holdings in Atlantic, Burlington and Ocean counties. Several of the tracts are managed for different purposes but all of the uses support the conservation or enhancement of the Mullica River and Great Bay ecosystems. Uses allowed within the refuge include nature study, hunting, fishing, picnicking, natural areas, boating, hiking and swimming. Relevant mandates that govern use include the Endangered Species Act, Migratory Waterfowl Act and Clean Water Act including the provisions related to nonpoint source pollution.

### **E. Other Relevant Regulations**

A number of DEP programs require that new development meet regulations and standards related to the maintenance and enhancement of air and water quality, regulation of freshwater wetlands, regulation of soil erosion, and the protection of flood hazard areas, wild and scenic rivers, and specified park areas. These programs must be consistent with the coastal rules to the extent permitted by their enabling legislation.

## **XIII. Resource Protection Plan**

### **1. Sewage Infrastructure Improvement Act**

The Sewage Infrastructure Improvement Act (SIIA) was adopted on August 3, 1988, and requires that all municipalities with stormwater systems discharging into the salt waters of Monmouth, Ocean, Atlantic and Cape May counties adopt a map of their stormwater sewer system. Maps will identify all interconnections and cross-connections between the stormwater and sanitary sewer system, and indicate whether the cross-connections have received a permit from the Department. Upon completion of the map, affected municipalities are required to monitor water quality periodically at the outfall lines for stormwater sewers discharging into salt waters. Ultimately, municipalities will be required to abate nonpoint source pollution entering surface waters.

Due to the amount of work necessary to meet the requirements of the SIIA, implementation is scheduled to be achieved through three phases. Under Phase I municipalities developed an inventory and preliminary map of their respective stormwater sewer systems. In Phase II, municipalities will develop a final map of their stormwater/sanitary sewer system. This includes identification of all cross-connections and interconnections, and performance of quarterly monitoring of discharges to salt waters. Using the information collected under Phase I and II, municipalities will then develop comprehensive stormwater management/nonpoint source pollution control programs during Phase III. Phase III will be the impetus of establishing statewide stormwater/nonpoint source control program at the municipal level and will be used as a starting point for the implementation of Section 6217.

### **2. The New Jersey State Planning Act of 1986**

In response to the growth pressures affecting the entire state, the state legislature enacted the New Jersey State Planning Act (N.J.S.A. 52:18A-196 et seq.). Although the Act specifically exempted the CAFRA region from the State Planning Commission's jurisdiction, DEP, the coastal counties, and municipalities found it in their respective interests to participate in the State Plan's cross-acceptance process. In particular, coastal county planning departments, DEP, the Pinelands Commission and the Office of State Planning compared plans and began to coordinate goals, objectives and policies with the State's regulatory coastal zone management program. From this process, recommendations were made for coastal counties to adopt growth areas included in the cross-acceptance reports, with DEP then adopting the State Plan's "Planning Areas" as part of the CAFRA rules. The State Development and Redevelopment Plan (SDRP) also serves as an umbrella to continue the coordination of state, county, municipal and special district activities with respect to the coastal zone. Continuation of the cross-acceptance process on a three-year cycle, as mandated by law, should facilitate this role for the State Plan.

### **3. Barnegat Bay Study Act of 1987**

With the National Estuary Program (NEP) as a model, the State of New Jersey targeted Barnegat Bay as an important estuary for a regional planning initiative. Study of the estuary and adjacent watershed area was called for in the Barnegat Bay Study Act of 1987 resulting in a three part program. As with the NEP, the first step was characterization of the health and use of the watershed. A second document identified planning goals and objectives and provided an analysis of possible management options for the watershed. A third document, the Barnegat Bay Watershed Management Plan (June 1993), identified actions to be taken by a variety of parties to promote a healthier bay and quality of life. The Barnegat Bay study process steps outside of

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jurisdictional limitations presented by local political boundaries and focuses on a bioregional definition of the study area. This program is now a part of the National Estuary Program with research and management priorities guided by a Comprehensive Conservation and Management Plan. Reserve staff members participate in all facets of this program thereby ensuring coordination of conservation and protection strategies.

# XIV. Integration Plan



## **XIV. INTEGRATION PLAN**

### **A. National Program**

The NERRS has devoted a great deal of time to foster integrated approaches to coastal management and conservation. Past efforts have permeated activities of workgroups, strategic planning activities, workshops, training sessions, and annual meetings. Over the past five years, two national issues have emerged that benefit from cross-sector participation—climate change and coastal ocean observations.

In 2006, members of the NERRS began to address the role of the Reserves in climate change. Preliminary objectives were to identify capacity of the NERRS to address climate change issues, exchange information on current Reserve programs related to climate change, and to produce a vision for future Reserve investment. In 2007, the theme for the annual NERRS/National Estuarine Research Reserve Association meeting focused on the NERRS niche in climate change. A variety of ideas were discussed for a workgroup to develop on behalf of the Reserve system. Clearly, climate change is a national issue that merits attention and action from the NERRS.

Since 2003, the NERRS has developed capacity to provide timely environmental information to support integrated research, education, and stewardship applications in diverse coastal and estuarine ecosystems as a key component of the Integrated Ocean Observing System.

The coastal component of the Integrated Ocean Observing System (IOOS) was envisioned as a national network of data acquisition and dissemination sites to provide comprehensive and timely information about the status, condition, and future of the nation's estuaries and coastal ocean waters (Nowlin, 2001; Ocean.US, 2002ab). The emerging federal backbone of the coastal IOOS consists of regional observing systems that represent a collaboration of state and federal agencies, academia, private industry, and non-governmental organizations. Data acquisition and dissemination activities encompassed by the coastal IOOS and regional observing systems are focused on three broad thematic areas: (1) efficient coastal marine services and mitigation of natural hazards; (2) improved coastal ecosystems and protection of public health; and (3) sustained production of living marine resources (Malone, 2001).

The National Estuarine Research Reserve System (NERRS) has been identified in several pivotal documents as a contributing partner to the integrated monitoring network (Gibbons, 1997) and as a key design element of the coastal observing system (CORE, 1999; Frosch, 2000). Most recently, the preliminary report of the President's Ocean Policy Commission recommends that existing water quality monitoring networks be linked to the IOOS and that data from these networks be translated into timely and useful information products that are easily accessible to the public and linked to output from the IOOS (Ocean Policy Commission, 2004).

The NERRS possesses existing strengths and capabilities to enhance the emerging network of regional Ocean observing systems and associations. These include a well-established System-wide Monitoring Program (SWMP), a Centralized Data Management Office (CDMO) that ensures SWMP data quality and accessibility, Coastal Training Programs for decision-makers, and nationally-acclaimed education programs. To date, real-time delivery of SWMP data has

been achieved, and pilot applications of SWMP data for coastal managers and the education community have been demonstrated.

### **B. JC NERR Program**

Historically, the JC NERR has used an integrated approach to address key coastal management issues affecting New Jersey and the nation. A few recent examples include efforts related to impacts of watercraft on shallow water habitat and nutrient impacts on coastal systems. These and other efforts required the research, education and CTP/stewardship sectors to design and deliver programs that capitalized on the diverse expertise of staff, and were grounded in use of the logic model to help develop expected outcomes and desired deliverables. This approach will continue to be used for major investment areas and program priorities where appropriate. In the next five years, key integration issues are:

1. Nutrient inputs into coastal waters
2. Effects of climate change on coastal and estuarine systems
3. Coastal observation systems
4. Remote sensing of land use and habitat change

Clearly, these issues are not mutually exclusive. Nutrient inputs into coastal systems are affected by climate change and patterns of human alteration of the coast. Coastal observation systems and remotely-sensed information can be used to detect, monitor and forecast effects of climate change on coastal habitat and resources, and the impact of human development on coastal habitat and resources. A framework has been developed to guide JC NERR programs across sectors for an integrated program comprised of the four integration issues.

### **C. Framework for Integrated Program**

An integration team has been established to oversee program development for the four key integration issues. Team members represent each of the primary sectors and include the Reserve Manager, Research Coordinator, Coastal Training Program Coordinator, Stewardship Coordinator, and the Education Coordinator. The team will be responsible for producing a logic model for the integrated program, meeting regularly to identify sector responsibilities, share information, coordinate respective program responsibilities, and to apply an integration “filter” on all Reserve programs and activities related to the four integration issues. Results and products, along with performance measurements will be developed as a result of the logic model process.

### **D. JC NERR Integrated Ocean Observing System**

The Integrated Ocean Observing System (IOOS) is a federal program designed to provide real-time and near real-time information on ocean processes at a range of scales for diverse user groups (see [http://www.ocean.us/what\\_is\\_IOOS](http://www.ocean.us/what_is_IOOS)).

## JC NERR Management Plan 2009 - 2014

Seven broad goals characterize this initiative:

- Improve predictions of climate change and weather and their effects on coastal communities and the nation
- Improve the safety and efficiency of maritime operations
- Mitigate the effects of natural hazards more effectively
- Improve national and homeland security
- Reduce public health risks
- Protect and restore healthy coastal ecosystems more effectively
- Enable the sustained use of ocean and coastal resources

A regionally-based framework has been developed to address the goals listed that involve data collection, data communication and management, and data analysis. Collaboration is encouraged among agencies, academic institutions, and the private sector, and the NERRS has been a partner in this endeavor for several years. NERRS efforts have been led by the JC NERR including data collection, management and development of pilot products for the resource management and education communities.

### **1. Data Collection, Management and Analysis**

Through the System Wide Monitoring Program (SWMP) the JC NERR collects real time data at five monitoring stations. Data collected includes physical, nutrient and meteorological datasets. Data is uploaded via a satellite connection to the Central Data Management Office (CDMO) for more details see the SWMP section under research and monitoring.

JC NERR research staff has collaborated with a state partnership at the New Jersey Department of Environmental Protection to provide real time remote sensing data on chlorophyll data for the NJ coastal region. Data is uploaded to an internet data server and provided daily (6 days a week) during the spring through fall.

JC NERR staff, in collaboration with the Center for Remote Sensing and Spatial Analysis (CRSSA) at Rutgers University, has created and maintained several key GIS databases for the NJ coastal region. These include but are not limited to mapped seagrass habitat data, buildout analysis for predicted coastal development in NJ DEP delineated watershed management areas 13 and 14 and multiple datasets showing anthropogenic land alteration (land use and land cover change). This dataset is provided in GIS format on the CRSSA website, [www.crssa.rutgers.edu](http://www.crssa.rutgers.edu).

An acoustic fish tag sensor array has been designed and deployed within the JC NERR reserve boundaries by scientists from Rutgers. This program posts near real-time acoustic telemetry data of the tagged striped bass movements and migrations to a web portal. The StriperTracker website hosts a suite of associated educational materials and has proven to engage a wide and diverse audience. Individuals and organizations can “adopt” a particular fish and follow its movements throughout the estuary. JC NERR staff maintains the data distribution website ([www.stripertracker.org](http://www.stripertracker.org)).

Another project correlated upwelling events with coastal bacterial counts and was completed during the summer of 2007. Data was collected to inform the Monmouth County Department of

Health on coastal ocean water quality and episodic upwelling events. This project took advantage of the IMCS Cool Room Codar datasets to monitor upwelling events.

### **2. Future Planned or Proposed Projects**

The JC NERR plans to support the broad goals of IOOS whenever possible by leveraging existing research programs (i.e. SWMP) and actively searching for new collaborations and research opportunities that fall within the IOOS purview. Examples listed below have been formally planned (already funded or proposed).

A real-time remote video/camera system linked to a GPS system is planned for installation on a NJ DEP airplane. This airplane will then make daily monitoring flights up and down the NJ coastline. This camera system will be controlled remotely, via cellular internet connection, allowing remote data collection and downloading. Potential uses for this camera system include marine floatable detection, forest fire identification, seagrass habitat mapping, brown tide bloom mapping, and any other event based data needs.

Another project proposes to address the movement of several commercial important fish species using acoustic tags and associated hydrophones co-located with SWMP data loggers. The research aims to 1) determine the patterns of timing, extent, and rate of migration for fishes, and 2) determine how these patterns for individual species are influenced by natural and anthropogenic variables, as measured by environmental variables in estuarine inlets and bays.

JC NERR staff plans to use the geospatial sciences to advance understanding of both natural and anthropogenic phenomena, provide training and technical expertise to our project partners. To accomplish these tasks we are actively seeking out partners and proposals to conduct research and outreach. Some future issues targeted for work include storm water basin mapping, land use and land cover change, habitat mapping, hazard mitigation, eutrophication, harmful algal blooms, priority land preservation and seagrass habitat mapping. LiDAR data collection has been identified as a key data gap for several New Jersey coastal regions including both Atlantic and Ocean Counties. JC NERR staff has taken the lead to collect LiDAR data for these coastal areas in partnership with the USGS, NJDEP, USFWS, and Ocean County Planning Department.

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# **Appendix A**

## **JC NERR Site Profile**



**CHARACTERIZATION OF THE JACQUES COUSTEAU  
NATIONAL ESTUARINE RESEARCH RESERVE**

**A Profile Report**

**Jacques Cousteau National Estuarine Research Reserve**

**130 Great Bay Boulevard**

**Tuckerton, New Jersey 08087**

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## **EXECUTIVE SUMMARY**

The Jacques Cousteau National Estuarine Research Reserve (JCNERR) is one of the 27 national estuarine reserves created to promote the responsible use and management of the nation's estuaries through a program combining scientific research, education, and stewardship (Figure 1). The JCNERR, which lies on the gently sloping Atlantic Coastal Plain of New Jersey, is the 22<sup>nd</sup> program site of the National Estuarine Research Reserve System (NERRS), having been officially dedicated on October 20, 1997. It consists of more than 45,000 ha of aesthetic upland, wetland, and open water habitats. The Mullica River watershed is a concentrated patchwork of federal and state lands managed in partnership through a variety of agencies. These land areas are remarkably pristine largely because of the federally protected New Jersey Pinelands, state and federal managed lands surrounding the coastal bays, and only 553 ha of developed landscape (< 2% of the total area). Most of the land of the JCNERR is in public ownership.

Upland vegetation in the JCNERR consists of pine-oak forests which are replaced seaward by freshwater-, brackish-, and salt (*Spartina*) marshes. Marsh habitat covers more than 13,000 ha (> 28%) of the reserve. JCNERR habitats generally exhibit excellent environmental quality, although Little Egg Harbor and Barnegat Bay waters have been identified as highly eutrophic. The JCNERR's mission is consistent with that of the NERRS, that is, to preserve areas that retain a healthy ecosystem and provide the opportunity to serve the needs of long-term research and monitoring programs.

Rich and diverse plant and animal communities inhabit watershed areas of the JCNERR. For example, 275 species of macroinvertebrates, 91 species of fish, and 350 species of algae have been documented in inland habitats of the Mullica River and its

tributaries. Watershed habitats support many species of shorebirds, wading birds, waterfowl, raptors, and songbirds. Amphibians, reptiles, and land mammals also utilize wetlands, riparian buffer, and upland habitats of the JCNERR and the contiguous pinelands.

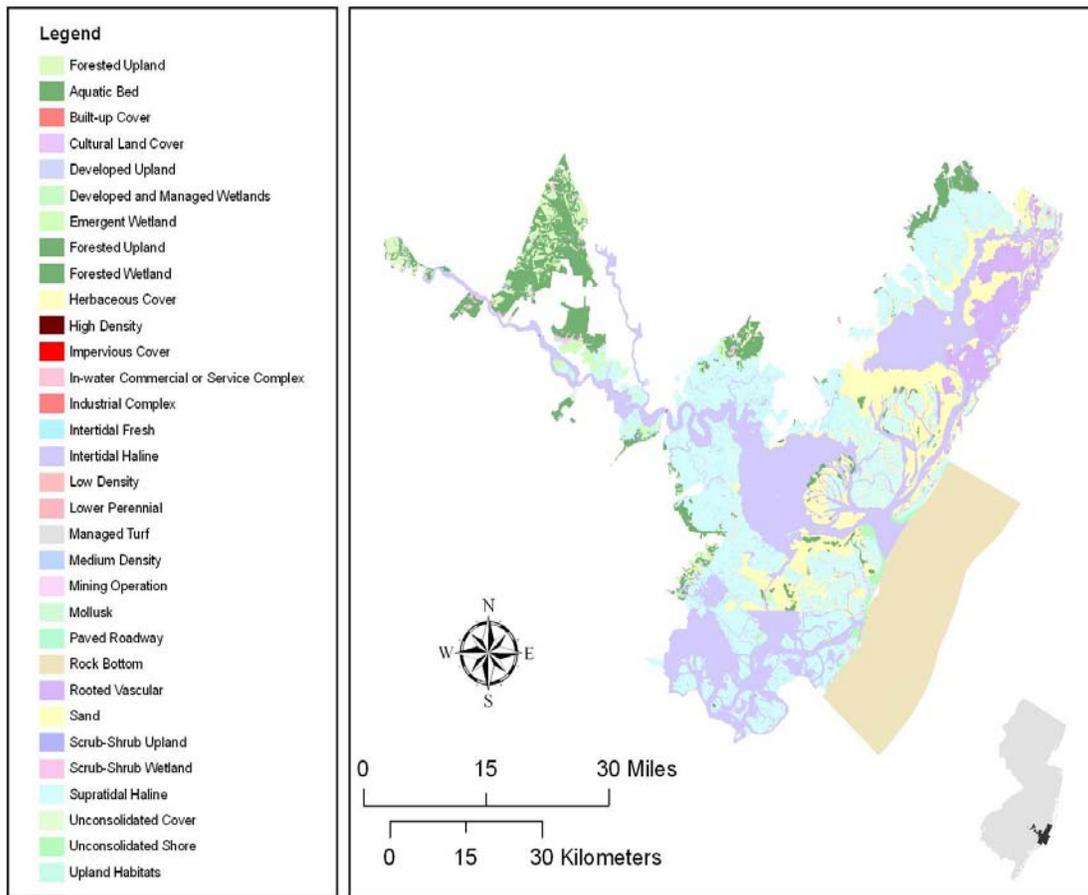


Figure 1. Map showing the location and habitats of the Jacques Cousteau National Estuarine Research Reserve (highlighted areas/Legend). Lower right: location of the JCNERR with respect to the state of New Jersey.

A wide range of aquatic habitats exists in the JCNERR, the most extensive of which consists of open waters covering more than 27,000 ha (Figure 1). Occurring within the unique New Jersey Pinelands forest ecosystem, the Mullica River-Great Bay Estuary is of special ecological value. Other open waters of the system include Little Egg Harbor, lower Barnegat Bay, Little Bay, Reeds Bay, and Absecon Bay to the south. These estuarine waters support numerous planktonic, nektonic, and benthic organisms. A number of finfish (e.g., bluefish, *Brevoortia tyrannus*; weakfish, *Cynoscion regalis*; summer flounder, *Paralichthys dentatus*; and winter flounder, *Pseudopleuronectes americanus*) and shellfish (e.g., blue crabs, *Callinectes sapidus* and hard clams, *Mercenaria mercenaria*) species are of recreational and commercial importance.

Submerged aquatic vegetation (SAV) forms critically important habitat in the coastal bays of the JCNERR. SAV, notably eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*), are found in lower Barnegat Bay



and Little Egg Harbor. Seagrasses provide vital ecosystem services in the coastal bays, generating considerable primary production, supporting numerous benthic invertebrate populations, and comprising important spawning, nursery, and feeding grounds for an array of finfish species. Some fish (e.g., Acanthuridae and Scaridae), turtles, waterfowl (e.g., American brant, canvasbacks, and green-winged teal) and sea urchins consume SAV. In addition, these vascular plants baffle waves and currents and mitigate substrate

erosion, thereby stabilizing bottom sediments. Eelgrass and widgeon grass are confined to the Barnegat Bay-Little Egg Harbor Estuary. In Great Bay and coastal bays to Absecon Bay, benthic macroalgae (e.g., *Ulva lactuca* and *Enteromorpha* spp.) proliferate, but seagrass is essentially absent due to elevated turbidity.

Eutrophication is an escalating problem in the coastal bays of New Jersey (Kennish and Townsend, 2007). The Barnegat Bay-Little Egg Harbor Estuary has been classified as a highly eutrophic system (Kennish et al, 2007a). Both phytoplankton and benthic algal blooms are becoming more frequent, as evidenced by repeated phytoplankton blooms in the summer months consisting of dinoflagellates, microflagellates, ultraplankton, and pelagophytes, as well as serious macroalgal blooms consisting of sea lettuce and other nuisance forms (Kennish et al., 2008). Picoplankton blooms commonly occur in the estuary, being dominated by *Nannochloris atomus* and *Aureococcus anophagefferens*. During bloom events, the phytoplankton cell counts often exceed  $10^6$  cells/ml. Brown tides composed of *A. anophagefferens* have been most intense and widespread in Little Egg Harbor, but they have also been documented in Barnegat Bay and Great Bay (Olsen

and Mahoney, 2001). These phytoplankton blooms are problematic because they cause a brownish water discoloration and shading effects that can be detrimental to SAV.



Nutrient enrichment fuels rapid phytoplankton growth in the summer months. Phytoplankton productivity in JCNERR coastal bays rivals or exceeds that of many other coastal bays in the U.S. and abroad (Seitzinger et al., 2001; Kennish et al., 2007a). Phytoplankton directly supports zooplankton and benthic invertebrate populations in the bays. Calanoid and harpacticoid copepods are major components of the zooplankton community in JCNERR estuaries. Meroplankton and ichthyoplankton are also important constituents and provide forage for benthic invertebrate and finfish populations.

The benthic invertebrate community is well represented in estuarine waters of the JCNERR. More than 150 benthic invertebrate species have been recorded in Great Bay, and more than 200 benthic invertebrate species, in the Barnegat Bay-Little Egg Harbor Estuary. The composition of bottom sediments, particularly the grain size, strongly influences the distribution and abundance of the benthic organisms. The amount of silt and clay is significant in this regard.

Finfish assemblages are abundant in estuarine waters of the system, especially during the warmer seasons of the year. These assemblages can be divided into several major finfish groups, specifically resident species, warm-water migrants, cool-water migrants, and stray species. Forage species, such as the bay anchovy (*Anchoa mitchilli*) and Atlantic silverside (*Menidia menidia*), typically dominate in numerical abundance. The occurrence and abundance of finfish populations in the JCNERR estuaries are highly variable due to seasonal migrations and the reproductive flux by seasonal and year-round residents. Annual variations in abundance of finfish populations commonly range from 50-100%. Many species found in the estuaries exhibit a clear preference for specific habitats (e.g., tidal creeks, eelgrass beds, and deep channels). Surveys conducted in these

systems by various investigators have revealed the significance of myriad habitats to the success of fishery resources in the JCNERR.

A comprehensive list of threatened and endangered species has been compiled for the Mullica River watershed and surrounding areas. This list includes a diversity of plants, amphibians, reptiles, mammals, birds, fish, and insects. These designations underscore the need to protect the environment of the JCNERR from habitat loss and alteration, over-exploitation, disturbance, contamination, and other anthropogenic impacts.

Waters of the Barnegat Bay-Little Egg Harbor Estuary are the most problematic within the JCNERR. This estuary is an impaired system both in respect to aquatic life support and human use. The principal cause of these problems is nitrogen over-enrichment mediated primarily by surface runoff from the Barnegat Bay watershed and atmospheric deposition from the overlying airshed.

Nutrient enrichment of the Barnegat Bay-Little Egg Harbor Estuary is closely linked to a series of cascading environmental problems, such as increased growth of phytoplankton and benthic macroalgae (including both harmful and nuisance forms), loss of SAV, and declining shellfish resources (Kennish et al., 2007a). These problems have also led to deterioration of sediment and water quality, loss of biodiversity, and disruption of ecosystem health and function. Human uses of estuarine resources have also been impaired.

Because of serious eutrophication problems in this system, it is important to continue to investigate the dynamics of seagrasses, macroalgae, and phytoplankton in the estuary. In addition, a detailed study of the structure and function of the benthic faunal

community is needed, as well as surveys of shellfish and finfish populations. This information is needed to determine if eutrophic conditions are impacting higher-trophic-level organisms in the estuary.

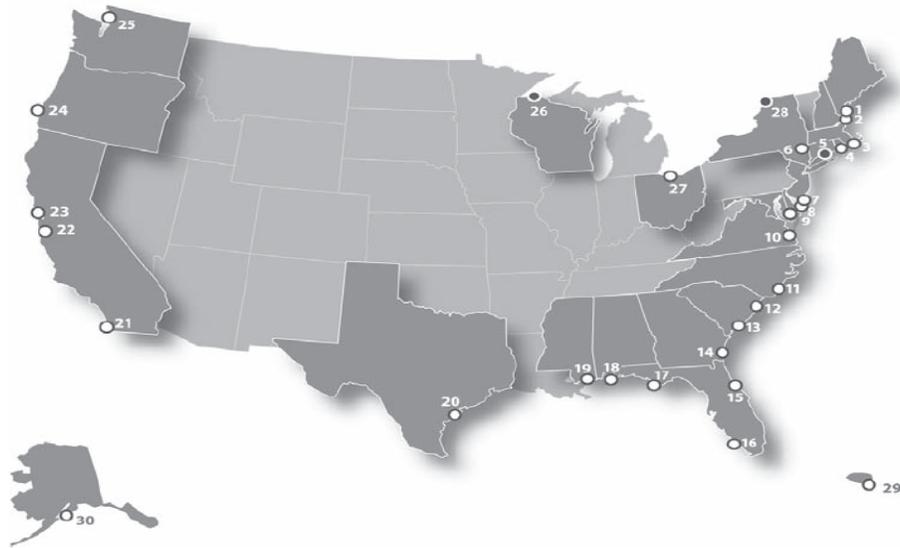
## **INTRODUCTION**

The Coastal Zone Management Act of 1972 established the National Estuarine Research Reserve System (NERRS). The JCNERR and 26 other reserve sites now exist in the United States (Figure 2). Each site is a partnership between NOAA and a coastal state. These 27 reserves form a network of protected areas that have been established to augment the Coastal Zone Management program by providing data needed for effective resource management. Aside from addressing estuarine resource protection issues, the NERRS program generates and disseminates comprehensive environmental databases via system-wide water quality monitoring, instruction within the Coastal Training Program, and graduate research fellowships. Through these elements, the NERRS program serves as a vehicle to improve the health of the nation's estuaries and coastal habitats.

The 27 NERRS sites occur in 22 states and one territory (Puerto Rico). They span 19 biogeographical sub-regions along the coasts of the Atlantic Ocean, Gulf of Mexico, Caribbean Sea, Pacific Ocean, and Great Lakes, and they encompass more than 500,000 ha of coastal habitats. These sites are essentially demonstration sites where monitoring and research data are used to assess coastal issues of local, regional, and national interest for the purpose of sustaining estuarine systems (NERRS, 2006a, 2007). Considerable variation exists among the reserves, with site estuaries ranging from relatively pristine to highly impacted by anthropogenic activity. A major goal of the NERRS is to ensure a

stable environment for research at the reserve sites through long-term protection of resources.

**National Estuarine Research Reserves — *A network of 27 protected areas***



- |  |                                    |
|--|------------------------------------|
| 1. Wells, Maine                            | 16. Rookery Bay, Florida           |
| 2. Great Bay, New Hampshire                | 17. Apalachicola, Florida          |
| 3. Waquoit Bay, Massachusetts              | 18. Weeks Bay, Alabama             |
| 4. Narragansett Bay, Rhode Island          | 19. Grand Bay, Mississippi         |
| 5. Connecticut *                           | 20. Mission-Aransas, Texas         |
| 6. Hudson River, New York                  | 21. Tijuana River, California      |
| 7. Jacques Cousteau, New Jersey            | 22. Elkhorn Slough, California     |
| 8. Delaware                                | 23. San Francisco Bay, California  |
| 9. Chesapeake Bay, Maryland                | 24. South Slough, Oregon           |
| 10. Chesapeake Bay, Virginia               | 25. Padilla Bay, Washington        |
| 11. North Carolina                         | 26. Wisconsin *                    |
| 12. North Inlet-Winyah Bay, South Carolina | 27. Old Woman Creek, Ohio          |
| 13. ACE Basin, South Carolina              | 28. St. Lawrence River, New York * |
| 14. Sapelo Island, Georgia                 | 29. Jobos Bay, Puerto Rico         |
| 15. Guana Tolomato Matanzas, Florida       | 30. Kachemak Bay, Alaska           |

*\* Proposed Reserve*

Figure 2. Location of designated and proposed reserve sites within the National Estuarine Research Reserve System. From the Estuarine Reserves Division, National Oceanic and Atmospheric Administration, Silver Spring, Maryland.

The NERRS also promotes increased public awareness of the importance of estuarine systems. To this end, the program focuses on four priority coastal management issues: (1) land use and population growth; (2) habitat loss and alteration; (3) water quality degradation; and (4) changes in biological communities (NERRS, 2006b). The NERRS 2005-2010 Strategic Plan outlines the strengths of the reserve system, and how it addresses the major challenges of coastal management on local, regional, and national scales. The following goals of the NERRS are outlined in the plan.

1. Strengthen the protection and management of representative estuarine ecosystems to advance estuarine conservation, research, and education.
2. Increase the use of reserve science and sites to address priority coastal management issues.
3. Enhance peoples' ability and willingness to make informed decisions and take responsible actions that affect coastal communities and ecosystems.

## **SYSTEM-WIDE MONITORING PROGRAM**

The NERRS established the System-wide Monitoring Program (SWMP) in 1994 to track physical, chemical, and biological conditions and ecological processes of estuarine ecosystems using system-wide, quality assurance protocols (Wenner et al., 2001; Sanger et al., 2002). Since their inception, the long-term monitoring and iterative habitat assessments conducted within the NERRS program have resulted in comprehensive databases for multiple purposes. Monitoring data serve as a basis for research to enhance fundamental understandings of the temporal and spatial dynamics of

estuarine processes. In addition, the data provide management-relevant information to evaluate changes in the ecosystem in response to natural perturbations and anthropogenic disturbance. Moreover, continued operation of the long-term monitoring effort will yield valuable data to inform user groups of assessments and models of the cumulative effects of environmental stressors in estuarine ecosystems (NERRS, 2007).

As noted above, a major focus of the SWMP is to improve the understanding of estuarine variability associated with both natural processes and anthropogenic activities through measurements of short-term variability and long-term changes in water quality, biotic community structure, aquatic habitat characteristics, and watershed land use and land cover (NERRS, 2007). In this regard, the SWMP initiatives have included efforts to obtain extensive and useful environmental databases. According to the NERRS (2002), some problems that could be targeted by the collection of these comprehensive databases include:

1. Changes in water quality associated with land use change, nutrient loading, or altered freshwater flow;
2. Comparison of natural, altered, and restored habitats; and
3. Correlation of water quality over broad spatial scales with occurrence, density, and distribution of biological resources.

Research and monitoring at the NERRS sites have yielded data on the processes that govern stability and change in estuarine ecosystems. The SWMP anchors research and monitoring efforts at the NERRS sites and ensures the standardization of sampling protocols, which allows reliable comparisons to be made of data collected at the reserve sites. The SWMP consists of three major elements: (1) abiotic monitoring; (2) biotic

monitoring; and (3) land use and habitat change characterizations (NERRS, 2007). Each of these elements contributes long-term data that are valuable for tracking changes in ecosystem features and for assessing relationships between these features to better understand the drivers of the observed changes.

### **Abiotic Monitoring**

Abiotic monitoring focuses on data acquisition of three major SWMP components: (1) water quality; (2) physical conditions; and (3) weather. Baseline data acquisition for these three components provides important contextual information on the physico-chemical



dynamics of an estuary. They also help track changes over time and across space that may be induced by human activities. For example, nutrient enrichment has increased dramatically in estuaries around the country and has become recognized as a significant stressor in many estuarine systems (Kennish and Townsend, 2007). The abiotic monitoring conducted through the SWMP provides important data on nutrient concentrations, on how nutrient concentrations are influenced by physical processes (e.g., precipitation, freshwater inflow, and tidal cycles), and on how they may affect other ecosystem conditions (e.g., chlorophyll *a* and dissolved oxygen). As this example shows, the tracking of abiotic features in the NERRS facilitates greater understanding of

estuarine processes and the factors that influence these processes. It also provides baseline data that guides improved management of estuarine ecosystems.

The SWMP fills an important void for an integrated national program that evaluates the status of marine environmental resources and the trends in estuarine water quality over protracted periods. Therefore, it differs from most existing nationwide monitoring programs which generally monitor estuarine conditions over shorter periods each year. Water quality parameters—temperature, conductivity, pH, dissolved oxygen, turbidity, and water depth—have been monitored within all NERR sites since 1995. Data are gathered using 6-series data sondes from Yellow Springs Instrument Company (YSI™), Yellow Springs, Ohio (YSI 6600 or YSI 6600 EDS models); they are deployed at four primary, long-term stations in each reserve. Each water quality parameter is measured at 15 minute intervals, and data from at least one data sonde per reserve (e.g., Buoy 126 in the JCNERR) are telemetered hourly via satellite to a central receiving station for near real-time use (NERRS, 2007). All data and metadata are archived and made web-available via the Centralized Data Management Office (CDMO) currently located at the North Inlet-Winyah Bay NERR in South Carolina (<http://cdmo.baruch.sc.edu>). The measured parameters track changes in key physico-chemical conditions and are indicative of habitat quality for numerous species. They also document environmental criteria that relate to human health and influence human use of estuarine areas.

Nutrients have been monitored at the data-sonde sites since January 2002. Replicate grab samples are collected monthly; in addition, monthly diel samples are taken at 2.5 h or shorter intervals over a lunar day (24 h: 48 min) at one site using an ISCO

sampler (Teledyne Isco, Inc., Lincoln, Nebraska, USA). All of the NERRS reserve sites gather data on ammonium, nitrate, nitrite, orthophosphate, and chlorophyll *a*. Additional nutrient parameters are measured by some of the reserves (e.g., silica, particulate nitrogen and phosphorus, dissolved total nitrogen and phosphorus, particulate and dissolved carbon, and total suspended solids) (NERRS, 2007). As coastal development and associated eutrophication problems have increased, nutrient monitoring is important for investigating patterns and drivers of change in nutrient concentrations and for devising effective mitigation and remediation strategies (Kennish, 2003; Kennish and Townsend, 2007).

### **Meteorological Monitoring**

Meteorological data are collected year-round through the NERRS SWMP. Monitoring stations are sited at locations typical of natural conditions of each reserve and are installed according to National Weather Service guidelines. The JCNERR collects meteorological data at the Richard Stockton College Marine Field Station at Nacote Creek. The parameters (i.e., air temperature, wind speed and direction, barometric pressure, relative humidity, precipitation, and photosynthetically-available radiation) are



measured every five seconds, with an average or total value output every 15 minutes. Data are telemetered hourly via satellite to a central receiving station for near real-time use (NERRS, 2007). The meteorological monitoring provides valuable contextual data for interpreting water quality implications of short-term weather events and for investigating estuarine responses to longer-term climatic variability. In addition,

understanding links between atmospheric deposition and nutrient loading to estuaries requires accurate meteorological records (Paerl, 1997; Paerl et al., 2002; Gao et al., 2007).

### **Biotic Monitoring**

The SWMP biomonitoring initiatives have yielded data on the species abundance, distribution, and diversity of biotic communities in the NERRS estuarine systems. These initiatives have also been used to track temporal changes in characteristics of the biotic communities. Biomonitoring projects also address specific research questions or management issues, such as the effect of water quality on species distributions or the influence of habitat degradation on the communities. More information on key biomonitoring components of the SWMP can be found in the focus areas of the NERRS Research and Monitoring Plan.

The implementation of the SWMP biomonitoring efforts commenced in 2004, with initial efforts focused on the monitoring of submerged aquatic vegetation (SAV) and emergent vegetation (Moore and Bultuis, 2003). Since that time, baseline data have been collected at most reserve sites to document the occurrence, growth, and spatial distribution of emergent and submerged vegetation. The monitoring of SAV and emergent vegetation is conducted using two approaches. One approach (referred to as Tier I) documents the areal extent and spatial distribution of SAV and emergent vegetation within reserve boundaries at annual or multi-annual time scales. Mapping is conducted using remote sensing, in-situ field surveys, or a combination of these methods as defined in NOAA's Coastal Change Analysis Program and the Chesapeake Bay Program (Dobson et al., 1995; NERRS, 2001). The second approach (referred to as Tier

II) examines the community and vegetative characteristics at permanent sampling stations located along transects within selected stands of SAV and emergent vegetation. It employs the protocols used in other successful monitoring programs (Neckles and Dionne, 2001; Roman et al., 2001; Neckles et al., 2002; Short et al., 2002) and targeted studies (e.g., Haag et al., 2008; Kennish et al., 2008; Moore and Jarvis, 2008). Tier II characterization of local plant communities can yield critically important data on vegetative growth and compositional changes over short- or long-term temporal scales.

As the biomonitoring program is expanded, it will track a suite of ecosystem components to elucidate basic ecological processes in estuaries and to better understand the implications of abiotic and biotic changes at the ecosystem level. Other components to be incorporated into the biomonitoring program include plankton, nekton, benthos, invasive species, and marsh birds (Kennish, 2003; NERRS, 2007). These biotic groups serve ecological roles ranging from primary producers to top-level consumers in the food web. They may also be indicators of disturbance (e.g., nutrient enrichment, habitat alteration, and climate change) and thus are of great interest and concern to coastal managers. As part of the SWMP, consistent protocols will be developed and tested for monitoring these biotic groups across the NERRS. Some of the NERRS sites already conduct site-specific monitoring and research of key indicator organisms.

### **Land Use and Habitat Change Characterizations**

Human settlement and population growth in the coastal zone have significantly altered the landscape of estuarine watersheds via habitat destruction and fragmentation. Secondary effects of landscape change have degraded water quality due to increased

surface water runoff, accelerated loading of nutrients and sediments, and freshwater diversions (Kennish, 2002). The land use and habitat characterization component of the SWMP tracks the magnitude and extent of habitat change and how these changes are linked to watershed land use practices.

To track land use and habitat change, a set of two standard monitoring procedures are applied at relevant scales in each reserve and its surrounding watershed. Through a partnership with NOAA's Coastal Services Center, the NERRS characterizes land cover in each reserve's watershed at moderate resolution (30-m) using data and protocols associated with the Coastal Change Analysis Program (C-CAP) (NERRS, 2001). These products are developed using remotely sensed imagery from which coastal intertidal areas, wetlands, and adjacent uplands are inventoried. Current inventories are maintained, and change analyses are conducted by updating the land cover maps at five-year intervals.

Fine-scale, high resolution habitat mapping and change analyses are conducted within each reserve's boundaries using a standardized classification scheme that incorporates habitat types as well as land use types (Kutcher et al., 2005). This classification structure organizes habitats by their salinity zone, flooding regime, substrate type, and vegetation cover to provide very detailed inventories of resources within each reserve. In most reserves, data for this characterization are derived from aerial photographs or other high-resolution, remotely-sensed images. Extensive ground-truthing ensures high levels of classification accuracy to support sensitive change analyses and trend assessments over time. A habitat classification map for the JCNERR is shown in Figure 1 above.

This component of the SWMP enables investigators to compare the local, regional, and national differences in watershed land use patterns, to understand how these differences influence estuarine habitat quality, and to assess the sensitivity of specific habitat types given land use change patterns. At local levels, these products provide important information needed for effective coastal land use planning and decision-making. They also provide critical data needed to assess specific issues, such as the risk posed to coastal habitats by sea level rise.

### **JACQUES COUSTEAU NATIONAL ESTUARINE RESEARCH RESERVE**

The National Oceanic and Atmospheric Administration (NOAA) officially designated the Jacques Cousteau National Estuarine Research Reserve (JCNERR) as the 22nd National Estuarine Research Reserve System (NERRS) program site on October 20, 1997 in honor of the famous ocean explorer Jacques-Yves Cousteau. The principal mission of the JCNERR program is to conduct long-term scientific research and monitoring to characterize the natural and anthropogenic processes governing change and stability in the reserve, and to provide the data necessary to effectively address coastal management problems. The reserve program also focuses on improving the protection of estuarine resources for designated uses such as public health, recreation, fish and shellfish populations, and support of the estuarine ecosystem. It attempts to enhance public awareness and understanding of estuarine and watershed areas through public education and interpretation.

The Institute of Marine and Coastal Sciences at Rutgers University oversees day-to-day operations of the JCNERR program. Rutgers University has been conducting research within the Mullica River-Great Bay estuarine system since the 1950s. With the acquisition of its marine field station on Great Bay in 1972, the University began collecting extensive data sets on the system. Other agencies and partners of the reserve have also conducted studies on the Mullica River-Great Bay Estuary and surrounding watershed areas. These include the Richard Stockton College of New Jersey, New Jersey Department of Environmental Protection (Division of Fish, Game and Wildlife at Nacote Creek), U.S. Fish and Wildlife Service, the Pinelands Commission, and Tuckerton Seaport.

The JCNERR is unique for several reasons. The Mullica River-Great Bay Estuary exhibits exceptional environmental quality and is generally considered one of the most pristine and least (anthropogenically) impacted systems in the densely populated urban corridor of the northeastern United States. This is largely attributed to the extensive undeveloped lands of the Pinelands National Reserve, state wildlife management areas, and federal reserves surrounding these waters (Figure 1). The Pinelands National Reserve, totaling nearly 450,000 ha, encompasses much of the forested land in the area that is not state-owned land. It restricts future



development (Psuty et al., 1993). Domestic and industrial development in the watershed, therefore, is limited. Encompassing more than 45,000 ha, the JCNERR consists of a wide array of terrestrial, wetland, and aquatic habitats ranging from upland pine-oak forests and hardwood swamps in the alluviated stream valleys of the Pinelands to tidal marshes, barrier islands, and open estuarine and coastal ocean waters. The land habitats are entirely in public ownership, which affords a significant level of resource protection.

Water is the predominant habitat in the JCNERR, covering 27,599 ha (~60% of the area). Marsh blankets an additional 13,034 ha (>28% of the area). Forest cover is the next largest category; it amounts to 4,616 ha (~10% of the area). Developed landscape, which is relatively sparse, provides the least cover (553 ha or slightly over 1% of the area). Domestic development is concentrated in two small communities, Mystic Island and Tuckerton, whose boundaries extend to within 3 km of Great Bay (Psuty et al., 1993).

Fringing wetlands (e.g., freshwater wetlands along the Mullica River, small palustrine (nontidal) wetlands, and *Spartina* salt marshes) and submerged aquatic vegetation (e.g., *Zostera marina* and *Ruppia maritima*)



support numerous organisms, including a number of endangered and threatened species. The marshes also serve as nursery and reproductive habitats, filters of nutrients and contaminants, and agents of flood and erosion control. The most extensive salt marshes

(~33.8 km<sup>2</sup>) occur along the perimeter of Great Bay. The marginal areas of the lower Mullica River are dominated by the smooth cordgrass (*Spartina alterniflora*) in the lower marsh and salt-meadow cordgrass (*S. patens*) in the upper marsh. Freshwater tidal marshes predominate along the tributary streams and headwaters of the Mullica River. A Holocene barrier island complex, which trends northeast-southwest, forms the seaward boundary of much of the reserve. This complex consists of one totally undeveloped barrier island fronting Great Bay, and the undeveloped parts of two other barrier islands (Psuty et al., 1993). Coastal habitats in the system serve as major migratory stopovers and wintering areas for many species of waterfowl, shorebirds, wading birds, raptors, and songbirds.

The boundaries for the JCNERR are designed to constitute a natural ecological unit. They encompass a core area of contiguous wetlands, riparian habitats, open waters in Great Bay, and nearshore ocean areas off Little Egg Inlet. The buffer zone includes upland forested areas adjacent to the core wetland habitats. These boundaries form a highly productive system that supports a rich diversity and high abundance of finfish, shellfish, and wildlife.

Great Bay harbors large concentrations of planktonic, benthic, and nektonic organisms. Biotic resources in the bay are similar to those of the Barnegat Bay-Little Egg Harbor Estuary to the north and the Brigantine Bay and marsh complex to the south. In addition, the Mullica River and its tributaries, notably the Batsto and Wading Rivers, support hundreds of plant and animal species (e.g., 350 species of algae, 62 species of aquatic macrophytes, 275 species of macroinvertebrates, and 91 species of fish) (U.S. Fish and Wildlife Service, 1996).

Scientific investigations in the JCNERR have concentrated on coastal upwelling effects, life history and habitat ecology of fishes, habitat characterization and mapping, shellfish resources, submerged aquatic vegetation, and potential impacts of human



disturbance. Water quality monitoring is another important component of the program. The JCNERR is a vital area of estuarine research, as well as a natural field laboratory, that provides valuable educational opportunities for teachers, students, and other individuals interested in this unique and relatively undisturbed coastal ecosystem. It is ideally suited as a reference site for assessing the modification and recovery of other estuarine systems.

### **Field and Laboratory Facilities**

The Rutgers University Marine Field Station (RUMFS) in Little Egg Harbor Township provides field and laboratory facilities for the JCNERR and



visiting scientists who conduct research and monitoring within reserve waters. It is situated at the end of a peninsula adjacent to Little Egg Inlet and is the site of a former

U.S. Coast Guard Lifesaving Station. RUMFS provides access to the New Jersey continental shelf and the Mullica River-Great Bay Estuary. RUMFS resources include the R/V CALETA, a 28 ft. aluminum hull research vessel, equipped with an A-frame and winches and a 48 ft. research vessel, the R/V ARABELLA, equipped with an A-frame, GPS navigation system, lab facilities, and mast-mounted wind sensors. JCNERR's boat, a 23' Carolina Skiff (R/V THE MULLICA EXPLORER) is docked at RUMFS. Several other small boats, docking facilities for larger vessels, analytical laboratories, a running seawater lab, dark room, dive locker, and a 20-bed dormitory and a classroom are also available. This field station serves as the shore base for the Rutgers' Long-term Ecosystem Observatory at 15 meters on the continental shelf (LEO-15), a component of the JCNERR. Research activities focus on fishery-related investigations including recruitment of marine organisms, early life history studies, and studies of sediment transport on the continental shelf. From 1957 to 1986, measurements of nutrient concentrations, productivity and basic physical parameters were made in the watershed and continue in partnership with the JCNERR.

A rail system connecting the dock to a service bay exists at RUMFS for servicing research vessels and oceanographic equipment. There is also additional dormitory/office/storage complex a short distance from the main laboratory. Recently, funds were



awarded from NOAA/NERRS to renovate and expand laboratory space at RUMFS for use by JCNERR investigators. This renovation added much needed capacity to handle and analyze field samples, and improve space required to support the SWMP. The JCNERR Education Center also has dormitory facilities for visiting scientists and students who conduct research within the reserve boundaries.

## **JCNERR Outreach and Education Programs**

### **Coastal Training Program**

The JCNERR Coastal Training Program (CTP) offers a variety of training programs, resources and outreach materials for New Jersey's coastal management community. The JCNERR has enhanced informed decision-making on coastal issues by transferring technical information to audiences that influence management of coastal resources. In 2006, the JCNERR CTP updated its strategic planning. Prior to 2003, the JCNERR hosted a variety of coastal decision maker workshops as noted below.

### **Small Motorized Watercraft Workshop 2000**

The JCNERR hosted science and management workshops to provide scientific research on the impacts of small motorized watercraft to habitats, living



resources, chemistry, and water quality. On November 7 and 8, 2000, at the Impacts of Motorized Boats on Shallow Water Systems workshop, speakers throughout the country presented research results and management strategies on small motorized watercraft. A

second workshop convened on December 12 and 13, 2000 delivered successful management approaches from state, county, and local governments.

### **Stormwater Management Roundtables**

Chaired by the JCNERR CTP, the Barnegat Bay Phase II Steering Committee has been conducting Phase II Stormwater outreach and offering technical assistance for the past five years. These efforts have been concentrated in the Barnegat Bay watershed which consists of 34 municipalities in Ocean County and 4 municipalities in Monmouth County. During this time, 10 workshops/technical assistance opportunities have been offered to municipal staff, and elected and appointed officials within the watershed.

Evaluation results showed an increased understanding of stormwater management topics that have enabled municipalities within the Barnegat Bay watershed to take the necessary steps to ensure compliance with their permits. A full evaluation of the stormwater outreach was conducted in spring 2007. These results can be found online at: [www.JCNERR.org/coastal\\_training](http://www.JCNERR.org/coastal_training).

### **Coastal Hazards Mitigation Outreach**

The JCNERR, in partnership with the New Jersey State Police, Office of Emergency Management Services, Federal Emergency Management Agency (FEMA), and the New Jersey Department of Environmental Protection, offered a CTP workshop on developing hazard mitigation plans for coastal municipalities. In light of hurricane Katrina and other recent coastal disasters, this workshop was created to meet the growing concerns of coastal municipalities regarding impacts of coastal storms.

As a follow-on program, the CTP offered a technical assistance seminar in the computer classroom at the JCNERR Coastal Center. A FEMA official demonstrated the use of an electronic hazard mitigation toolkit. Participants working in county-specific groups from Ocean, Monmouth and Essex counties gained hands-on experience with the toolkit and discussed preparation of mitigation plans. An outcome resulting from these outreach sessions included an agreement between all 34 municipalities in Ocean County to work cooperatively on a multi-jurisdictional hazard mitigation plan.

### **Project Power**

The JCNERR offered a workshop on “Protecting Our Wetlands through Education and Regulations” (PROJECT POWER) in partnership with the staff of the New York Aquarium and the NJDEP Division of Land Use Regulations and the Coastal and Estuarine Land Use Compliance. A grant from the EPA enabled the New York Aquarium to partner with various educational associations throughout the coastal zone to deliver these workshops. A local workshop was delivered to local realtors and past wetland regulation violators. Presentations focused on the ecological and functional importance of wetlands, the NJDEP freshwater and coastal wetland regulations, and compliance and enforcement issues.

### **Adopt-A-Storm Drain Municipal Assistance**

The JCNERR CTP, in partnership with the Barnegat Bay National Estuary Program, implemented an Adopt-a-Storm-Drain program in three towns within the watershed in 2007. A flyer was developed to promote the program to all residents.

Towns adopting the program received GPS units and training on how to mark and map their storm drain inlets, individualized database programs for maintenance of storm drain adoption records, and personalized storm drain labels.

### **Online Outreach Training Courses**

In order to maintain their licenses, local construction code officials are required to continue education through the New Jersey Department of Community Affairs (DCA). In August 2006, needs assessment construction code officials identified land use regulations as a highly desired topic for additional technical training. The online course was offered through the JCNERR CTP website ([www.JCNERR.org/coastal\\_training](http://www.JCNERR.org/coastal_training)). The five-week course was divided into five modules which included information pertaining to waterfront development, CAFRA, coastal and freshwater wetlands, stream encroachment and tidelands, and map and data miner webquest. As a result of the success of this course, four additional sessions have been offered.

Based on the success of the Land Use Regulations Online Course and the results of the 2006 needs assessment, a second online course was developed and offered in March 2007. This course covered the floodplain regulations and construction standards. In addition to construction code officials, this course was offered to state floodplain managers. The modules included an overview, and information pertaining to forces of floods on buildings, floodplain mapping, design and construction standards, and administration of a local floodplain program.

The JCNERR, in partnership with the NJDEP, also developed a day-long workshop to provide the most current and relevant scientific data regarding submerged

aquatic vegetation (SAV) to staff of the NJDEP's Land Use Regulations and Enforcement Department. Hosted at Island Beach State Park, the workshop highlighted the importance of SAV as a habitat, its biology and the major impacts affecting SAV. An update was given on the current state of knowledge on the restoration of SAV. Overviews of GIS products available for mapping SAV were provided by the Center for Remote Sensing Spatial Analysis (CRSSA) of Rutgers University. An explanation of a scientific model to predict SAV habitat and the techniques on evaluating SAV habitat in the winter were also presented. Participants went on a field trip to SAV habitats in Island Beach State Park.



### **K-12 Education**

The education program of the JCNERR uses state-of-the-art science and technological assets to develop innovative education programs and products that meet the educational needs of K-12 educators and their students. Elements of these programs are extended to the general public or watershed community, most notably individuals likely to visit partner institutions such as the Cape May Nature Center, Tuckerton Seaport, and Forsythe Refuge. Education programs offered as part of outreach initiatives at the Tuckerton Seaport and other partner institutions provide vital information on water quality conditions, habitats, and biotic resources in the JCNERR.

### **Marine Activities, Resources and Education (MARE)**

In 1994, Rutgers' Institute of Marine and Coastal Sciences adopted an interdisciplinary K-8 marine science curriculum called the Marine Activities Resources and Education (MARE) program which now serves as a valuable source of information and inspiration for creative, hands-on teaching. This interdisciplinary, whole-school program engages teachers, students, parents, administrators and the community in the transformation of elementary and middle schools into dynamic laboratories for the study of the ocean. The program, created in 1991 by the Lawrence Hall of Science at the University of California at Berkeley, has been successfully implemented in hundreds of inland and coastal schools nationally. MARE is especially designed to improve science instruction for all students while promoting equity, language acquisition, environmental awareness, and academic excellence.

The MARE program has achieved the following results since its inception in New Jersey in 1994: (1) approximately 3,650 educators have been directly trained as Leadership Teams through the annual six-day



MARE Summer Institute; (2) approximately 12,000 K-6 educators have received training or have become involved in the program through turn-key training opportunities

conducted by Summer Institute participants or MARE Master Trainers; (3) approximately 150 Ocean Week Celebrations have been conducted in elementary schools throughout the state; (4) dozens of student field trips associated with the MARE program have been supported; and (5) more than 20 pedagogical workshops and collaborative projects, including “Bay Grasses for Classes” and the Tidal Marsh Assessment Protocol (TMAP) project have been conducted.

### **COOL Classroom**

The JCNERR education staff, with support from the National Ocean Partnership Program (NOPP) and the help of a group of scientists, technicians, school administrators, and educators, developed a series of instructional modules for use on the Internet known as the Coastal Ocean Observation Laboratory (COOL) Classroom ([www.coolclassroom.org](http://www.coolclassroom.org)). These modules are designed to capitalize on the technology and data associated with the New Jersey Shelf Observing System to develop critical thinking and analytical skills among middle and high school students. Using the modules, students participate in the same predictive process used by scientists through the comprehension of basic scientific principles as applied to marine science, accessing real-time oceanographic data, analyzing data patterns and trends, and predicting ocean conditions.

The COOL Classroom site began as a series of professional development workshops in 1998 and 1999, where educators learned about the data and technologies associated with the research of the NJSOS. Participants helped to develop several online lesson plans over the two-year period, and a basic web site was developed to host the lessons. Evaluation results from the workshops in 1998-99 indicated that participants

were more comfortable with integrating technology into their lesson plans following the training, but were less comfortable with using real-time scientific data with their students.

In 1999, additional support was secured from NOPP and an advanced web site was developed through a collaboration of educators, scientists and the JCNERR education staff. The COOL Classroom site was formally launched in an advanced draft state in the spring of 2002, and has since been piloted twice with classroom educators. The latest pilot, involving 20 educators from around the country, was completed during April – June 2003. The COOL Classroom site continues to be improved and updated. The launch of a newly improved COOL Classroom website is scheduled for summer 2008.

### **Shore Bowl**

Since 2000, the JCNERR has engaged high school students in the study of coastal and ocean sciences through the Shore Bowl, a high school academic competition focused on ocean-related topics. These topics include the biology, chemistry, physics, and geology of the oceans, as well as navigation, geography, and related history and literature. The Shore Bowl is one of 23 regional competitions that comprise the National Ocean Sciences Bowl, sponsored by the Consortium for Oceanographic Research and Education (CORE). Each year, the Shore Bowl provides the opportunity for up to 16 teams to compete for a variety of prizes and awards, including the right to compete in the national competition.

### **National Estuaries Day**

On behalf of National Estuaries Day, the JCNERR has conducted programs to engage the local citizenry in a better understanding of their estuarine resources, as well as the mission and programs of the reserve. National Estuaries Day is an interagency campaign to celebrate the importance of estuaries and the need to protect them. Local communities across the country celebrate their estuaries with a variety of special events, many of which are hosted by reserves within the NERRS.

The JCNERR has gone beyond a local celebration of National Estuaries Day by participating in EstuaryLive, a series of live Internet video broadcasts from several reserves and National Estuary Program sites around the country. The live field trips are available to educators, students, and the public via any computer with an Internet connection, and participants can interact with on-camera personalities in real time via e-mail. The JCNERR participated in the live broadcasts of the event each fall from 2001 to 2005 involving scientists, educators, and students.

### **Graduate Research Fellowship Program**

The JCNERR Graduate Research Fellowship (GRF) program provides graduate students with an opportunity to conduct research of local and national significance that focuses on enhancing coastal zone management. Fellows conduct their research at a NERRS site and gain hands-on experience by participating in their host reserve's research and monitoring programs. GRF projects are based on a reserve's local needs, the NERRS national priorities, and the student's interest.

Since 1999, the JCNERR has supported the research and education activities of 11 GRFs (Appendix 1). The research projects of the GRFs have involved studies in the coastal watersheds of the reserve (Mullica River and Barnegat Bay watersheds) as well as the estuarine waterbodies themselves



(notably the Mullica River-Great Bay Estuary and Barnegat Bay-Little Egg Harbor Estuary). The projects have included the application of land use change models, nutrient biogeochemistry, the investigation of fish species dynamics and habitat use, fish larval occurrence and abundance, decapod crustacean abundance and diversity, and seagrass epiphytic biomass.

### **JCNERR CHARACTERISTICS**

The JCNERR is located in southeastern New Jersey (~39°N, 74°W) approximately 15 km north of Atlantic City. It lies astride the Pinelands forest ecosystem on the Atlantic Coastal Plain and the Pleistocene and Holocene barrier island complexes of the coastal margin. The geographic scope includes a part of the Mullica River drainage basin (Figure 3). It also encompasses lower Barnegat Bay, Little Egg Harbor, Great Bay, and inland back-bays (e.g., Little Bay, Reeds Bay, and Absecon Bay) as far south as Absecon. The downstream boundary extends about 9 km onto the adjacent inner continental shelf to the area of the Long-Term Ecosystem Observatory (LEO-15), a 2.8

km<sup>2</sup> offshore research site of Rutgers University. LEO-15 is located at a shallow (~15 m deep) sand ridge (Beach Haven Ridge at 39°8'18"N, 74°15'10"W) measuring about 4.5 km long and 1 km wide on the inner continental shelf off Little Egg Inlet.

## Physical-Chemical Characteristics

### Estuary/Watershed

The Great Bay-Little Egg Harbor estuarine complex, which occurs in the central portion of the Mid-Atlantic Bight, consists of shallow, polyhaline embayments bordered

by more than 280 km of shoreline, as well as extensive salt marshes. Great Bay covers an area of 41.6 km<sup>2</sup>, and Little Egg Harbor, an area of ~125 km<sup>2</sup>. These coastal bays are shallow microtidal systems (tidal range < 0.5-1 m in Little Egg Harbor and > 1 m near the mouth of Great Bay) with an average depth of < 2 m at mean low water

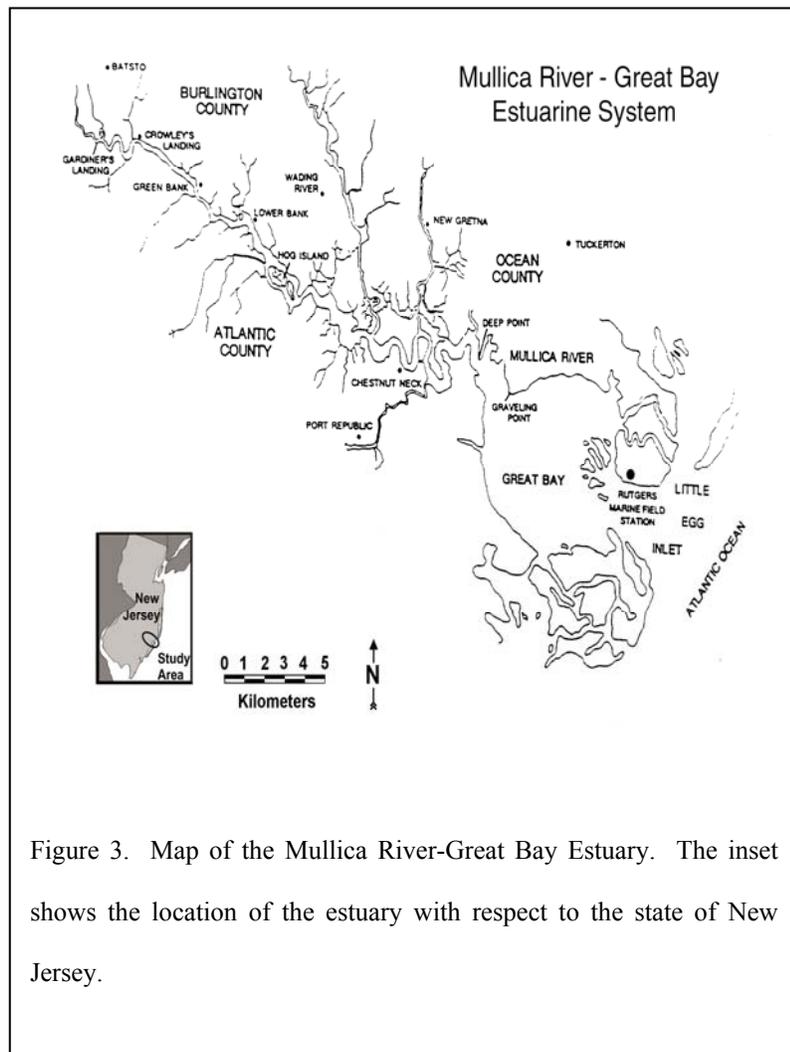


Figure 3. Map of the Mullica River-Great Bay Estuary. The inset shows the location of the estuary with respect to the state of New Jersey.

(Chizmadia et al., 1984; Durand, 1984). Because of their shallow depths, both systems respond relatively rapidly to air temperature changes; thus, they are characterized by a broad annual temperature range (~2 to 30°C). Salinity in the embayments ranges from ~10- to 32‰ (Szedlmayer and Able, 1996).

Most land areas surrounding the Mullica River, Great Bay, Little Egg Harbor, and lower Barnegat Bay systems are managed by state and federal government agencies which minimize adverse anthropogenic impacts. Among the state-owned lands are the following: Absecon Wildlife Management Area, Great Bay Boulevard Wildlife Management Area, Port Republic Wildlife Management Area, Swan Bay Wildlife Management Area, Clarks Landing State Natural Lands Trust, Kinslow Preserve, Mystic Island State Natural Lands Trust, Bass River State Forest, Wharton State Forest, North Brigantine State Natural Area, Absegami State Natural Area, and Great Bay State Natural Area. Federal-owned and managed lands include the Brigantine National Wildlife Refuge and the Barnegat National Wildlife Refuge. The upper part of the Mullica River-Great Bay drainage basin also lies in the pristine Pinelands National Reserve which affords a considerable degree of protection from anthropogenic environmental alteration (Good and Good, 1984; Able et al., 1996). The Pinelands Management Area encompasses ~75% of the Mullica River watershed, and most of the watershed remains in public ownership. Underwater lands of the Mullica River-Great Bay Estuary are all state owned.

## Climate

A number of weather stations collect meteorological data in the region. The National Weather Service at Pomona (~16 km west of Atlantic City; elevation 19.5 m) monitors weather conditions 24 hours a day and has a comprehensive meteorological database dating back to 1943. Other official National Weather Service observation sites maintained in the Pine Barrens include Belleplaine State Forest (9.1 m elevation), Chatsworth (30.5 m), Hammonton (25.9 m), Indian Mills (30.5 m), Lakehurst Naval Air Station (39.0 m), Mays Landing (6.1 m), McGuire Air Force Base (43.6 m), Pemberton (24.4 m), and Toms River (3.0 m) (Havens, 1998). More locally, the Oyster Creek Nuclear Generation Station, located in the Barnegat Bay watershed at Forked River, has collected meteorological data since 1966. The U.S. Coast Guard Station on Long Beach Island at Barnegat Light also collects meteorological data, as does the Rutgers University Marine Field Station at the terminus of the Great Bay Boulevard Wildlife Management Area. Finally, a Campbell Scientific Weather Station operated by the Richard Stockton College in partnership with the JCNERR records meteorological data near Nacote Creek as part of the NERRS System-wide Monitoring Program.

Havens (1998) has reviewed the climate in the region. The JCNERR is characterized by temperate conditions typical of the Mid-Atlantic region. The seasons are well defined; however, seasonal air temperatures vary considerably from year to year as in other temperate systems. The coldest temperatures occur during January, and the warmest temperatures, during July. While the average winter temperature ranges from 0-2.2°C, the average summer temperature ranges from 22-24°C. The Atlantic Ocean moderates seasonal air temperature extremes in the lower drainage basin and open

estuarine areas. Farther inland away from the influence of the ocean, temperature extremes can be great. For example, winter temperatures less than -20°C have been recorded in the Pine Barrens region, with summer temperatures occasionally exceeding 38°C.

Winds predominate from the northwest and southwest during the year (Figure 4). The prevailing winds from the December through March period are from the northwest. Southerly onshore winds dominate in the late spring and summer. Wind velocities are generally less than 15 km/hr. Warm tropical air masses from the south and southwest bring hot, humid weather conditions during summer. Afternoon sea breezes reduce summer temperatures within 10-15 km of the shoreline.

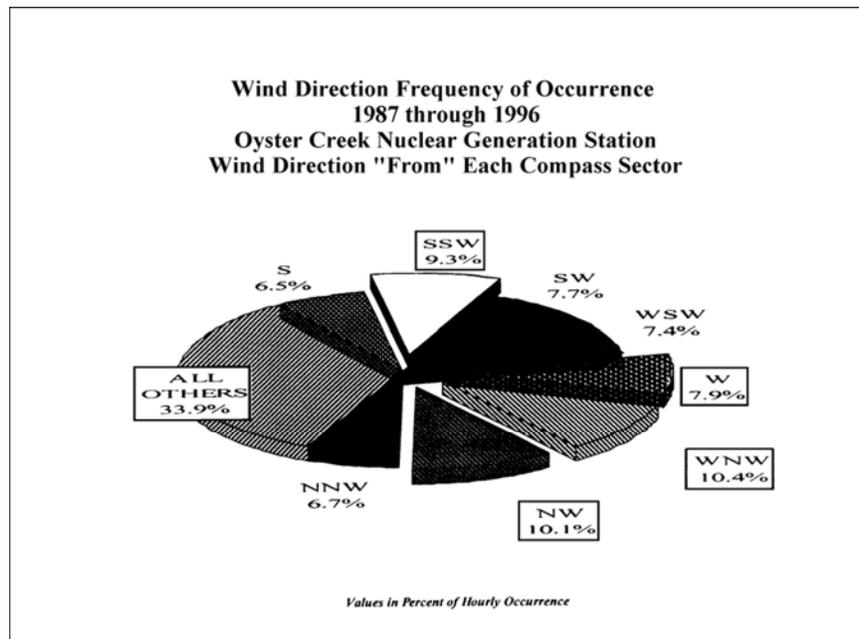


Figure 4. Wind direction frequency of occurrence recorded at the Oyster Creek Nuclear Generating Station during the 1987 to 1996 period. From Kennish, M. J. (ed.). 2001a. Characterization Report of the Barnegat Bay-Little Egg Harbor Estuary and Watershed. Technical Report Submitted to the Barnegat Bay Estuary Program, Toms River, New Jersey. 1,100 p.

Northwesterly winds in winter develop from high pressure areas with very cold air masses over central Canada and the northern Great Plains of the United States. Periodic surges of cold air masses flow southeastward across the eastern United States, and they affect the study area. The frequency of these cold air surges diminishes through the spring, as the jet stream retreats northward, ultimately being replaced in summer by warm and humid southerly breezes originating from a large, subtropical high pressure area (a semi-permanent feature) centered near Bermuda in the Atlantic Ocean (i.e., Bermuda high). More quiescent weather conditions typically arise in the fall in association with stationary or slow-moving, high pressure areas which originate as cold, shallow highs over Canada and stagnate over the eastern United States as warm highs (Havens, 1998).

Precipitation, mainly in the form of rain, averages between 100-122 cm/yr in the region. It is relatively evenly distributed year-round. Northeasters commonly deliver large amounts of precipitation in the winter, with thunderstorms caused by localized convection frequently observed during the summer and early fall. The thunderstorms are generally of high intensity and short duration. Northeasters typically develop in waters off the southeast coast of the United States and move north and northeast producing strong winds, heavy surf, and occasional tidal flooding. Extratropical storms and hurricanes arise during late summer and early fall, although they often pass east of the reserve. These storms can also generate destructive winds and considerable precipitation (e.g., 10 cm or more) that occasionally cause serious flooding problems, soil erosion, and structural damage.

The Gulf Stream plays a vital role in the development of northeasters. This northward flowing, warm-water current parallels the eastern seaboard, heating the overlying air and creating a front along the coast. Subsequently, surface low pressure systems can form as jet stream disturbances move over this newly formed temperature gradient. Heavy rains and strong winds often ensue because of the large amount of moisture from the ocean and the aforementioned temperature gradient of the coastal front. Strong winds from the east and northeast associated with these storms may cause barrier beach erosion, overwashes, and back-bay flooding. In severe storms, wind gusts have exceeded 90 km/hr, and sustained winds, 80 km/hr. During any given calendar year, three-to-five coastal storms typically occur in the region, with the most severe storms observed in the fall.

### **Geology**

The Mullica River watershed lies within the Atlantic Coastal Plain, which formed during the last 170-200 million years by depositional and erosional processes (Figure 5). In New Jersey, the coastal plain



covers ~10,500 km<sup>2</sup> and is underlain by a thick wedge (400-1,830 m) of unconsolidated clays, silts, sands, green sands, and marls deposited during the past 135 million years in response to multiple sea level changes and associated transgressive and regressive sequences. These sediments comprise at least 15 geologic formations predominantly of Cretaceous and Tertiary Age. The Raritan Formation (lower Cretaceous Age) lies at the bottom of the wedge, and the Kirkwood and Cohansey Formations of Tertiary (Miocene)

Age (overlain by a thin veneer of Quaternary deposits) occur at the top (Table 1). The wedge of sediments thickens eastward (seaward), exceeding 1,900 m in southern Cape May County (Zapeczka, 1989). The alternating layers of clay, silt, sand, and gravel characterizing coastal plain sediments trend northeast-southwest and dip gently eastward at ~2 m/km (New Jersey Geological Survey, 1996). Most sedimentary strata underlying the Atlantic Coastal Plain have formed by deposition in deltaic and shallow marine environments.

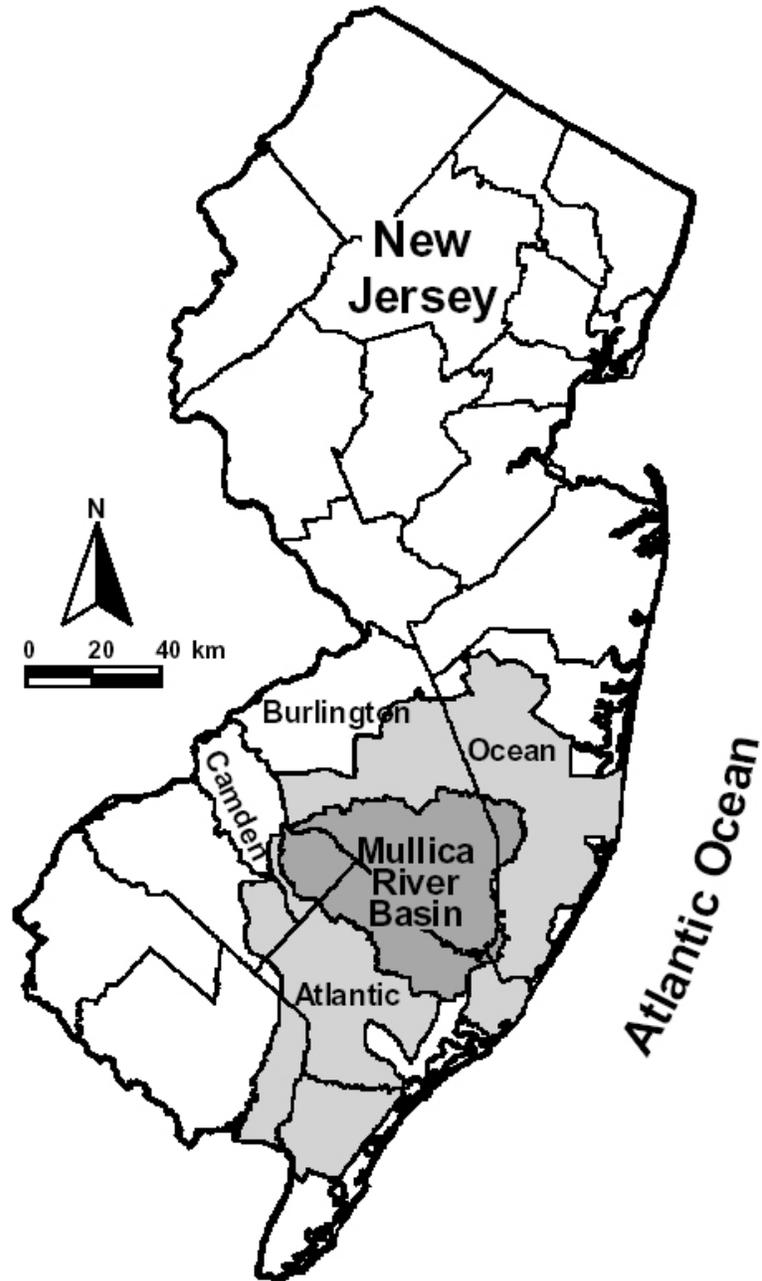


Figure 5. Map illustrating the regional location of the Mullica River Basin. From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

Table 1. Upper strata of the New Jersey coastal plain.

| Time and age  | Lithology  | Thickness (m)                     |
|---|--|-----------------------------------|
| Quaternary<br>Holocene<br>(0.01)                      | Clay, silt, sand, bog iron, and peat   | 0-3                               |
| Pleistocene<br>(1.8)                                  | Clay, silt, sand, and gravel   | 0-37                              |
| Tertiary<br>Pliocene (?)<br>(5)<br>and<br>Miocene (?) | Gravel, sand, and silt; some sand beds<br>are hardened with iron oxide             | 0-6<br>0-21                       |
| Miocene<br>(22.5)                                     | Sand and Gravel<br>Sand with gravel, silt, and clay<br>Clay, silt, sand and gravel | 0-6, usually <3<br>8-61<br>15-137 |

From Rhodehamel, E. C. 1998a. Geology of the Pine Barrens in New Jersey. In: R. T. T. Forman (ed.), *Pine Barrens: Ecosystems and Landscape*. Rutgers University Press, New Brunswick, New Jersey, pp. 39-60.

Geological characteristics of the Pinelands, specifically low relief, sandy, droughty soils underlain by water-bearing sandy layers and confining clay layers, provide a unique surface and ground water system (Markley, 1998; Zampella and Bunnell, 2000; Zampella et al., 2001). The Kirkwood and Cohansey Formations are the principal aquifers in the region, with ground water seepage from the Cohansey aquifer providing inflow (base flow) to the regional stream system. They contain an estimated 65 trillion liters of freshwater. Overlying Quaternary deposits, such as the Cape May Formation, serve an important hydrologic function by transmitting water to these underlying aquifers. The underlying Potomac-Raritan-Magothy aquifer system is the most

productive and heavily used confined aquifer in the coastal plain, with withdrawal rates from individual wells ranging up to 7,700 l/min.

Four other aquifers occur in the watershed area. These include (from shallowest to deepest): (1) the Atlantic City 800-Foot Sand; (2) the Wenonah-Mount Laurel aquifer; (3) the Englishtown aquifer system; and (4) the Potomac-Raritan-Magothy aquifer system. These productive formations consist principally of sand and gravel, with confining units in the sedimentary wedge comprised of silts and clays. The only unconfined aquifer in the region is the Kirkwood-Cohansey system.

### Soils

In general, the surface of the coastal plain is a gently rolling terrain, with sandy, droughty soils and few outcrops. The lower component of the region's Kirkwood outcrop consists of very fine, dark, micaceous sand with a pebbly glauconitic basal layer. The



upper component is made up of silt and clay. The 8,930 km<sup>2</sup> Cohansey formation ranges from the surface to depths of 6 m to more than 60 m. The Cohansey consists of fine to coarse grained quartzose sand with foot-thick lenses of gravel. Generally, clay content is less than 20%. The Cohansey and the Kirkwood are the principal aquifers in the region and may contain as much as 65 trillion liters of water. The tremendous water reserves are a result of the sandy soil, flat terrain, and evenly distributed precipitation.

The Mullica River watershed contains sandy, siliceous, droughty soils with low nutrient concentrations. They derive largely from the Cohansey Sand, which in the Wharton Tract consists of 93% sand beds, 3.5% silt beds, and 3.5% clay beds. The lithology of the Cohansey Sand varies within the Pine Barrens region, being composed principally of yellow limnetic quartz sand with minor amounts of pebbly sand, fine to coarse sand, silty and clayey sand, and interbedded clay (Rhodehamel, 1998a). The quartz dominated Cohansey Sand yields soils with little or no clay and minimal textural change upon weathering. In addition, the soils are highly acidic with small amounts of organic matter, low cation exchange capacity, and poor capacity to attenuate nutrients.

Markley (1998) identified 16 soil series in the Pine Barrens ranging from excessively drained to very poorly drained types. These include the following series: (1) Lakewood; (2) Evesboro; (3) Woodmansie; (4) Downer; (5) Sassafras; (6) Aura; (7) Lakehurst; (8) Klej; (9) Hammonton; (10) Atsion; (11) Berryland; (12) Pocomoke; (13) Muck; (14) Woodstown; (15) Fallsington; and (16) Fort Mott. The distribution of these soils forms a conspicuous mosaic pattern in the Pine Barrens region (Table 2).

Several soil types predominate in the Mullica River watershed, notably the Lakewood, Evesboro, Woodmansie, Downer, Lakehurst, Klej, Atsion, and Muck series. Lakewood soil, a podsol, consists of highly leached sands with a thickly bleached surface horizon ( $\geq 18$  cm). The Evesboro is comprised of loose, excessively drained soils devoid of a thickly bleached surface horizon. Both the Woodmansie and Downer series are well-drained soils with a sandy loam subsoil. Lakehurst soils have relatively poorly drained sands with a bleached gray sandy surface 18 cm or more thick. Rather poorly drained sands or loamy sands characterize the Klej series. Atsion soils also exhibit

poorly drained sands, and in addition, have a gray or thin black surface soil and a dark brown subsoil. In contrast to the aforementioned sandy series, Muck soils consist of poorly drained, organic-rich soils overlying a sandy substratum. They form in narrow submerged valleys (Markley, 1998).

Table 2. General distribution and extent of soils in the New Jersey Pine Barrens.

| Soil Series | Former Classification | General Distribution in Pine Barrens | Area in Pine Barrens and Percent of Pine Barrens (Hectares) | Position in Landscape | Most Common Trees (In Order of Abundance)   |
|-------------|-----------------------|--------------------------------------|---|-----------------------|---|
| Lakewood    | Lakewood              | Rare in southern part                | 56,000 (12%)  | High                  | Pitch and shortleaf pines, and few chestnut oaks; dwarf form where fires have been severe   |
| Evesboro    | Sassafras             | Entire region                        | 40,000 (9%)   | High                  | Pitch and shortleaf pines and few chestnut oaks   |
| Woodmansie  | Lakewood              | Burlington and Ocean counties        | 20,000 (4%)   | High                  | Dwarf pitch pine  |
| Fort Mott   | Sassafras             | Mostly in southern part              | 45,000 (<1%)  | High                  | Black, white, and chestnut oaks, hickories, and few pitch and short leaf pines              |
| Downer      | Sassafras             | Entire region                        | 80,000 (17%)  | High                  | Black, white, scarlet, red, and chestnut oaks, hickories, and few pitch and shortleaf pines |
| Sassafras   | Sassafras             | Mostly in southern part              | 12,000 (3%)   | High                  | Black, red, white, and scarlet oaks, hickories, and few beeches                             |
| Aura        | Sassafras             | Mostly in southern part              | 24,000 (5%)   | High                  | Black, white, red, and scarlet oaks, hickories, and few pitch and shortleaf pines           |
| Lakehurst   | Lakewood              | Mostly in northern part              | 52,000 (11%)  | Intermediate          | Pitch pine and few black, white and chestnut oaks   |

|             |                       |                                    |               |              |  |
|-------------|-----------------------|------------------------------------|---------------|--------------|--|
| Klej        | Sassafras             | Entire region                      | 16,000 (3%)   | Intermediate | Black and white oaks, blackgum; and few red maples, sweetgums, pitch and shortleaf pines |
| Hammonton   | Woodstown             | Entire region                      | 20,000 (4%)   | Intermediate | Black, white, red, southern red, and scarlet oaks and few pitch and shortleaf pines      |
| Woodstown   | Woodstown             | Mostly in southern part            | 2,000 (<0.5%) | Intermediate | Red, white, black, southern red oaks, hickories, and few beeches                         |
| Atsion      | Leon <sup>b</sup>     | Entire area except Cape May County | 58,000 (12%)  | Low          | Pitch pine, red maple, and blackgum  |
| Fallsington | Portsmouth            | Southern part                      | 2,000 (<0.5%) | Low          | Swamp white oak, red maple, blackgum, sweetgum, sweet birch, beech, and few pitch pines  |
| Berryland   | St Johns <sup>b</sup> | Entire area                        | 20,000 (4%)   | Low          | Pitch pine, red maple, blackgum, and few Atlantic white cedars                           |
| Pocomoke    | Portsmouth            | Entire area                        | 8,000 (2%)    | Low          | Swamp white oak, red maple; blackgum, sweetgum, willow oak, and few pitch pines          |
| Muck        | Swamp                 | Entire area                        | 48,000 (10%)  | Low          | Atlantic white cedar and bay magnolia  |

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From Rhodehamel, E. C. 1998a. Geology of the Pine Barrens in New Jersey. In: R. T. T. Forman (ed.), *Pine Barrens: Ecosystems and Landscape*. Rutgers University Press, New Brunswick, New Jersey, pp. 39-60.

Most soils in the New Jersey Coastal Plain range from sandy clay loam to sand. Organic-rich soils exist along estuarine shorelines and in surrounding wetlands habitat. They also occur near the mouth of coastal plain streams and in broad flooded reaches of the streams. These soils have greater nutrient holding capacity.

Overall, most soils of the Mullica River watershed consist of fine to coarse sands that form a dry, infertile, acid-rich environment. They typically are well leached with low nutrient holding capacity. As a result, the soils are depleted in nutrients, which tend to be concentrated within the vegetative media of the coastal plain.

### **Topography**

The coastal plain at the site of the Mullica River watershed is characterized by low and relatively flat terrain. To the west in the Pine Barrens, the coastal plain undulates gently eastward, but relief is low throughout this region (Tedrow, 1998). Although the



coastal plain in New Jersey consists of a series of marine terraces, there are no steep slopes or mountain peaks in the watershed area. Small hills (maximum height = 62 m) sporadically interrupt the low topographic relief of the Pinelands landscape, which mainly lies between 15-46 m above sea level.

### **Historical and Cultural History**

People have been living in the Mullica River-Great Bay region for more than 8000 years. Evidence of these pre-historic cultures has been found in over 1000 sites in

the Pine Barrens, including over 100 sites along the Mullica River and its tributaries. The people living in the Mullica River-Great Bay area at the time of contact with early settlers were part of a large group known as the Lenni Lenape. These Native Americans became known as the Delawares to the settlers. The Delawares occupied the areas which are now the state of Delaware, southeastern Pennsylvania, and all of southern New Jersey. In 1758, the remnant of the Delaware Indians living in New Jersey was placed on a reservation of over 1200 ha (3000 ac), known as Edgepillock or "Brotherton." The reservation was located at the headwaters of the Mullica River at what is now known as Indian Mills, Burlington County. The Delawares were relocated to New York State in 1801 and again later to Oklahoma. The Native Americans which originally resided in the Mullica River-Great Bay region were known to be skilled gamehunters and fishers of finfish and shellfish.

The first settlement of the Mullica River-Great Bay region occurred in 1697, when the Finnish settler Eric Palsson Mullica obtained a piece of land from other settlers in the nearby Swedish settlements along the



Delaware River. Most of the early settlers in the region were from Sweden. In the late 1690's, several parcels of land were sold within the area that is now Tuckerton. Mullica obtained one of these pieces of land in what is now Lower Bank on the Mullica River. Before the outbreak of the Revolutionary War, there were more than 30 homesteads reaching from Tuckerton up the Mullica and Wading Rivers. By 1735, the area consisted of 35 to 40 dwellings. By the mid-18th century, there were sawmills on each of the

Mullica River's four stream branches. A dam was built on the Basto River in 1765 and a grist mill, and several more sawmills were built in the early 1700's. The first ship to be built in the area was constructed in 1724, marking the beginning of a long shipbuilding history.

Pirating and privateering trade also began, with ships built in the area being used to raid British ships and for contraband activities. On September 30, 1778, British forces, 400 strong in nine ships, destroyed the fort at Chestnut Neck, but their flagship Zebra with Captain Henry Collins in command, ran aground and had to be abandoned by the British troops. Their plan to continue up the Mullica River and destroy Batsto was abandoned. However, the British Captain and his crew did destroy the small village of Chestnut Neck, killing several men and destroying their storehouse, as well as taking prisoners. The Chestnut Neck Battle Site is on the National Registry of Historic Places.

The industrial and commercial ventures along the Mullica River and Great Bay region drew on the natural resources of both the land and water. The river was used to transport goods to the bay where they were



then shipped to New York, Philadelphia, and even the West Indies. In addition, iron furnaces were crafted in Batsto and Atsion, which provided the bulk of musket and cannon balls for American troops in the American Revolution and the War of 1812. Beginning in 1814, a glass industry was established in the Pine Barrens. Bottle glass and window glass were both produced in these factories. Two cotton mills were established on the upper reaches of the river system located in Pleasant Mills in Atsion. One was

later converted into a paper mill. Paper mills in the area used native salt hay. Sawmills produced lumber for both housing and shipbuilding throughout the industrial period.

Early horticulture was practiced by the Native Americans when the early settlers arrived. Most of the houses built during the 18th and 19th century were farmsteads. Work was seasonal, with most farming done at the subsistence level. The cranberry industry started in 1835 and is still flourishing today. Cranberry bogs were dug out along the freshwater reaches of the streams that flow into the Mullica River. Blueberries were first cultivated in the Pine Barrens early this century. Fruit and vegetables grown in the area were sent to markets by truck beginning in the mid 1800's.

### **Mullica River Watershed**

The Mullica River Basin is the largest watershed in the Pinelands, covering an area of 1,474 km<sup>2</sup> and draining parts of 23 municipalities (Figures 6 and 7). The Mullica River drainage basin delivers most of the freshwater that enters Great Bay, with an annual mean discharge of 29 m<sup>3</sup>/s (MacDonald, 1983). The Mullica River watershed is divided into the Upper Mullica-, Lower Mullica-, Batsto River-, Bass River-, Oswego River-, Mullica Wading-, and Great Bay subwatersheds (Figure 7). Undeveloped forested habitat predominates, with only about 15% of the basin being developed or farmed (Figures 8-10). The Upper and Lower Mullica River subwatersheds have the greatest potential for increase in development, whereas the Great Bay and Bass River subwatersheds have the least available land for development. Eighty-two percent of the watershed lies within Pinelands Management Areas.

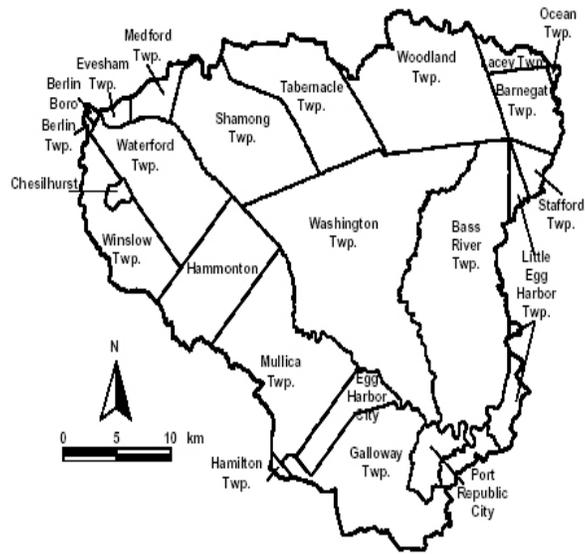


Figure 6. Location of 23 municipalities in the Mullica River Basin (Atlantic, Burlington, Camden, and Ocean Counties). From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

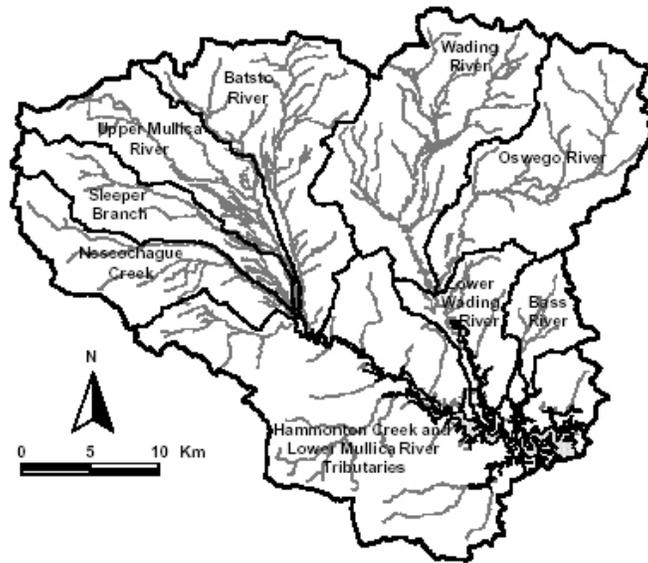


Figure 7. Major tributaries draining into the Mullica River-Great Bay Estuary. From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

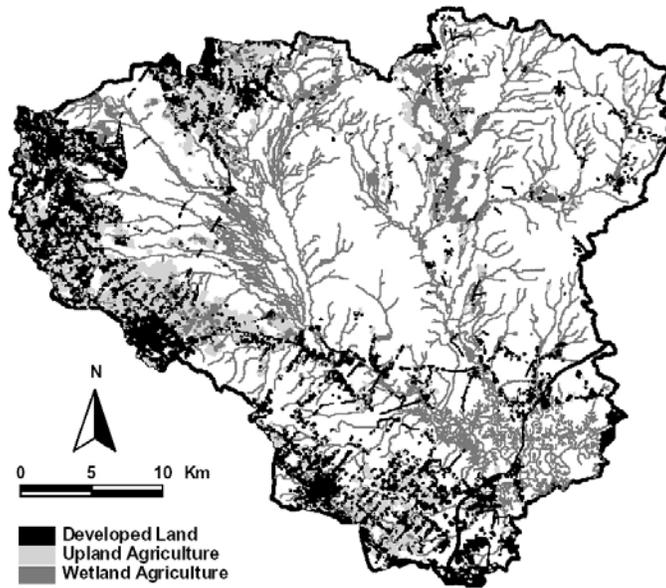


Figure 8. Distribution of developed land, upland agriculture, and wetland agriculture in the Mullica River Basin. From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

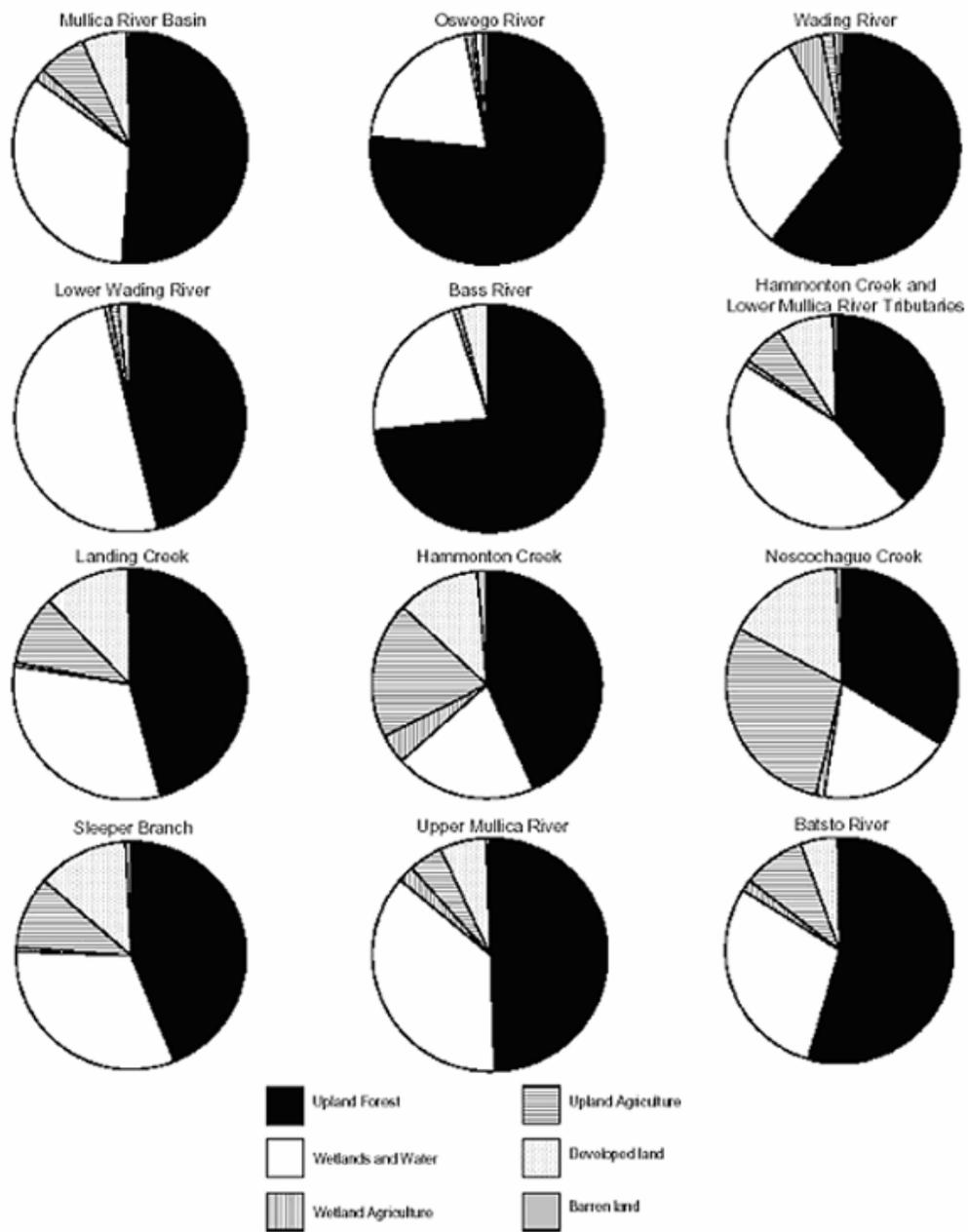


Figure 9. Land use profiles within the Mullica River Basin. From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

Zampella et al. (2001) investigated landscape changes in the Mullica River Basin during the 1979 and 1991 periods. Land cover types identified in the basin by Zampella et al. (2001) included salt marsh, herbaceous vegetation, scrub/shrub, forest, cranberry bogs, blueberry fields, orchards, crop land, barren land, managed grassland, developed land, and water (Table 3). Changes in land cover and land use through time are important in the basin because investigators have shown that the unique acid-water plant and animal communities inhabiting the Pinelands are vulnerable to water quality degradation, fires, and other human activities (Forman and Boerner, 1981). Most important are the changes in water quality coupled to developed and agricultural landscapes (Zampella and Laidig, 1997; Zampella and Bunnell, 1998, 2000; Bunnell and Zampella, 1999; Zampella et al., 2001). Forests covered ~75% of the basin in 1991, with all other land cover types totaling less than 5% each at this time. Zampella et al. (2001) estimated that 5.3% of the total basin area had a change in land cover type between the 1979 and 1991 periods, including several major basinwide transitions. According to Zampella et al. (2001, p. 19), these changes were as follows:

- Orchard land was converted to crop land and blueberry fields.
- Barren land cover was also converted to blueberry fields.
- Crop land was converted to orchards and managed grassland, and some crop land succeeded to scrub/shrub cover.
- Herbaceous cover succeeded to scrub/shrub cover and forest cover.
- Scrub/shrub cover was converted to forest cover.

Table 3. Commission land-cover types and related Landsat and NJDEP classes found within 72 photoplots in the Mullica River Basin. Commission and Landsat classifications were modified from the NOAA Coastal Change Analysis Program. For Commission forest, scrub/shrub, herbaceous, barren-land, and water cover types, disturbances included development, agricultural activities, resource extraction, timber harvests, and fire. NJDEP land-use classes are referred to using the revised Pinelands terminology.

| 1979 and 1991 Commission Land-cover Types  | 1991 Landsat Thematic Mapper Land-cover Types  | 1995 NJDEP Land-use Classes  |
|--|--|--|
| <ul style="list-style-type: none"> <li>• Developed Land</li> <li>• Residential development, including houses/driveways, outbuildings, and swimming pools               <ul style="list-style-type: none"> <li>• Nonresidential development, including buildings/asphalt, paved roads, railroads, campgrounds vehicles, and junkyard/storage areas</li> </ul> </li> </ul>                             | <ul style="list-style-type: none"> <li>• Developed land (% impervious and barren land)               <ul style="list-style-type: none"> <li>•Light: wooded (25-50%)</li> <li>•Light: unwooded (25-50%)                   <ul style="list-style-type: none"> <li>•Moderate (50-75%)</li> <li>•High (&gt;75%)</li> </ul> </li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Developed land, excluding recreational lands and athletic fields               <ul style="list-style-type: none"> <li>• Rural density residential development</li> <li>• Low density residential development</li> <li>• Medium density residential development</li> <li>• High density residential development</li> <li>• Nonresidential development, including commercial/services, industrial, transportation/communications/utilities, and other urban uses</li> </ul> </li> </ul> |
| <ul style="list-style-type: none"> <li>• Crop land, including crop land, turf fields, and gardens               <ul style="list-style-type: none"> <li>• Orchards</li> <li>• Tree farms</li> <li>• Blueberry fields</li> </ul> </li> <li>• Cranberry bogs, including bogs and reservoirs</li> </ul>  | <ul style="list-style-type: none"> <li>• Agricultural land               <ul style="list-style-type: none"> <li>• Vines/Bushes</li> </ul> </li> </ul>  | <ul style="list-style-type: none"> <li>• Upland agriculture, excluding orchards/vineyards/nurseries/horticultural areas</li> <li>• Orchards/vineyards/nurseries/horticultural areas               <ul style="list-style-type: none"> <li>• Wetland agriculture</li> </ul> </li> </ul>  |
| <ul style="list-style-type: none"> <li>• Managed grassland</li> <li>• Residential grass (lawns)               <ul style="list-style-type: none"> <li>• Nonresidential grass, including pastures/corrals, recreation land, athletic fields, commercial lawns, and roadside vegetation</li> </ul> </li> <li>• Herbaceous, including several unmanaged disturbance-related herbaceous covers</li> </ul> | <ul style="list-style-type: none"> <li>• Grassland, including managed and unmanaged herbaceous areas</li> </ul>  | <ul style="list-style-type: none"> <li>• Recreation lands, athletic fields, and managed wetlands               <ul style="list-style-type: none"> <li>• Herbaceous wetlands</li> </ul> </li> <li>• Old fields (&lt;25% brush covered)</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Forest, including undeveloped vegetated land and several disturbance-related tree covers</li> <li>• Scrub/shrub, including</li> </ul>   | <ul style="list-style-type: none"> <li>• Forest, including seven forest types</li> <li>• Scrub/shrub, including two scrub/shrub types</li> </ul>   | <ul style="list-style-type: none"> <li>• Upland forest and wetlands, excluding scrub/shrub subclasses and tidal, herbaceous, disturbed, and managed wetlands</li> <li>• Upland forest and wetlands composed of scrub/shrub subclasses</li> </ul>   |

|   |   |  |
|---|---|--|
| several disturbance-related scrub/shrub covers  |   | and excluding tidal, herbaceous, disturbed, and managed wetlands   |
| <ul style="list-style-type: none"> <li>• Barren land</li> <li>• Residential barren land</li> <li>• Nonresidential barren land, including several disturbance-related barren-land covers <ul style="list-style-type: none"> <li>• Sand roads</li> <li>• Fire breaks</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• Barren land, including barren land and areas with &lt;25% vegetated cover</li> </ul> | <ul style="list-style-type: none"> <li>• Barren land, including extractive mining, altered lands, transitional areas, undifferentiated barren lands, and disturbed wetlands</li> </ul> |
| <ul style="list-style-type: none"> <li>• Salt marsh</li> </ul>  | <ul style="list-style-type: none"> <li>• Salt marsh, including unconsolidated shore and emergent wetlands</li> </ul>          | <ul style="list-style-type: none"> <li>• Tidal wetlands, including saline marshes</li> </ul>   |
| <ul style="list-style-type: none"> <li>• Water, including tidal water, retention basins, impoundments, irrigation ponds, ditches/canals, and other disturbance-related water cover</li> </ul>   | <ul style="list-style-type: none"> <li>• Water, including unconsolidated shore and emergent wetlands</li> </ul>               | <ul style="list-style-type: none"> <li>• Water and tidal waters</li> </ul>   |

From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

A net decrease in forested land cover occurred between 1979 and 1991 largely due to its conversion to barren land, managed grassland, and developed land. The conversion of one agricultural type to another was also evident during this time period.

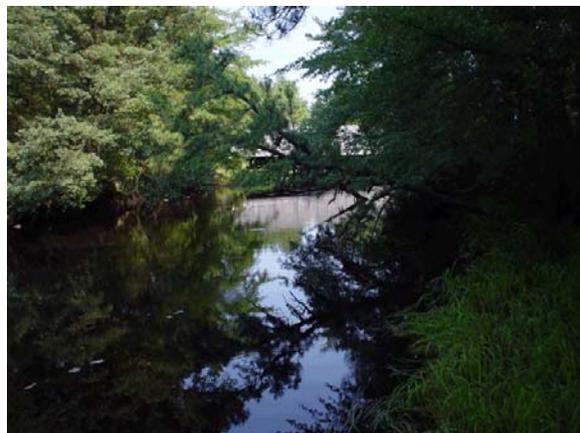
### **Watershed Build-Out**

A build-out analysis has been completed for both the Mullica River watershed (Appendix 2) and Barnegat Bay watershed (Appendix 3). The objective of this work is to map the expected location of future development in the watershed and to provide estimates of the number of new dwelling units when all land available in the watershed for development has been developed to the highest intensities possible. Although the build-out analysis of the watersheds does not project when build-out will actually occur, it yields valuable information for long-term planning efforts as a way to understand

potential future growth. This is accomplished by assessing three indicators - the number of dwelling units, population, and percent impervious cover - as ways to quantify the amount of development possible at build-out.

There is currently little development in the Mullica River watershed, whereas considerable development exists in the Barnegat Bay watershed, particularly in the northern portion. As a result, land areas in the Mullica River watershed, as well as in the southern part of the Barnegat Bay watershed may be the target of future development. To determine the amount of developable land in these watersheds, it is necessary to exclude land already developed, wetlands, preserved open space, parcels with severed developmental rights, and buffer zones around water bodies and wetlands. A Geographic Information System (GIS) has been applied to map land use and future developmental pressures in the watersheds.

The Mullica River watershed remains one of the most pristine watersheds in New Jersey. A total of 88% of the watershed was in a natural or unaltered state in 1986. Between 1986 and



2000, little degradation occurred here, with only 0.7% of the forest and wetlands cover lost. Urban land cover in the watershed increased from 5.8% in 1986 to 6.6% in 1995 and 6.9% in 2000; most development occurred in areas designated for growth along the southwest perimeter. There was a real loss of only ~1% of the watershed to development between 1986 and 2000. Impervious surfaces (e.g., roads, driveways, sidewalks, roofs, and other impenetrable surfaces)

covered an estimated 1.34% of the Mullica River watershed in 1986 and 1.53% in 1995. The build-out analysis predicts a range of impervious surface in the watershed between 2.50% and 2.83%. By comparison, the impervious surface is projected to increase to 12% in the Barnegat Bay watershed. The low percentage of impervious surface projected for the Mullica River watershed reflects a non-impacted condition, well below the 10% threshold level for impacted areas defined by Arnold and Gibbons (1996). The amount of impervious surface in a watershed is an indicator of the intensity of human land use and also correlates with water quality degradation and altered runoff patterns (Arnold and Gibbons, 1996; Charbeneau and Barrett, 1998).

The population in the Mullica River watershed increased by 9% from 1990 (n = 76,383) to 2000 (n = 83,501). The build-out population is projected to range from 110,363, to 124,334 people (Appendix 2). This population is far less than the 812,556 to 842,777 people projected at build-out for the Barnegat Bay watershed (Appendix 3).

## **Hydrography**

### **Rivers and Streams**

The Mullica River flows eastward across southern New Jersey and the Pine Barrens covering a distance of ~65 km, and it discharges into Great Bay (Figure 10). The river terminates at a line drawn between Graveling Point and Oysterbed Point on the northwestern side of Great Bay. The Batsto River, a major tributary, enters the Mullica River ~40 km upstream from its mouth. The Wading River, in turn, discharges into the Mullica River ~13 km from its mouth (Durand, 1988, 1998).

Most of the freshwater flowing into estuaries of the reserve enters as discharge from streams draining the Pine Barrens, a 550,000-ha area of pristine habitat covering a large portion of the New Jersey Coastal Plain (Figure 10). These low-gradient, southeasterly flowing streams originate as ground water inflow from the Kirkwood-Cohansey aquifer. According to Nicholson and Watt (1997), the aquifer system is generally in good hydraulic connection with surface water bodies, and streams typically gain flow from the aquifer year-round. The unique surface and ground water system in the Mullica River watershed derives from the sandy, droughty soils of the Pine Barrens which are underlain by water-bearing sand layers and confining clay layers as noted above. The low relief of the region also influences surface runoff.

The depth to the water table in upland forests of the watershed ranges from ~1 to 25 m. However, water occurs near the land surface in lowland forests at least part of the year. Water table levels vary by as much as 3 m from spring to fall in a given year (Rhodehamel, 1998b).



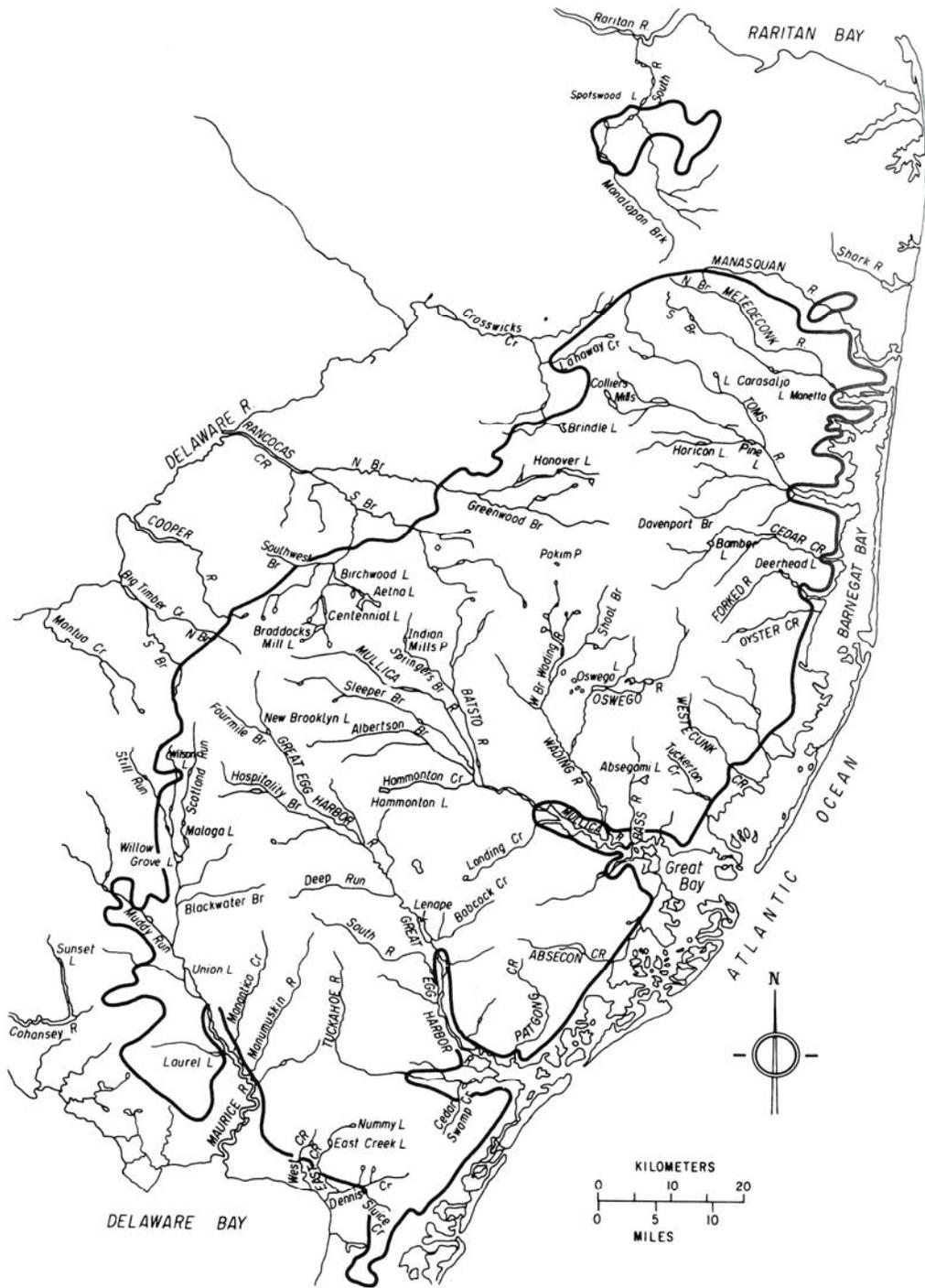


Figure 10. Location of the New Jersey Pine Barrens (within bold boundary line) showing the Mullica River and other major rivers and streams in the region. From Patrick, R., B. Matson, and L. Anderson. 1998. Streams and lakes in the Pine Barrens. In: R. T. T. Forman (ed.), *Pine Barrens: Ecosystems and Landscape*. Rutgers University Press, New Brunswick, New Jersey, pp. 169-193.

As precipitation falls on the Mullica River drainage basin and the Barnegat Bay watershed, it rapidly percolates through porous and droughty, sandy soils to the shallow water table, which then feeds the area streams as ground water seepage. Surface water discharge, therefore, is



limited (U.S. Fish and Wildlife Service, 1996). For example, because of the large infiltration of precipitation into the porous soils and surface strata, only ~5% of the total precipitation falling on the Mullica River basin discharges as surface flow into the head of Great Bay (Psuty et al., 1993). In general, ground water seepage accounts for ~80% of the total discharge of South Jersey streams. Streams in the watershed gradually receive ground water as they flow seaward. Much of the precipitation in the watershed, therefore, discharges through shallow aquifers to the surface water system, supporting the base flow of streams.

Only a small amount of the total precipitation in the area falls directly on the stream surfaces. Approximately 45% of the total precipitation entering the drainage basin infiltrates into the ground water system with a considerable amount lost via evapotranspiration. Most of the ground water in the unconfined aquifer system follows short flow paths and discharges locally to surface water bodies or follows longer, deeper flow paths and discharges to distant streams at lower elevations, or directly to the estuaries. A minor fraction leaks into deeper aquifers. Ground water relative to surface water in the Pine Barrens has: (1) higher concentrations of carbon dioxide, iron, and

aluminum; (2) lower concentrations of sulfate and phosphate; and (3) less variable pH, sodium chloride, silica, temperature, and color (Rhodehamel, 1998b).

The Bass, Wading, Oswego, and Batsto rivers, as well as several smaller tributaries (e.g., Bull Creek, Landing Creek, Nacote Creek, Nescochague Creek, and Hammonton Creek) occur in the Mullica River drainage basin (Figure 7).



The Pinelands streams have a high concentration of humic acids from decaying vegetation, as well as a high iron content, which causes brown coloration of the water. Several major subwatersheds join at the head of tide near the town of Batsto to form the mainstem of the Mullica River; they include the Batsto River, Atsion (upper Mullica) River, Sleeper Branch (Mechesactauxin), Nescochague Creek, and Hammonton Creek. The headwater areas of the Mullica River, Sleeper Branch, Nescochague Creek, Hammonton Creek, and Landing Creek drainage basins contain the most developed land and upland agriculture in the Mullica River Basin.



Upper headwaters of the Mullica River are bordered by an array of unique habitats, such as cranberry bogs, *Sphagnum* bogs,

and white cedar swamps. The tidally-influenced mainstem from Batsto to the mouth at Great Bay (Deep Point) is ~34 km long. Tributaries that enter the Mullica River from the south include the Landing Creek and Nacote Creek. Those entering the Mullica River from the north are the Bull Creek, Wading River, and Bass River. Tidal marsh communities fringe all of these tributaries.

The Mullica River, with a surface drainage area of 119.4 km<sup>2</sup>, has a mean annual runoff of 83.8 cm. By comparison, the Batsto River has a surface drainage area of 182 km<sup>2</sup> and a mean annual runoff of 61.2 cm, and the Oswego River, a drainage area of 102 km<sup>2</sup> and a mean annual runoff of 46.4 cm (Rhodehamel, 1998b). Seasonal stream flow fluctuates considerably in response to variations in meteorologic and hydrologic conditions. However, cyclic seasonal stream flow patterns are evident in the drainage basin, with highest stream discharges recorded during winter and early spring when evapotranspiration is slight, and lowest stream discharges registered during late summer and fall after a protracted period of elevated evapotranspiration. Rhodehamel (1998b) noted that the Pine Barrens receives more than 40 cm of precipitation during the December through April period, when direct runoff from riparian areas peaks at ~175.4 m<sup>3</sup>/day/km<sup>2</sup> or 1.02 x 10<sup>6</sup> m<sup>3</sup>/day for the 5,828 km<sup>2</sup> contiguous Pine Barrens region. The annual ground water contribution to runoff equals more than 50 cm or ~89% of the total annual discharge. Thus, ground water flow for the 5,828 km<sup>2</sup> contiguous Pine Barrens region amounts to ~1,388 m<sup>3</sup>/day/km<sup>2</sup> or 8.1 x 10<sup>6</sup> m<sup>3</sup>/day.

Several small streams in the Pine Barrens also discharge limited volumes of freshwater from the Barnegat Bay watershed into Little Egg Harbor. Included here are Cedar Run, Westecunk Creek, and Tuckerton Creek. In addition, a number of other

creeks (i.e., Thompson Creek, Ezras Creek, Dinner Point Creek, and Parker Run) terminate near the upland-salt marsh boundary in the area. Absecon Creek drains into the shallow backbay region ~15 km south of Great Bay. Relative to the Mullica River, all of these small influent systems discharge substantially smaller volumes of freshwater to the coastal bays of the reserve.

Table 4 provides an annual hydrological budget for the New Jersey Pine Barrens region based on the work of Rhodehamel (1998b). This budget relates water input (precipitation) to water yield (stream runoff) plus water loss (evapotranspiration) for the system. It is defined by the following equation: precipitation (114.3 cm) = interception (15 cm) + evapotranspiration from undrained depressions (2.3 cm) + evapotranspiration from soil and ground water (39.9 cm) + direct runoff (6.3 cm) + ground water contribution to runoff (50.8 cm). Nearly 40% of the total precipitation, therefore, is lost via evapotranspiration, with the remainder entering the ground water reservoir. The annual runoff of Pine Barrens streams equals 57.1 cm and ranges from 36 cm to 84 cm of water. This runoff is important when considering salinity levels in the lower reaches of Pine Barrens streams and contiguous estuarine waters.

Seawater enters Great Bay and Little Egg Harbor through Little Egg Inlet. Great Bay and the backbays to the south (e.g., Little Bay, Reeds Bay, and Absecon Bay) experience semidiurnal tides, and tidal influence extends a



considerable distance up Pine Barrens streams. For example, tidal effects are observed over the lower ~40 km of the Mullica River, although the upper limit of saltwater penetration is ~20 km (Durand and Nadeau, 1972). Lower Bank, located ~25 km upstream from the head of Great Bay, marks the upper end of the estuary (Durand, 1988). Above this location, salinities are generally <1‰. The saltwater-freshwater interface in Pine Barrens streams usually lies 8-16 km upstream from the head of the bay, but reduced stream flow can cause upstream extension of the saline water and upstream displacement of salinity gradients. Salinity in these low gradient streams varies from upriver to downriver and seasonally in response to semidiurnal tides, frequency and intensity of precipitation, and evapotranspiration (Durand, 1988). Seasonal variations can be significant; for example, in the lower 8 km of the Mullica River, seasonal salinity levels vary by as much as 10-20‰ (Durand, 1988). Great Bay, Little Egg Harbor, and backbay waters to the south are generally well mixed, with mean salinity values typically ranging from ~25-30‰. From the head of the Mullica River to the nearshore ocean at LEO-15, salinity ranges from ~0->34‰.

Table 4. Annual hydrological budget for the New Jersey Pine Barrens region, 1931-1964.<sup>1,2</sup>

|             |   | <b>Centimeters of<br/>Water</b> | <b>Water<br/>(m<sup>3</sup>/day/km<sup>2</sup>)</b> | <b>Water<br/>(m<sup>3</sup>/day/km<sup>2</sup>)</b> |
|-------------|---|---------------------------------|---|---|
| Water input | Precipitation                                       | 114.3                           | 3127  | 18,224,000  |
| Water loss  | Interception  | 15.0                            | 409   | 2,384,000   |
|             | Evapotranspiration<br>from<br>undrained depressions | 2.3                             | 58.5  | 341,000   |
|             | Evapotranspiration                                  | 39.9                            | 1096  | 6,387,000   |

|             | from soil<br>and ground water             |      |        |           |
|-------------|---|------|--------|-----------|
| Water yield | Total water loss                          | 57.2 | 1563.5 | 9,112,000 |
|             | Direct runoff                             | 6.4  | 175.5  | 1,023,000 |
|             | Ground water<br>contribution to<br>runoff | 50.8 | 1388   | 8,089,000 |
|             | Total water yield                         | 57.2 | 1563.5 | 9,112,000 |

<sup>a</sup>Water input – water loss = water yield, or Precipitation = evapotranspiration + runoff.

<sup>b</sup>Pine Barrens region is approximately 5,828 km<sup>2</sup>.

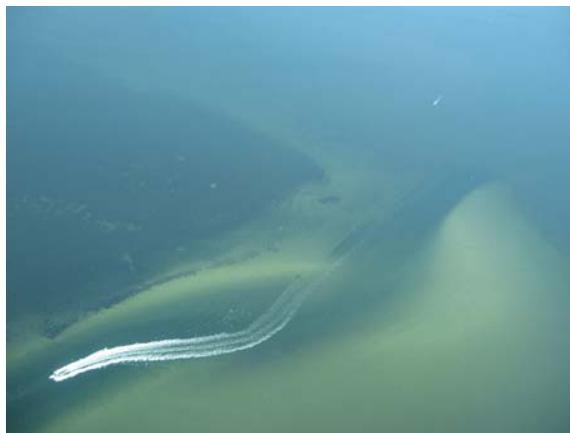
From Rhodehamel, E. C. 1998b. Hydrology of the New Jersey Pine Barrens. In: R. T. T. Forman (ed.), *Pine Barrens: Ecosystems and Landscape*. Rutgers University Press, New Brunswick, New Jersey, pp. 147-167.

### **Estuarine Circulation**

The extreme enclosure and shallowness of estuaries in the reserve strongly influence circulation patterns. Winds, tides, and salinity gradients are also of paramount importance. Northeasters, hurricanes, storm surges and other meteorological events can significantly alter the circulation patterns in these systems, although their effects are ephemeral. The strongest currents occur in the vicinity of Little Egg Inlet, where they are dominated by semidiurnal tidal motion. However, the shallow depths and complex morphologies of these backbays result in the distortion of the semidiurnal tidal motion via overtides and strong residual motion. Relatively rapid tidal currents (> 2 m/s) are observed at Little Egg Inlet, and they flow westward into Great Bay and northward into Little Egg Harbor. The tidal range at the inlet exceeds 1 m (Chant et al., 2000).

## Great Bay

Great Bay is a roughly circular embayment ~7 km in diameter, with an average depth of ~3 m at mean high water. Shallow sand bars occur near Little Egg Inlet at the mouth of the bay. Sandy sediments, which derive from marine sources, predominate in the eastern bay.



Silt and clay increase in the western bay and likely originate from riverine inputs and fringing salt marshes (Figure 11) (Durand and Nadeau, 1972). The predominant circulation pattern in the bay is counterclockwise, with currents entering at Little Egg Inlet flowing mainly along the northern perimeter. Sediments entering the bay through Little Egg Inlet and the Mullica River have built extensive intertidal sandflats and mudflats covering 1,358 ha, which constitute ~22% of the total area of the estuary (U.S. Fish and Wildlife Service, 1996). Salt marsh islands (e.g., Seven Islands) exist along the northeastern margin near the Great Bay Boulevard Wildlife Management Area. The principal outflow is along the southeastern perimeter, which incorporates discharge from the Mullica River and Motts Creek. This circulation pattern creates a counterclockwise gyre in the central portion of the bay (Durand, 1988) (Figure 12), which helps to retain biotic and abiotic components in the estuary. For instance, nutrient inputs from the Mullica River may concentrate for longer periods of time in the bay, thereby stimulating primary production when light conditions are favorable. Eggs and larvae of organisms

also tend to be retained in the bay by this type of circulation. Because Great Bay is a spawning and nursery area for many organisms, the cyclonic circulation pattern appears to play a significant role in the overall production of the system.

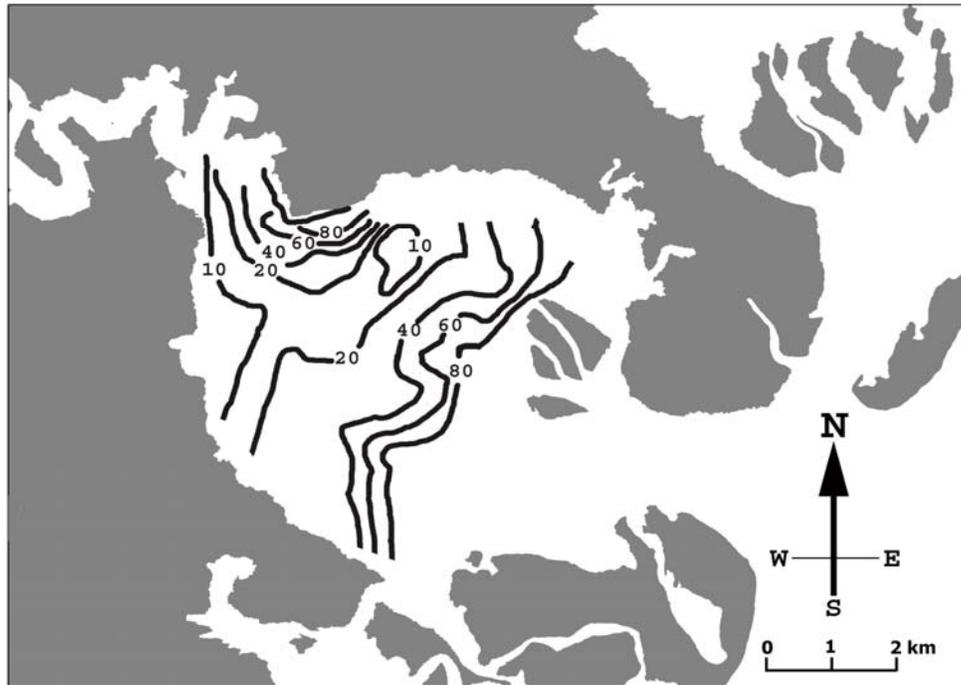


Figure 11. Map of Great Bay displaying the percent sand in bottom sediment contours. Modified from Durand, J. B. and R. J. Nadeau. 1972. Water Resources Development in the Mullica River Basin. Part I. Biological Evaluation of the Mullica River-Great Bay Estuary. Technical Report, New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey. 138 p.

Turbidity values are higher along the southern part of the bay because more turbid water flows from the Mullica River along this perimeter. Incoming seawater has less turbidity, and hence water clarity along the northern part of the bay is greater (Durand, 1988). Although the principal circulation in the bay follows a cyclonic pattern, much of the water exits the bay during periods of high flow from the Mullica River (Durand and Nadeau, 1972). In addition, a component of seaward-flowing water along the southeastern part of the bay flows southward into Little Bay.

Great Bay is affected by periodic upwelling of cold, higher density seawater from deeper waters on the continental shelf. For example, during 2000, 12 episodes of coastal upwelling were recorded at the LEO-15 site. The effects of upwelling on circulation, nutrient inputs, productivity, and other factors in the estuary have not been extensively investigated.

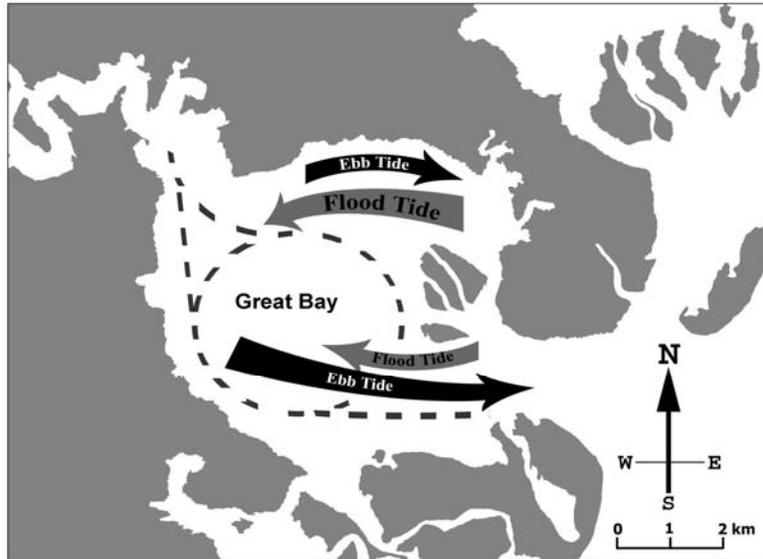


Figure 12. Major water circulation patterns in Great Bay. Modified from Durand, J. B. and R. J. Nadeau. 1972. Water Resources Development in the Mullica River Basin. Part I. Biological Evaluation of the Mullica River-Great Bay Estuary. Technical Report, New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey. 138 p.

### **Little Egg Harbor**

Little Egg Harbor is a shallow (1-7 m), irregular tidal basin located immediately north of Great Bay. It is enclosed by Long Beach Island (a barrier island) on the east and the New Jersey mainland on the west. Seawater enters the estuary via Little Egg Inlet, a relatively wide (~2.5 km) breach in the barrier island complex. Coastal pumping driven by sea level motion, together with the inlet-bay configuration, strongly influences water

exchange within the backbay system (Chant, 2001). Water circulation in lower Little Egg Harbor is greatly affected by tidal currents through Little Egg Inlet, deep channels (> 10 m) landward of the inlet, and a cluster of sand bars and marsh islands (i.e., Story Island, Hither Island, Middle Island, Drag Sedge, Good Luck Sedge, and Johnny Sedge) in the southern perimeter. Tidal currents, which flow northward during flood tide, diverge into northwestward and northeastward components (Carriker, 1961; Figure 13a). Strongest flood currents are observed on the western side of the lower embayment, where they pass through narrow channels between marsh islands on their northward path. Complex circulation patterns develop in the central basin of lower Little Egg Harbor in response to the diverging northward-flowing tidal currents. As the currents flow northward, they dissipate from maximum velocities of ~0.5 m/s in the southern reach to <0.05 m/s in upper Little Egg Harbor. During flood tide, lateral variability in currents and salinities is enhanced. Currents are reversed during ebb tide, being stronger on the eastern side of the embayment (Figure 13b). Hydrodynamic surveys conducted by Chant et al. (2000) in the spring of 1996 and 1997 show the magnitude of tidal currents in lower Little Egg Harbor (Figure 14).

Little Egg Harbor exhibits weak vertical salinity and thermal stratification. In summer, wind action (including strong sea breezes), high evaporation rates, small inputs of freshwater runoff, and the aforementioned advective processes create more homogeneous conditions in the water column and relatively uniform (high) salinities. These conditions are indicative of extensive mixing of the water column. However, as stated by Chant et al. (2000, p. 539), “Maximum salinity occurs at the end of flood, which corresponds to the mid-tidal stage on the falling tide, while minimum salinity

occurs at mid-stage during the rising tide.” Figure 15 shows salinity differences at flood and ebb in Little Egg Harbor.

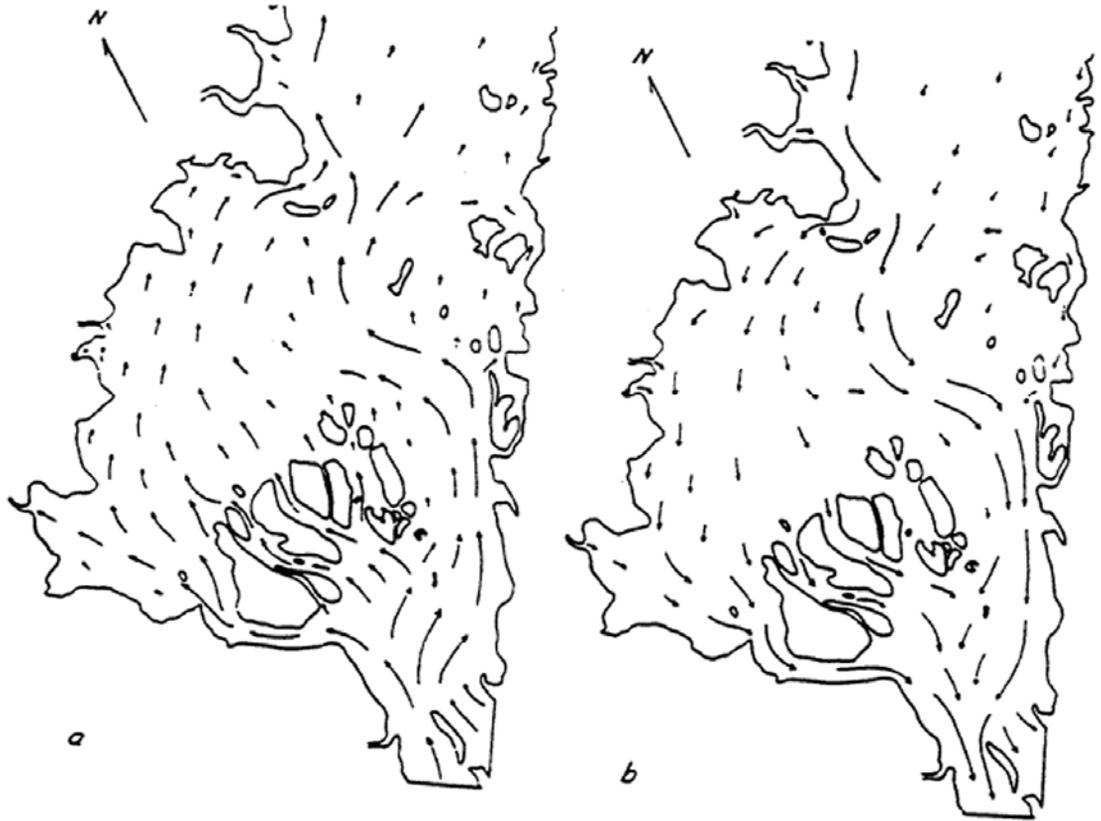


Figure 13. Direction and magnitude of tidal currents in lower Little Egg Harbor during the mid to late flood tide stage (a) and mid ebb tide stage (b). From Carriker, M. R. 1961. Interrelation of functional morphology, behavior, and autecology in early stages of the bivalve *Mercenaria mercenaria*. *Journal of the Elisha Mitchell Science Society* 77:168-241.

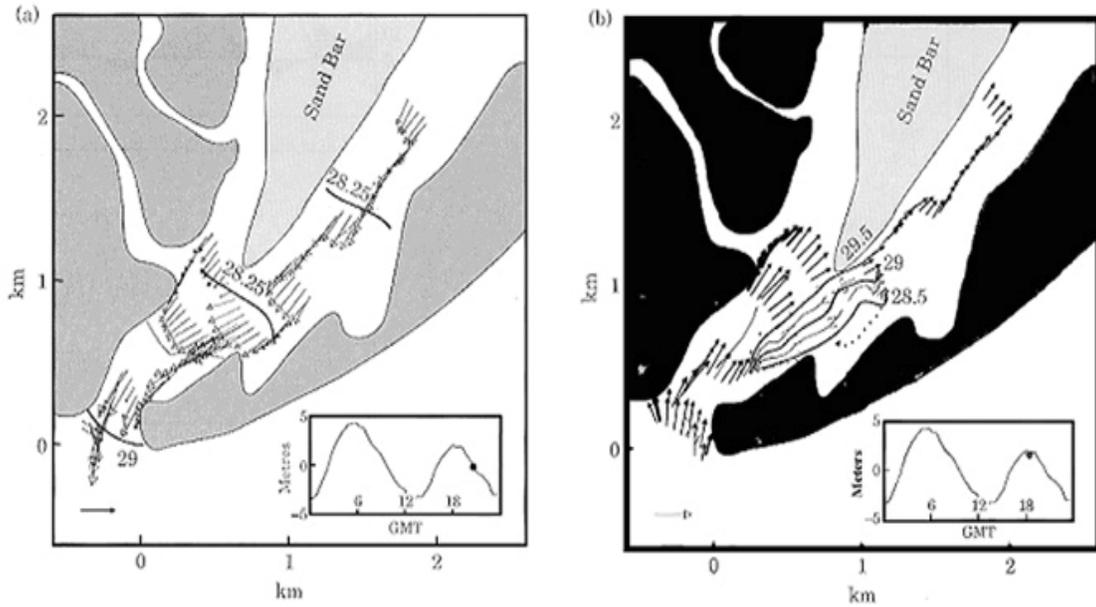


Figure 14. Synoptic current field during flood (a) and ebb (b) in lower Little Egg Harbor on May 7, 1996. Sea level data are plotted in the graph in the lower right corner of each panel with the time of the current vector estimates. The sand bar (light grey) is more exposed during low water. From Chant, R. J., M. C. Curran, K. W. Able, and S. M. Glenn. 2000. Delivery of winter flounder (*Pseudopleuronectes americanus*) larvae to settlement habitats in coves near tidal inlets. *Estuarine, Coastal and Shelf Science* 51:529-541.

Coastal pumping, remotely forced by coastal sea level, drives more than 70% of the subtidal motion in the estuary (Chant, 2001). It is the major forcing factor responsible for the movement of seawater from Little Egg Harbor into Barnegat Bay, with local winds accounting for another 20% of the variance in the subtidal transport in the estuary. However, strong winds can completely alter the circulation patterns in this shallow, enclosed estuary over short periods of time.

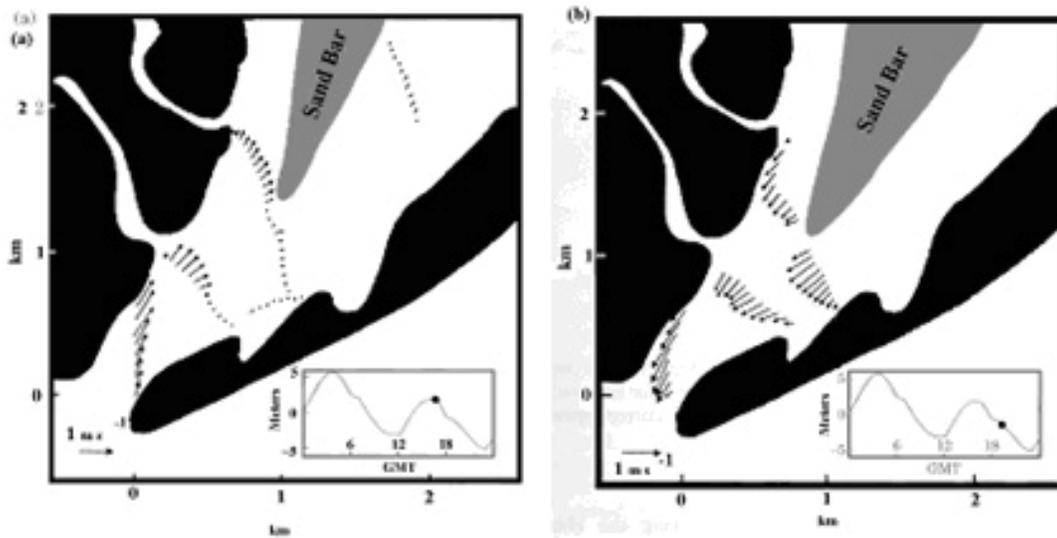


Figure 15. Current field and salinity during ebb (a) and flood (b) in lower Little Egg Harbor on April 29, 1997. Salinity record is contoured at 0.25 intervals. Sea level data are plotted in the lower right corner of each panel with the time of the current vector field estimate denoted by the dot. From Chant, R. J., M. C. Curran, K. W. Able, and S. M. Glenn. 2000. Delivery of winter flounder (*Pseudopleuronectes americanus*) larvae to settlement habitats in coves near tidal inlets. *Estuarine, Coastal and Shelf Science* 51:529-541.

## Water Quality

Extensive investigations of water quality conditions in the Mullica River-Great Bay Estuary have been conducted since the mid-1950s (Able et al., 1992, 1999). During the period from 1957-1986, Durand (1988) collected detailed physical-chemical data (temperature, salinity, dissolved oxygen, nitrogen, phosphorus, carbon, and chlorophyll) throughout the estuary and into the nearby waters of the Atlantic Ocean, while also focusing on primary production (Appendix 4). Since 1985, many water quality measurements have been made in the system as a component of targeted ecological studies (Able et al., 1999).

The most comprehensive database on water quality has been collected since 1996 as part of the System-wide Monitoring Program (SWMP) established by the National Estuarine Research Reserve System (NERRS). The goal of NERRS SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of representative estuarine ecosystems and coastal watersheds for the purpose of contributing to effective national, regional, and site specific coastal zone management. Data derived from NERRS SWMP can be used for the following purposes: (1) to address circulation problems in the estuarine systems; (2) to support site-specific, nonpoint source pollution control programs by implementing a network of continuous water quality monitoring stations; and (3) to develop a nationwide database on baseline environmental conditions in NERRS estuarine systems. A major initiative of SWMP is to collect long-term water quality and ecological data that will be of value for coastal resource management.

### **JCNERR Research and Monitoring Program**

Since 1996, the NERRS has concentrated on (SWMP) monitoring of physical and chemical water quality parameters and local and regional weather conditions and impacts. Future efforts will also focus on monitoring environmental stressors,



mapping habitat change, assessing watershed land use, and investigating biodiversity (Greene and Trueblood, 1999; Kennish, 2003). One of the primary objectives of SWMP is to provide the baseline data necessary to systematically evaluate anthropogenic effects on estuarine ecosystems and to restore the functionality of these estuaries to their undisturbed conditions (Wenner et al., 2001).

During the past 13 years, SWMP has collected data semi-continuously year-round on a series of physical-chemical parameters (i.e., temperature, salinity, dissolved oxygen, pH, turbidity, and depth) using automated data loggers (Yellow Springs Instrument Company, 6-series data loggers; YSI 6000® or YSI 6600®). These instruments operate at shallow depths, relaying water quality measurements to internal memory. They run unattended for protracted periods (i.e., weeks at a time). Some effort has been made to analyze NERRS data system-wide. Wenner et al. (2001), for example, have analyzed SWMP water quality data (temperature, salinity, dissolved oxygen (mg/l), dissolved oxygen (% saturation), pH, and depth) from NERRS reserves for the 1996-1998 period. The purpose of this analysis was to accomplish the following:

- Provide a characterization of water quality for each NERR site.
- Determine the degree to which SWMP is producing important scientific information on the water quality of the nation's estuaries.
- Ascertain if SWMP could be modified to make it more effective or efficient or to obtain more ecologically relevant water quality information.

More recently, Sanger et al. (2002) analyzed water quality data collected by the NERRS program over the 1995-2000 (Phase 1) period.

Analysis of the SWMP database is ongoing. It is hoped that this effort will yield important information for comparing estuarine water quality conditions both regionally and nationally. It is also hoped that analysis of the data will be vital for planning the next phases of the SWMP monitoring program.

The focus of the research and monitoring program of the JCNERR is to identify and track short-term variability and long-term changes in the physical-chemical characteristics, biotic resources, and integrity of estuarine and coastal marine waters of the reserve site, as well as nearby



coastal watersheds, for the purpose of contributing to effective coastal zone management. Important components of the program are water quality monitoring, biomonitoring, ecosystem research, and the assessment of land use and land cover elements within the reserve boundaries. Monitoring data collected as part of the System-wide Monitoring Program (SWMP) of the NERRS help to define baseline conditions and establish data trends for waterbodies and aquatic resources of the reserve. JCNERR SWMP provides a critical delineation and coordination of water quality conditions within the reserve's estuarine waters, and it provides the platform for making systematic, long-term observations of vital ecosystem parameters. Research and monitoring activities of the JCNERR fall within three distinct areas: (1) water quality monitoring (abiotic factors); (2) habitat and biotic community characterization; and (3) watershed land use and land cover analysis. These activities foster greater understanding of the relationship between

disturbance/change and physical, chemical, and biological processes required to sustain biotic communities and resources in the reserve.

The JCNERR research and monitoring program currently operates five SWMP monitoring stations: four semi-continuous, water quality monitoring (data logger) stations (Lower Bank and Chestnut Neck in the Mullica River and Buoy 126 and Buoy 139 in Great Bay) and one weather station at the Richard Stockton College Marine Field Station at Nacote Creek. A suite of environmental parameters is monitored every 15 minutes at these stations (i.e., temperature, salinity, DO concentration, DO percent saturation, depth, pH, and turbidity at the water monitoring stations; temperature, humidity, atmospheric pressure, wind speed and direction, solar radiation, and precipitation at the weather monitoring station). Nutrient chemistry is also monitored at each of the four SWMP water quality monitoring stations on a monthly basis. Two of these stations (Chestnut Neck and Buoy 126) have been equipped with telemetry equipment that broadcasts water quality data to a GOES satellite, which is then posted to the World Wide Web.

SWMP is part of a comprehensive national effort of NERRS to monitor the health and functionality of U.S. estuaries. It currently involves activities at the 27 reserve sites nationwide, encompassing estuarine waters, wetlands, and uplands in five major estuarine/coastal regions (i.e., Northeast and Great Lakes, Mid-Atlantic Coast, Southeast Coast, Caribbean, Gulf Coast, and West Coast) representing nearly every recognized climatic zone (Figure 2). Initiated in 1995, SWMP is comprised of three integrated components: (1) water quality; (2) biological communities and habitats (biomonitoring); and (3) watershed land use changes. These components are being implemented in phases at all reserve sites. Phase 1 (abiotic parameters) of the reserve program focuses on

monitoring key physical and chemical parameters that help to define the health of the estuarine system. These parameters include basin water quality indicators (e.g., pH, dissolved oxygen, and turbidity), meteorological conditions, and specific processes (e.g., tidal action). Phase 2 (biodiversity) of the NERRS program addresses two fundamental features of the system: (1) basic community structure in major estuarine habitats (e.g., uplands, lowlands, wetlands, and open water); and (2) population trends of important “target species” or indicator organisms (e.g., SAV, salt marsh plants, and endangered species). Phase 3 (land use patterns) of the reserve examines patterns of change in human use of surrounding watersheds. Data are compiled on major patterns of habitat classification and use in the watersheds, which will be periodically resurveyed to detect and track changes in land use as reflected by land cover change and other alteration. Remote sensing techniques are being applied in these studies, and the resultant information will be used in local and regional planning and management efforts.

An array of priority research projects is ongoing in the JCNERR that accompanies water quality monitoring. These include an assessment of nutrient loading and estuarine eutrophication of the Barnegat Bay-Little Egg Harbor system, demographic analysis of submerged aquatic vegetation, examination of phytoplankton and zooplankton dynamics, characterization of benthic habitat and communities, studies of shellfish and finfish populations, and mapping of watersheds. Work products generated in support of estuarine research activities consist of grant-writing documents, written technical reports and journal publications, seminar presentations, staff field and laboratory investigations, undergraduate and graduate student research projects, and partner surveys.

## **Benthic Research**

Benthic habitat characterization of estuarine environments in the JCNERR has been conducted since 2003, with the most extensive work being reported for the Barnegat Bay-Little Egg Harbor Estuary. This work consisted of collecting SAV (as part of a biomonitoring program) samples and sediment cores, utilizing quadrats, deploying sediment profile imaging camera systems, and using underwater videography to assess habitat condition. Several hundred benthic cores were taken in seagrass habitats to assess seagrass aboveground and belowground biomass, density, blade length, and areal cover in the system. Habitats were investigated to establish long-term databases.

Benthic habitat quality in the estuary was investigated employing a sediment profile imaging (SPI) camera to collect samples during summer 2006. This instrument was used to assess the condition of bottom habitats, analyzing degradation caused by hypoxia and other stressors. The long-term goal is to generate benthic habitat quality (BHQ) indices for different areas of the estuary for making comparisons over time. Benthic grab sampling using a Young-modified Van Veen Grab has been conducted in JCNERR waters and is also scheduled for future benthic community characterization work.



## **Bottom Sediments**

Sediments have been collected and analyzed at numerous sampling sites in Great Bay and the Barnegat Bay-Little Egg Harbor Estuary as part of a larger effort to assess

and characterize benthic environments in the JCNERR. Sediment size and percent organic matter are being collected throughout the reserve system to determine if and how sediments influence biotic communities. Grab samplers and corers are being used to collect sediment samples in SAV beds, algal flats, and unvegetated bay bottom areas.

### **Zooplankton**

A number of field study sites have been established to monitor biofouling in the estuary. This work has also provided data useful for examining the dynamics of meroplankton, larval settlement, and epibenthic community structure. The goal is to develop a more complete database on zooplankton dynamics in JCNERR waters.

### **Submerged Aquatic Vegetation**

Nitrogen over-enrichment can significantly impact seagrass habitat (Kennish et al., 2007a). The JCNERR research and monitoring group completed a three year (2004-2006) submerged aquatic vegetation study in the Barnegat Bay-Little Egg Harbor Estuary, which



characterized the abundance and distribution of seagrass beds in the system (Kennish et al., 2007b, 2008). This study, which included estuarine waters of the JCNERR, is the most comprehensive *in situ* work ever conducted on seagrass habitat in New Jersey. It generated a large database on the demographic characteristics and habitat change of

seagrass in estuarine waters of the JCNERR. It also yielded valuable information on the effects of nitrogen enrichment on the species composition, frequency of occurrence, and potential impacts of benthic macroalgae on the eelgrass beds in the estuary. The results can be found in a report submitted to ERD in January, and a recent publication in the scientific literature (Kennish et al., 2007b; Kennish et al., 2008).

### **Nitrogen Enrichment**

Detailed research is being conducted on the eutrophication of the coastal bays in New Jersey. Nitrogen loading and its impact on submerged aquatic vegetation and fishery resources (e.g., shellfish populations) have been



documented. Eutrophication is the most serious threat to the ecosystems of the New Jersey coastal bays (Kennish et al., 2007a). Nutrient data have been collected extensively in the Barnegat Bay-Little Egg Harbor Estuary since 2004 as part of benthic habitat characterization studies conducted by Rutgers University (Kennish et al., 2007b, 2008). Seagrass blades collected in the estuary in 2008 are being used to establish a nitrogen loading index for the Barnegat Bay-Little Egg Harbor Estuary.

### **Fisheries**

Comprehensive studies are being conducted at the Rutgers University Marine Field Station to determine the habitat needs of resource species such as summer flounder,

striped bass, and bluefish. Acoustic tracking of these species is playing an important role in documenting their habitat requirements. The occurrence of bay scallops (*Argopecten irradians*) and other shellfish species has been investigated in JCNERR estuarine waters using underwater videographic imaging technology that has not been applied at other NERRS sites.

Finfish research has focused on acoustic tracking of recreational and commercial species, such as summer flounder (*Paralichthys*



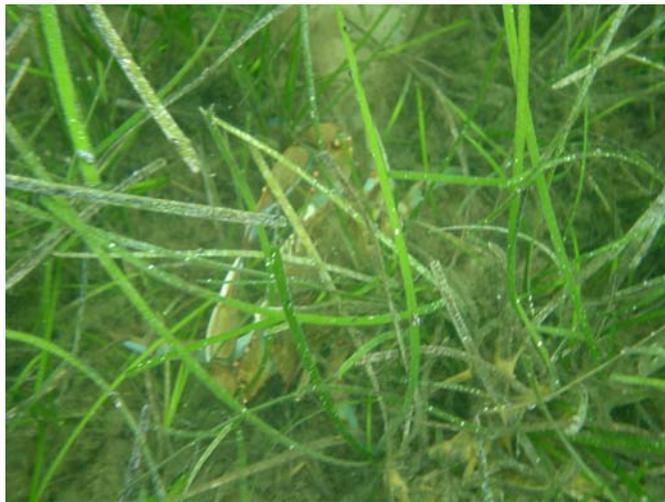
*dentatus*) and striped bass (*Morone saxatilis*). Research on the dynamics of other finfish species in the Great Bay and contiguous waters is ongoing. These studies have revealed detailed behavioral patterns of key finfish species in JCNERR waters.

### **Aquatic Habitat Assessment**

Studies are ongoing to determine habitat requirements of shellfish species (*Mercenaria mercenaria* and *Argopecten irradians*) under increasingly eutrophic

conditions of the Barnegat Bay-Little Egg Harbor Estuary.

Research is also ongoing to determine the dynamics of biofouling populations in the JCNERR. In addition, investigations are ongoing with

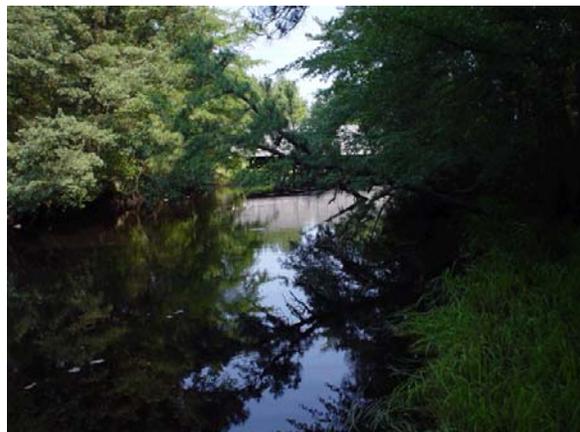


respect to assessing the environmental conditions necessary for the long-term success of seagrass populations in estuarine waters of the JCNERR, determining the impacts of nuisance and toxic algal blooms on seagrass beds and other critical habitat, and recommending to coastal managers the necessary measures for remediation of damaged environments.

### **Stream Water Quality**

The water quality of bay tributaries is coupled to development in watershed areas. For example, in developed areas of the Barnegat Bay watershed, higher concentrations of nitrogen, phosphorus, sulfate, and other inorganic constituents, as well as elevated pH and specific conductance have altered water quality of influent systems (Hunchak-Kariouk et al., 2001). The size of a drainage basin and the type of land cover greatly influence the pollutant loads transported by streams and rivers in the watershed. Undeveloped rural areas with natural vegetative covers yield much lower constituent loads than urban centers and heavily developed residential zones.

Ayers et al. (2001) indicated that human activities associated with urban and agricultural land uses are the principal factors affecting water quality of streams and the health of aquatic life statewide. In areas where forest and wetland habitats are replaced by urban and suburban development, changes in natural flow of streams, habitat conditions, and biodiversity are evident. In addition, shifts toward species more tolerant



of disturbance typically occur. Although pollutants that alter water quality of tributary streams may derive from both point and nonpoint sources, those originating from nonpoint sources are particularly problematic because they are so difficult to control. Nonpoint sources are diffuse and often extend throughout the watershed, whereas point sources are localized and heavily regulated.

U.S. Geological Survey investigations of water quality in New Jersey streams have commonly detected an array of chemical contaminants such as fertilizers, pesticides, and industrial and fuel-related compounds (volatile organic compounds or VOCs) (Nicholson et al., 2003). Analysis of streambed samples has frequently revealed the occurrence of environmentally persistent contaminants (e.g., DDT, PCBs, chlordane, dieldrin, polycyclic aromatic hydrocarbons, and trace metals). Impaired water quality in urban watersheds has been related to increases in impervious surfaces, which facilitate stormwater runoff and inputs of contaminants to tributary streams and estuarine basins. A similar suit of contaminants detected in ground water reflects the impact of human activities associated with developed land and upland agriculture. Especially noteworthy are elevated concentrations of nitrate in shallow ground water underlying agricultural areas in southern New Jersey. Other concerns are with the concentrations of volatile organic compounds and methyl tert-butyl ether (MTBE) which increase in regions of greater residential and industrial land use. Several major factors determine whether chemical contaminants in ground water will reach an estuary. Included here are the physical characteristics of aquifer systems, chemical characteristics of the contaminants, and the various processes taking place in the subsurface near the ground water and

surface water interface that tend to reduce contaminant concentrations (e.g., adsorption, biodegradation, and denitrification).

It is clear, therefore, that human activities can play a significant role in the degradation of surface and ground water resources of New Jersey. The most commonly occurring contaminants associated with human activities that have been documented in New Jersey watersheds are pathogens (disease causing microorganisms), elevated nutrients, organic compounds (e.g., pesticides, PCBs, oil, grease, gasoline), trace elements, and sediments. The pathogens originate from various sources, such as malfunctioning septic systems, leaking sewer lines, improper boat sanitation disposal, and animal waste. Nutrients often derive from fertilizers used for domestic and agricultural purposes, although a substantial amount may also enter estuarine systems via atmospheric deposition. Similarly, trace element inputs are typically linked to atmospheric deposition, as well as acid rain drainage, and industrial waste discharges. Sediments eroded from roadways, construction sites, and farm fields can clog streams, alter stream flow, and degrade aquatic habitats (Kennish, 2001a).

A general pattern of decreasing water quality with increasing watershed development is evident in both the Mullica River watershed (Zampella, 1994; Dow and Zampella, 2000) and the Barnegat Bay watershed (Hunchak-Kariouk et al., 2001; Lathrop and



Conway, 2001). Along a watershed disturbance gradient of increasing development and agricultural land use intensity and wastewater flow in the Mullica River drainage basin, Zampella (1994) and Dow and Zampella (2000) found a gradient of increasing pH, specific conductance, and nutrients (i.e., total nitrate plus nitrite, total ammonia, and total phosphorus). Altered water quality along the watershed disturbance gradient coupled to increasing developed land and upland agricultural cover adversely affects the structure and function of biotic communities in wetland and aquatic systems (Morgan and Philipp, 1986; Zampella and Laidig, 1997; Zampella and Bunnell, 1998). More specifically, the biological consequences of water quality degradation in the impacted areas include invasion of the region's aquatic and wetland plant communities by non-native species and the elimination of native species (Zampella et al., 2001).

Lathrop and Conway (2001) assert that the percentage of impervious surface in a watershed is a strong indicator of the intensity of human land use and the amount of nonpoint source pollution, and it correlates closely with altered runoff patterns and water quality degradation. Watersheds with higher levels of nonpoint source pollution generally are those characterized by more intense development and a larger percentage of impervious surface cover. Over the 10-year period from 1986 to 1995, Lathrop and Conway (2001) calculated that the impervious surface cover in the Barnegat Bay watershed increased from 7% to 8%. In the Mill Creek/Westecunk Creek subwatershed and Tuckerton Creek subwatershed that drain into Little Egg Harbor, the percentage of urban land in 1995 amounted to 14% and 18%, respectively. One important approach to protect the water quality in a drainage basin is to minimize the amount of impervious cover and maximize the amount of undisturbed native vegetative cover.

The U.S. Geological Survey has analyzed surface water quality at more than 100 sites throughout the four physiographic regions of the state. Samples collected at each site four times a year have been analyzed for a number of physical-chemical properties, including nutrients, biological oxygen demand, major ions plus boron, organic carbon, suspended sediment, field parameters (pH, water temperature, specific conductance, dissolved oxygen concentration, and turbidity), pesticides, trace elements, and volatile organic compounds (Watt, 2001). The water quality data have been published annually in water resources data reports of the U.S. Geological Survey. Results of this sampling program indicate that surface water quality in streams of the Mullica River drainage basin is less degraded than that in more heavily developed watersheds in the densely populated northern counties of the state.

### **Estuarine Nutrient Dynamics**

Several studies have examined nutrient concentrations in streams draining the Mullica River Basin (Durand and Nadeau, 1972; Zimmer, 1981; Durand, 1988, 1998; Zampella, 1994). Nitrogen has been the focus of most of these studies because it is the nutrient element principally limiting to primary production in Barnegat Bay, Little Egg Harbor, Great Bay and the other backbay waters of the JCNERR. The fractions of nitrogen measured include ammonium, nitrate, nitrite, and organic nitrogen forms. Phosphate levels have also been measured. Nitrogen concentrations recorded in the Mullica River by the aforementioned studies are as follows: ammonium (0-<10 µgat N/l), nitrate (0->70 µgat N/l), nitrite (0-<2 µgat N/l), and total organic nitrogen (0->60 µgat N/l)). Phosphate typically ranges from 0-<5 µgat P/l.

Durand (1984, 1998) has discussed the processes controlling nitrogen inputs to the Mullica River. The input of nitrogen at the upper drainage area is mainly as nitrate, with highest concentrations observed in streams draining agricultural and urban areas of the Pine Barrens and lowest levels in streams of relatively undisturbed areas of the drainage basin. Much nitrate derived from nitrification of ammonium in farmland soils is not utilized in the Mullica River, which is usually turbid. The nitrate that enters Great Bay and the other coastal bays fuels phytoplankton production. Even when nitrate enters the bays in low concentrations from influent systems, primary production is stimulated. However, primary production in the bays is often limited by low nitrogen concentrations. Light penetration is greater in the less turbid bay waters, where the compensation depth generally extends to the bottom. Benthic regeneration of inorganic nitrogen is an important process in the shallow backbays, but also plays a role in cycling of nitrogen in upriver areas. Phytoplankton nutrient uptake utilizes much of the inorganic nitrogen in the bays, thereby converting most of the nitrogen stocks there to organic form. As a result, the largest fraction of nitrogen transported to the coastal ocean from the bays exits in organic combination (Figure 16).

A conspicuous seasonal pattern of nitrogen concentrations is observed in upriver areas. Both ammonium and nitrate levels peak in these areas during the winter months. Higher concentrations of nitrate occur upriver than in the bay, where levels are reduced to near 0 during summer due to biotic uptake. An upriver to downriver decreasing gradient in nitrate levels is evident year-round. Nitrogen inputs to the coastal bays from the Mullica River and Barnegat Bay watersheds regulate primary production in the coastal bays. As summarized by Durand (1984, p. 49), “A balance between nitrogen input into

the bays, cycling by regeneration, primary production, and light penetration exists such that nitrogen enters the system largely as nitrate in the upper drainage and leaves the estuary to the nearshore ocean as organic nitrogen.”

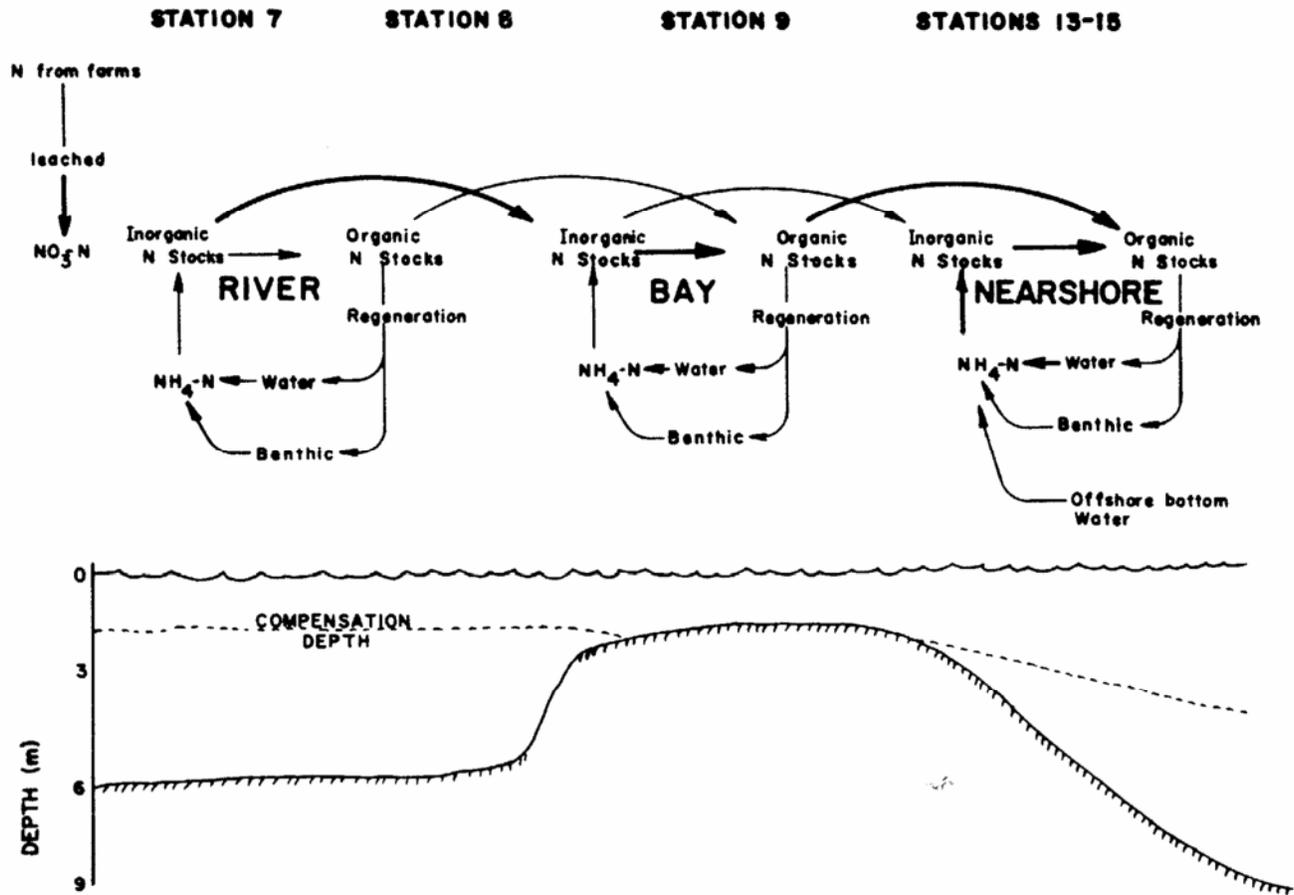


Figure 16. Schematic model of the Mullica River-Great Bay Estuary, exhibiting nitrogen dynamics through the system. From Durand, J. B. 1984. Nitrogen distribution in New Jersey coastal bays. In: M. J. Kennish and R. A. Lutz (eds.), *Ecology of Barnegat Bay, New Jersey*. Springer-Verlag, New York, pp. 29-51.

McGuirk Flynn (2008) examined how the biogeochemical processes and hydrological dynamics in the Mullica River-Great Bay Estuary influence the distribution, flux, and fate of DOM and DIN. In a study of nutrients in the estuary during the 2002 to 2004 period, she observed seasonal cycles for DOC, DON, and DOP, with concentrations increasing from spring to fall, and maximum concentrations occurring in the summer and early fall. The temporal distribution of DOC, DON, and DOP may be attributed to a combination of seasonal terrestrial sources and autochthonous primary production. Data from this study suggest seasonal watershed inputs of DOM may be significant in regulating the observed seasonal cycle of DOM within this estuarine system. Watershed inputs of DOM likely have a greater influence on the temporal distribution of DOM in the upper estuary and mid-estuary regions than in the lower estuary and coastal bay inlet. Autochthonous DOM production may be of greater importance in regulating the distribution of DOM in the lower estuary and coastal bay inlet than in the upper estuary and mid-estuary regions.

The annual mean export of DIN ( $15.7 \times 10^6 \text{ mol yr}^{-1}$ ) and DON ( $17.4 \times 10^6 \text{ mol yr}^{-1}$ ) from the lower estuary to the coastal area was approximately equal. During transport through the estuarine system, it appears that a portion of the DIN in the TDN pool is converted to DON, resulting in an equal export of DIN and DON to the coastal area. The annual mean export of DIP ( $0.76 \times 10^6 \text{ mol yr}^{-1}$ ) and DOP ( $0.44 \times 10^6 \text{ mol yr}^{-1}$ ) represented approximately 63% and 37%, respectively, of the total TDP exported from the lower estuary to the coastal area during this study period. The increase in the DIP fraction of the TDP pool may be attributed to release of DIP from particulate phosphorus during transport through the estuarine system.

The total estuarine system is a net source of DOC, DON, and DIP and a net sink of DIN on an annual time scale. In contrast, DOP is likely in balance within the total estuarine system. The upper estuary is a net sink of DIN, DON, and DIP, whereas the lower estuary is a net source. DOP in the upper estuary and lower estuary appears to be in balance on an annual time scale. In contrast, the mid-estuary region appears to be a clear sink of DOP. A LOICZ model estimates that this estuarine system is net heterotrophic, consuming 1.1 to 1.4 mol C m<sup>-2</sup> yr<sup>-1</sup>. Furthermore, the lower estuary is estimated as net heterotrophic, consuming an estimated 1.8 to 5.8 mol C m<sup>-2</sup> yr<sup>-1</sup>.

In summary, nitrate is the primary limiting nutrient in the Mullica River-Great Bay Estuary. On rare occasions, phosphate may be limiting. Based on the work of Durand and Nadeau (1972), nitrite never accounts for more than 3% of the total inorganic nitrogen in the system. Ammonium comprises most of the inorganic nitrogen present in Great Bay, and nitrate most of the inorganic nitrogen present upriver (i.e., in the Mullica River). Particulate carbon (i.e., detritus production) also appears to be greatest in upriver areas.

According to McGuirk Flynn (2008), the entire estuarine system is a net source of nutrients with the exception of DIN and DOP. The lower estuary acts as a net exporter of all dissolved organic and inorganic nutrients to the nearshore coastal area, serving as a potentially significant source of nutrients for primary production in the nearshore coastal region. This estuarine system appears to serve an important role in the cycling and processing of dissolved nitrogen and phosphorus, ultimately controlling the fraction of organic and inorganic nitrogen and phosphorus delivered to the coastal zone.

## Estuarine Water Quality

Able et al. (1992) analyzed long-term measurements of temperature (Appendix 5), salinity (Appendix 6), tides (Appendix 7 and 8), and other hydrographic conditions at the Rutgers University Marine Field Station (RUMFS) on Great Bay over the 15-year period from 1976 through 1990. They showed that water temperature at the station ranged from 0.1-25.2°C and salinity from 23.6-34.5‰ during this period. Highest salinities were registered during the summer and fall seasons (Figure 17). Mean turbidity at RUMFS ranged from 4.9-17.9 NTU, although no seasonal trends were apparent (Appendix 9).

Commencing in August 1996, Rutgers University began an intense water quality monitoring effort by using data loggers to measure six physical-chemical parameters at two sites (Buoy 126 and Buoy 139 in Great Bay) as part of JCNERR program.



Subsequently, data loggers were also deployed in the Mullica River at Chestnut Neck (September 1996) and Lower Bank (October 1996), as well as at Little Sheepshead Creek (April 1997), Nacote Creek (May 1997), and Tuckerton Creek (November 1998). The Nacote Creek monitoring site was discontinued in December 1998. A limited data logger deployment (March-June 2000) was conducted in Lake Pohatcong and at Mill Run. Data logger deployment was temporarily discontinued at Buoy 139 in Great Bay in July 1999, but was resumed in May 2002 and later discontinued again.

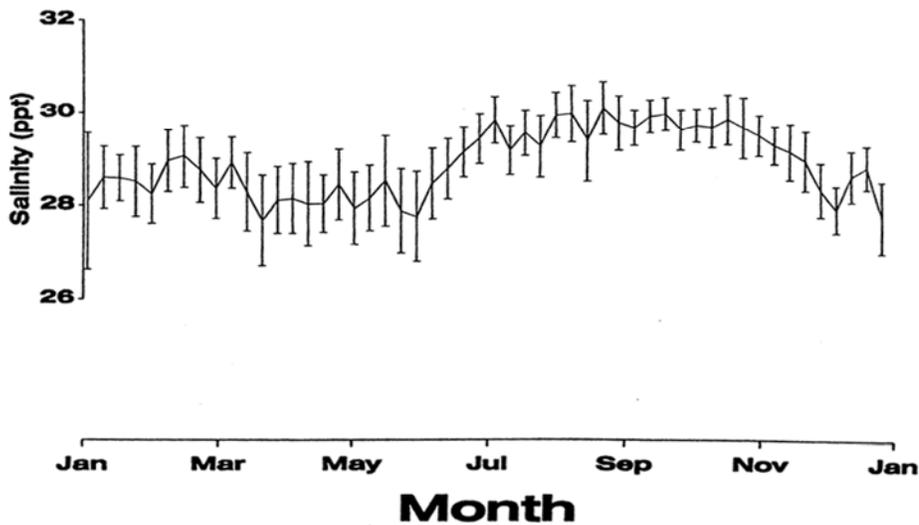


Figure 17. Mean monthly salinity recorded at the Rutgers University Marine Field Station on Great Bay during the period from 1976 through 1990.

JCNERR currently monitors physical-chemical parameters at four SWMP aquatic sites in the reserve system using YSI 6-series data loggers (Figure 18). These instruments are programmed to simultaneously record six physical-chemical parameters (i.e., water temperature, salinity, dissolved oxygen (mg/l and % saturation), pH, turbidity, and water depth). These measurements are recorded over a two-week period, and the data loggers are then switched out with newly programmed data loggers at the end of the deployment period. The monitoring sites cover a distance of ~33 km, extending from the freshwater/saltwater interface at Lower Bank, downriver to Chestnut Neck, into the polyhaline waters of Great Bay at Buoy 126 and Buoy 139 (Figure 18). As noted previously, physical-chemical data are also collected in nearshore ocean waters at LEO-15, although not with 6-series data loggers. Monitoring data in the program are available over the Internet at <http://marine.rutgers.edu/rumfs/RUMFSdata.htm>.

Each YSI data logger is inserted into a 3-6 m length of Schedule 40 PVC pipe when deployed in the field. The pipe is positioned vertically in the water column, being attached to a buoy, bridge piling, or other stabilized structure. Prior to deploying the PVC pipe, slots 2.5-cm wide and 20-cm long are cut 15 cm above the bottom such that they encircle the pipe. A 1.2-cm bolt is placed below the pipe slots to prevent the data logger from falling through the pipe to the estuarine floor when deployed. A PVC cap with a locking mechanism is then placed over the pipe. A rope is attached to the cap and the opposite end fastened to the bail of the data logger for retrieval of the instrument.

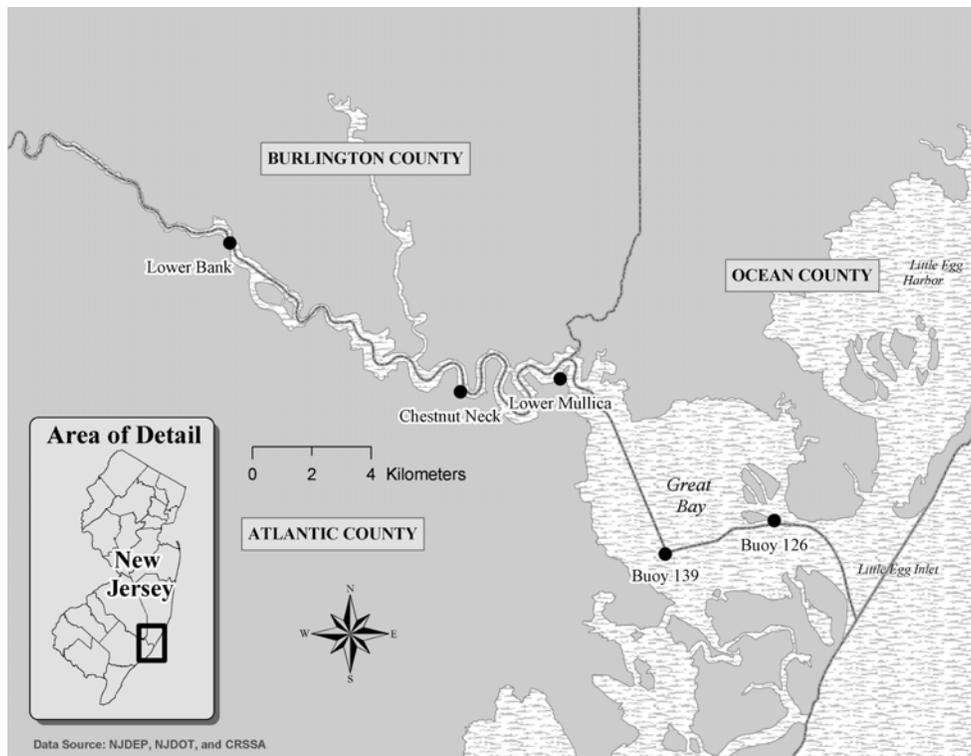


Figure 18. Map of the Jacques Cousteau National Estuarine Research Reserve showing the location of the System-wide Monitoring Program sites (closed circles) for water quality assessment in the Mullica River-Great Bay Estuary. The Lower Mullica River site was discontinued in 1998. Inset displays the location of the reserve with respect to the state of New Jersey.

Every 15 minutes during the deployment period, the programmed data loggers record temperature, salinity, dissolved oxygen (mg/l and % saturation), pH, turbidity, and water depth. At the end of the deployment period (~14 days), the data logger is removed from the PVC pipe, and then a YSI 600 data logger attached to a YSI 610-DM handheld unit is lowered into the pipe to record *in-situ* post-retrieval conditions at the same depth. These post-retrieval readings are compared to the last deployment values to provide “ground-truthing.” Irregular and spurious data observed during this process are documented on deployment records. A newly calibrated and programmed YSI data logger is subsequently switched with the previously deployed instrument. The replaced data logger is returned to the laboratory for downloading of data, re-calibration, and re-programming prior to being exchanged at a different monitoring site.

The beginning and end of each data file are compared to the YSI 600 readings, and the data are checked for probe failure and fouling. The data loggers are programmed to start recording data a few hours before being deployed in the field. Records are maintained indicating which data loggers are used at each location and if any specific problems exist with the data loggers and their probes.



Uploading, cleaning, maintenance, and calibration are conducted as described in the YSI Operating Manual. Calibration standards required for pH and conductivity are purchased from a scientific supply house. A two-point calibration is used for pH, the first

being pH 7 followed by pH 4. The lower pH standard is used because of the more acidic properties of the Mullica River. A standard of 20,000  $\mu\text{S}/\text{cm}$  is employed to calibrate for conductivity. The membrane on the oxygen probe is changed with every deployment, and it is carefully examined during the maintenance and calibration process. Servicing an instrument generally takes about two hours for each data logger plus the time involved with retrieval and deployment.

The longest monitored SWMP site in the JCNERR is Buoy 126, located at 39°30.478'N, 74°20.308'W on the eastern side of Great Bay ~100 m from the nearest land mass (i.e., natural marsh island). Semidiurnal tides (range = 0.68-1.55 m) characterize the site, and tidal currents range from ~3.5-5.5 km/hr. Bottom sediments consist of fine- to coarse-grained sands. Mean physical-chemical measurements recorded at this site during 2000 are as follows: temperature (13.5°C, with a range of -1.7-27.1°C); salinity (29.6‰, with a range of 22.5-33.3‰); dissolved oxygen (9.5 mg/l, with a range of 3.2-16.0 mg/l) (104.0% saturation, with a range of 42.8-159.8% saturation); pH (7.95, with a range of 7.0-8.4); turbidity (11.18 NTU, with a range of 0-196.0 NTU); and water depth (3.05 m, with a range of 0.59-4.29). Measurements of pH were highly variable between data logger deployments in 2000, possibly due to fouling of the original pin-hole-style pH probe on YSI 6000 units.

The Mullica River is ~65 km long with an average depth and width of 12.8 m and 590 m, respectively. The Chestnut Neck SWMP site is located in the Mullica River at 39°32.872'N, 74°27.676'W. The width of the river at this location is ~250 m. Tidal currents are less than 2 km/hr at this site during both ebb and flood tide. The data logger is attached to the dock of a small marina along the southern shore of the river adjacent to

the main channel. Here, the bottom sediments consist of sand. Mean physical-chemical data recorded at this site during 2000 are as follows: temperature (14.8°C, with a range of -1.3-27.7°C); salinity (15.0‰, with a range of 4.1-26.9‰); dissolved oxygen (8.6 mg/l, with a range of 4.6-13.7 mg/l) (88.1% saturation, with a range of 61.3-115.3% saturation); pH (7.4, with a range of 6.6-8.1); turbidity (7.9 NTU, with a range of 0-107.0 NTU); and water depth (1.73 m, with a range of 0.27-2.63 m).

The other SWMP data logger site in the Mullica River is at Lower Bank (39°35.618'N, 74°33.091'W). At this location, the Mullica River is ~200 m wide, and a data logger is attached to the center of a bridge spanning the river. Semidiurnal tides characterize the Lower Bank site, with the tidal range being 0.46 m to 1.55 m. Here, tidal currents are ~2 km/hr. As a result, bottom sediments consist of cohesive fine sand. Mean physical-chemical measurements recorded at this site for 2000 are as follows: temperature (15.3°C, with a range of -0.7-29.6°C); salinity (2.1‰, with a range of 0-11.2‰); dissolved oxygen (9.2 mg/l, with a range of 3.1-14.9 mg/l) (88.0% saturation, with a range of 39.3-110.5% saturation); pH (6.2, with a range of 4.5-7.7); turbidity (24.3 NTU, with a range of 16.3-32.4 NTU); and water depth (1.73 m, with a range of 0.63-2.58 m).

In addition to these three SWMP sites, physical-chemical data are measured at Buoy 139 in Great Bay and periodically in nearshore ocean waters at LEO-15, about 9 km east of Little Egg Inlet. At LEO-15, continuous observations of coastal ocean processes are made at two instrumented platforms (known as Node A, 74°15.73'W, 39°27.70'N and Node B, 74°14.75'W, 39°27.41'N) anchored to the seafloor and spaced 1.5 km apart. Optical fibers transfer site data in 1-second intervals to computers at the

RUMFS. These data are fed to the Internet and are made immediately available at the Institute of Marine and Coastal Sciences at Rutgers University in New Brunswick, New Jersey.

Water quality has been monitored in Tuckerton Creek for extensive periods since November 1998, and the data loggers have periodically provided real time data to the visitors of the historic Tuckerton Seaport. Tuckerton Creek is a tidally influenced water body with freshwater inflow from nearby Lake Pohatcong. Similar to the Mullica River, Tuckerton Creek receives significant amounts of tannic acids leached from soils of the Pine Barrens. Lake Pohatcong and Mill Run were monitored with YSI data loggers in the spring of 2000 to obtain additional data for a potential fish stocking program and installation of a fish ladder on Lake Pohatcong. Both of these freshwater systems are characterized by low pH. Water quality has been sampled in Little Sheepshead Creek since April 1997 in support of long-term ichthyoplankton sampling, which has been conducted in the creek by RUMFS personnel for nearly two decades.

It is important to note that, while data loggers have provided near-continuous measurements of physical-chemical factors at the monitoring sites, data gaps do exist due to equipment failure, unusual environmental events, and adverse weather conditions. Another problem leading to potentially spurious data readings is an apparent systematic downward “drift” in dissolved oxygen measurements recorded by the data loggers 3-5 days after their deployment. Wenner et al. (2001) suggested that this drift may have been caused by fouling of living organisms on the membrane covering the oxygen probe. These data have been removed from the database. Despite these deficiencies, this long-

term water quality monitoring program has effectively created a large database to assess environmental conditions at the NERRS system of estuaries.

Physical-chemical data collected in the JCNERR to date show that water quality varies considerably from the Lower Bank to LEO-15 monitoring sites. Although waters of both the Mullica River and Great Bay are relatively pristine, some fundamental differences in water chemistry are apparent. For example, the river contains high concentrations of tannins and humic compounds which discolor the water dark brown. These substances originate in the Pine Barrens. They tend to sorb to particulate matter and settle to the bay bottom. Thus, water clarity in the bay is greater than in the river.

Data collected at the monitoring sites also help to address issues related to estuarine circulation. For instance, because of the close proximity of the lower bay station (Buoy 126) to Little Egg Inlet, investigators have been able to examine tidal current flow into Great Bay. The upwelling of seawater from the coastal ocean into the Great Bay may significantly influence the transport of fish and shellfish larvae, as well as other organisms, up estuary. This colder ocean water that enters the bay can also have dramatic effects on the growth rates of organisms inhabiting the estuary. JCNERR data loggers provide the means to effectively track certain events within the estuary such as occurrences of upwelling, storms, and storm surges.

### **Meteorology**

Meteorological data are collected at the Richard Stockton College Marine Science and Environmental Field Station at Nacote Creek. This meteorological station is unique in that it has two collection platforms (at 10 m and 19 m elevation) for wind speed and

direction, and all data are available in real time at the Institute of Marine and Coastal Sciences website (<http://marine.rutgers.edu>). The weather station records wind speed and direction, air temperature, short wave radiation, photosynthetically active radiation, barometric pressure, and relative humidity. In addition, precipitation is also recorded. This station has been collecting SWMP meteorological data since September 2002.

The weather station is located approximately 14.3 km WSW of Little Egg Inlet, the primary saltwater influence of the JCNERR. The unit is mounted on a 13-m tower adjacent to the Nacote Creek, approximately 20 m from the high tide line. The elevations above the marsh surface are as follows: barometric pressure - 2.2 m, temperature and relative humidity - 2.9 m, PAR - 4.5 m, wind - 12.5 m, and the highest point on the tower (lightning rod) - 14 m. The rain gauge is approximately 2.1 m above the surface and 1.5 m north of the tower. The area is sparsely covered with clam shell debris and upland grasses.

Meteorological parameters are measured every 5 seconds to produce 15-minute averages of air temperature, relative humidity, barometric pressure, rainfall, wind speed, wind direction, and PAR (Table 5). An instantaneous sample is taken every 15 minutes. Telemetry equipment was installed at the Nacote Creek Meteorological station on November 15, 2005, and it transmits data to the NOAA GOES satellite, NESDIS ID #3B00D112. The transmissions are scheduled hourly and contain four data sets reflecting 15-minute sampling intervals. By this process, the JCNERR effectively contributes to the Integrated Ocean Observing System (IOOS).

Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from LoggerNet in a comma-delimited format and

uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing, out of sensor range, or outside 2 or 3 standard deviations from the historical seasonal mean. The edited file is then returned to the JCNERR where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database.

Table 5. Monthly averages of select meteorological parameters at the JCNERR during 2007.

| Month (Avg.)      | Air Temp (°C) | RH (%)    | BP (mb)     | Wspd (m/s) | Wdir (degrees) | PAR (mmoles/m <sup>2</sup> ) |
|-------------------|---------------|-----------|-------------|------------|----------------|------------------------------|
| JANUARY           | 4.0           | 69        | 1017        | 3.0        | 237            | 137.6                        |
| FEBRUARY          | -1.7          | 58        | 1014        | 3.4        | 242            | 213.4                        |
| MARCH             | 5.9           | 63        | 1020        | 3.5        | 212            | 296.5                        |
| APRIL             | 9.4           | 69        | 1011        | 3.5        | 205            | 302.8                        |
| MAY               | 16.9          | 67        | 1019        | 3.1        | 192            | 458.9                        |
| JUNE              | 21.5          | 73        | 1013        | 2.8        | 204            | 411.7                        |
| JULY              | 23.5          | 74        | 1013        | 2.5        | 203            | 408.0                        |
| AUGUST            | 23.4          | 79        | 1014        | 2.5        | 187            | 302.4                        |
| SEPTEMBER         | 19.8          | 75        | 1020        | 2.4        | 199            | 386.5                        |
| OCTOBER           | 17.1          | 81        | 1019        | 2.8        | 200            | 259.6                        |
| NOVEMBER          | 7.3           | 74        | 1019        | 2.7        | 229            | 159.6                        |
| DECEMBER          | 3.3           | 79        | 1020        | 2.8        | 218            | 113.8                        |
| <b>YEAR (avg)</b> | <b>12.5</b>   | <b>72</b> | <b>1016</b> | <b>2.9</b> | <b>211</b>     | <b>287.6</b>                 |
| Std. dev. (YEAR)  | 8.82          | 6.67      | 3.25        | 0.39       | 17.40          | 114.78                       |

Sensors on the weather station are inspected monthly for damage or debris. If any is found, it is repaired and/or cleaned. Sensors are removed and returned to Campbell Scientific for calibration at a minimum of every two years, depending on sensor specifications. Tables 5 and 6 show monthly averages recorded on specific meteorological parameters at the weather station during 2007.

Table 6. Monthly rainfall totals recorded by the JCNERR weather station during 2007.

| <b>Month (total)</b> | <b>Precipitation (mm)</b> |
|----------------------|---------------------------|
| JANUARY              | 98.1                      |
| FEBRUARY             | 73.9                      |
| MARCH                | 108.3                     |
| APRIL                | 138.5                     |
| MAY                  | 23.6                      |
| JUNE                 | 131.9                     |
| JULY                 | 54.6                      |
| AUGUST               | 82.2                      |
| SEPTEMBER            | 54.2                      |
| OCTOBER              | 0.6                       |
| NOVEMBER             | 36.6                      |
| DECEMBER             | 180.4                     |
| <b>YEAR</b>          | <b>982.9</b>              |

NERRS SWMP mandates that meteorological data collected by all reserves must be documented, edited, and submitted along with metadata to the CDMO on a regular schedule. These data, together with SWMP water quality data, constitute some of the most detailed measurements on physical-chemical parameters ever recorded in estuaries. They provide the basis for determining if environmental conditions in these coastal ecosystems are improving, deteriorating, or remaining unchanged through time.

## **Water Quality Monitoring - Data Years 1996-1998**

Wenner et al. (2001) analyzed water quality data collected at 44 NERRS sampling sites nationwide, including those of the JCNERR. This analysis covered the data years between 1996 and 1998. The following discussion of water quality data on the JCNERR largely derives from the work of Wenner et al. (2001) based on water sampling conducted by reserve site personnel.

Focusing on two sampling sites in the JCNERR (i.e., Lower Bank and Buoy 126), Wenner et al. (2001) presented a suite of graphical data analysis techniques and statistical testing procedures to assess water quality conditions. At the Lower Bank site, temperature, salinity, and dissolved oxygen data recorded during 41 data logger deployments between August 1996 and November 1998 were analyzed statistically. The data loggers were deployed at a mean depth of 1.7 m below sea level and 0.3 m above the river bottom. Mean seasonal water temperatures at the site typically varied from 2-5°C in winter to 24-26°C in summer, with the minimum and maximum temperatures being 0.2°C (January 1997) and 30.1°C (July 1997), respectively. Tidal cycles were responsible for 60% of the temperature variance based on harmonic regression analysis.

Salinity at the Lower Bank site averaged 0-2‰ in winter and spring and 2-8‰ in summer and fall 1997-1998. The salinity ranged from a minimum of 0‰ to a maximum of 15.6‰. Nearly every month of data contained 0‰ salinity readings from this site.

During the 1996-1998 period, hypoxia was observed at all estuarine reserves in the Mid-Atlantic region except the JCNERR. Dissolved oxygen at Lower Bank typically ranged from 85-105% saturation year-round. Mean dissolved oxygen values were lowest in summer (80-100% saturation) and highest in winter (105-125%). Although hypoxia

did not occur at the study site, supersaturation was documented periodically in the system. The percent saturation fluctuated 20-40% over daily and biweekly cycles during the year. Wenner et al. (2001) ascribed 38%, 34%, and 28% of the dissolved oxygen variance to diel cycles, tidal cycles, and tidal-diel cycle interaction, respectively.



Water temperature at Buoy 126 followed a similar seasonal cycle as at Lower Bank. Between 1996 and 1998, water temperature at Buoy 126 ranged from  $-1.4^{\circ}\text{C}$  (January 1997) to  $28^{\circ}\text{C}$  (August 1998). Mean winter temperatures were typically  $4\text{-}6^{\circ}\text{C}$ , and mean summer temperatures,  $22\text{-}24^{\circ}\text{C}$ . Daily ( $1\text{-}2^{\circ}\text{C}$ ) and biweekly ( $3\text{-}10^{\circ}\text{C}$ ) temperature fluctuations were observed year-round. Tidal cycles accounted for 60% of the temperature variance as demonstrated by harmonic regression analysis.

Salinity at Buoy 126 ranged from 13‰ (May 1998) to 35.4‰ (April 1997). The mean salinity for the data set was 25-31‰, although strong daily and biweekly variations were documented. Tidal cycles were responsible for 82% of the salinity variance.

Mean dissolved oxygen at Buoy 126 regularly exceeded 100% saturation, with the range generally between 85-120% saturation. As at Lower Bank, hypoxia was never evident at Buoy 126. While moderate fluctuations (20-40%) in % saturation were discerned for daily and bi-weekly cycles, supersaturation was documented during eight

months in the summer and fall of 1996-1998. Wenner et al. (2001) ascribed 41% of dissolved oxygen variance at this site to interaction between tidal and diel cycles, 34% of dissolved oxygen variance to tidal cycles, and 25% of dissolved oxygen variance to diel cycles. Based on observations at Buoy 126 and Lower Bank, the Mullica River-Great Bay Estuary appears to be a well-oxygenated system.

### **Water Quality Monitoring - Data Years 1999-2000**

Appendix 10 provides summary statistics for environmental parameters monitored at three SWMP sites (i.e., Buoy 126, Chestnut Neck, and Lower Bank) in the JCNERR for data years 1999 and 2000 (covering the period from December 1998 to November 2000). The parameters of concern include temperature ( $^{\circ}\text{C}$ ), salinity ( $\%$ ), dissolved oxygen (mg/L and  $\%$  saturation), pH, turbidity (NTU), and water depth (m). Appendix 11 and Appendix 12 show statistical results of ANOVA applications on these data. Environmental parameters across sites are compared for 1999 (Appendix 11) and 2000 (Appendix 12). Appendix 13 provides the results of t-tests comparing environmental parameters between years (1999 and 2000).

### **Temperature**

Water temperature followed a well-defined seasonal cycle at all three SWMP sites (Figure 19). Minimum (winter) and maximum (summer) temperatures during the 1999-2000 study period were  $1.7^{\circ}\text{C}$  and  $27.9^{\circ}\text{C}$  at Buoy 126,  $-1.3^{\circ}\text{C}$  and  $29.39^{\circ}\text{C}$  at Chestnut Neck, and  $-0.7^{\circ}\text{C}$  and  $31.5^{\circ}\text{C}$  at Lower Bank. The mean temperature was highest at Lower Bank for both 1999 ( $13.76^{\circ}\text{C}$ ) and 2000 ( $15.69^{\circ}\text{C}$ ). Analysis of variance

(ANOVA) models were run using the SAS statistical software package. The ANOVA determinations indicated no significant difference ( $P > 0.05$ ) in mean temperatures among monitoring sites during 1999. However, a significant difference ( $P < 0.05$ ) in mean temperatures among monitoring sites occurred in 2000. The application of standard statistical tests revealed a significantly higher ( $P < 0.05$ ) mean temperature at Chestnut Neck and Lower Bank than at Buoy 126 in 2000.



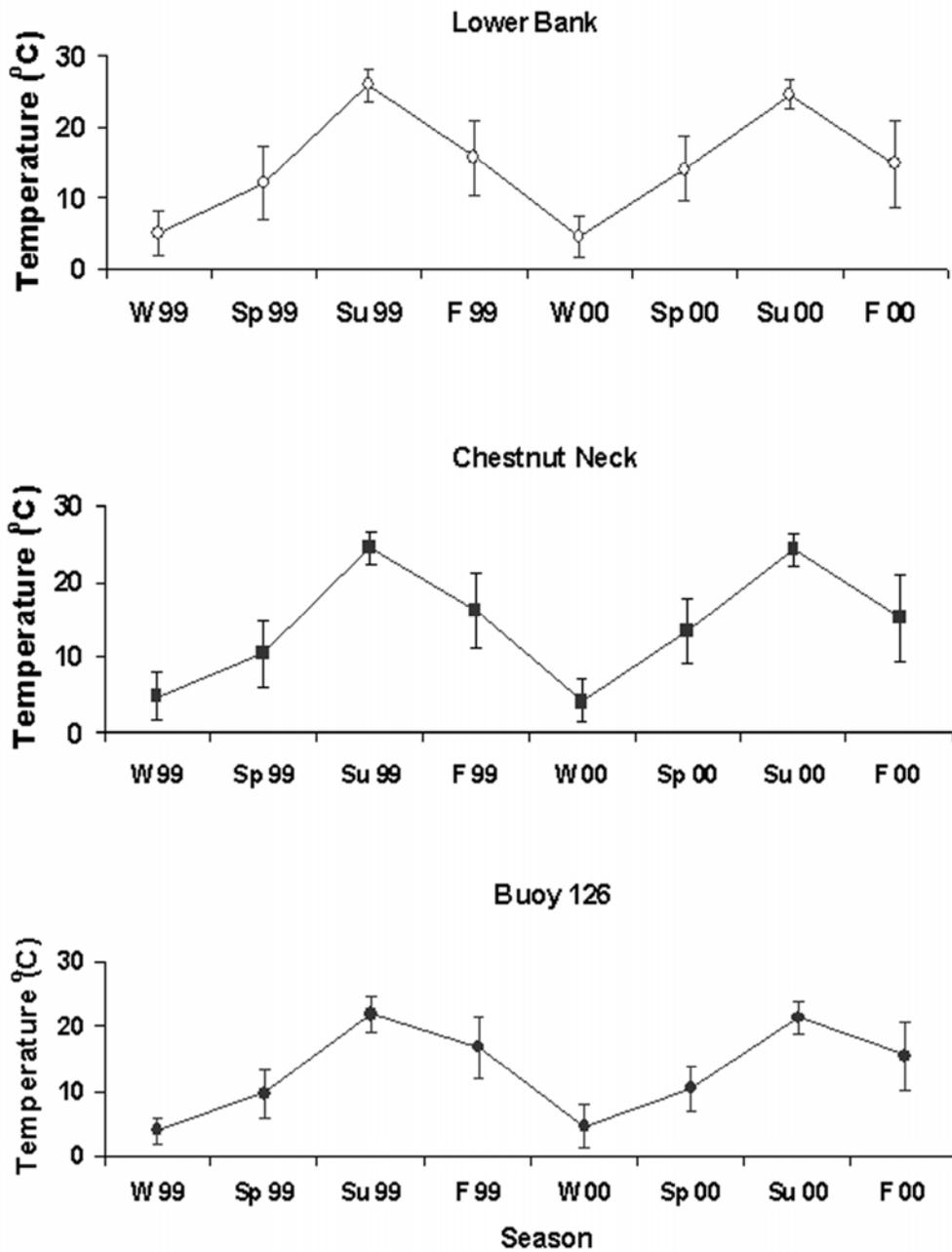


Figure 19. Mean seasonal water temperature and standard deviation values at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

The mean temperature at Chestnut Neck and Lower Bank was not significantly different ( $P > 0.05$ ) between years (1999 and 2000). However, it was significantly different ( $P < 0.05$ ) between years at Buoy 126 (Appendix 13). This difference may reflect the effect of coastal upwelling and other aperiodic factors at this site.

### **Salinity**

A pronounced salinity gradient exists from the head to the mouth of the Mullica River-Great Bay Estuary, and this gradient is reflected in salinity measurements obtained at the SWMP sites (Figure 20). Salinity levels are lowest at Lower Bank (generally  $< 5\text{‰}$ ),



which marks the freshwater/saltwater interface  $\sim 25$  km upstream of the Mullica River mouth. Intermediate salinity levels ( $\sim 15\text{‰}$ ) are found at Chestnut Neck located  $\sim 13$  km upstream of the Mullica River mouth. Highest salinity levels ( $> 25\text{‰}$ ) are recorded at Buoy 126 in the lower estuary.

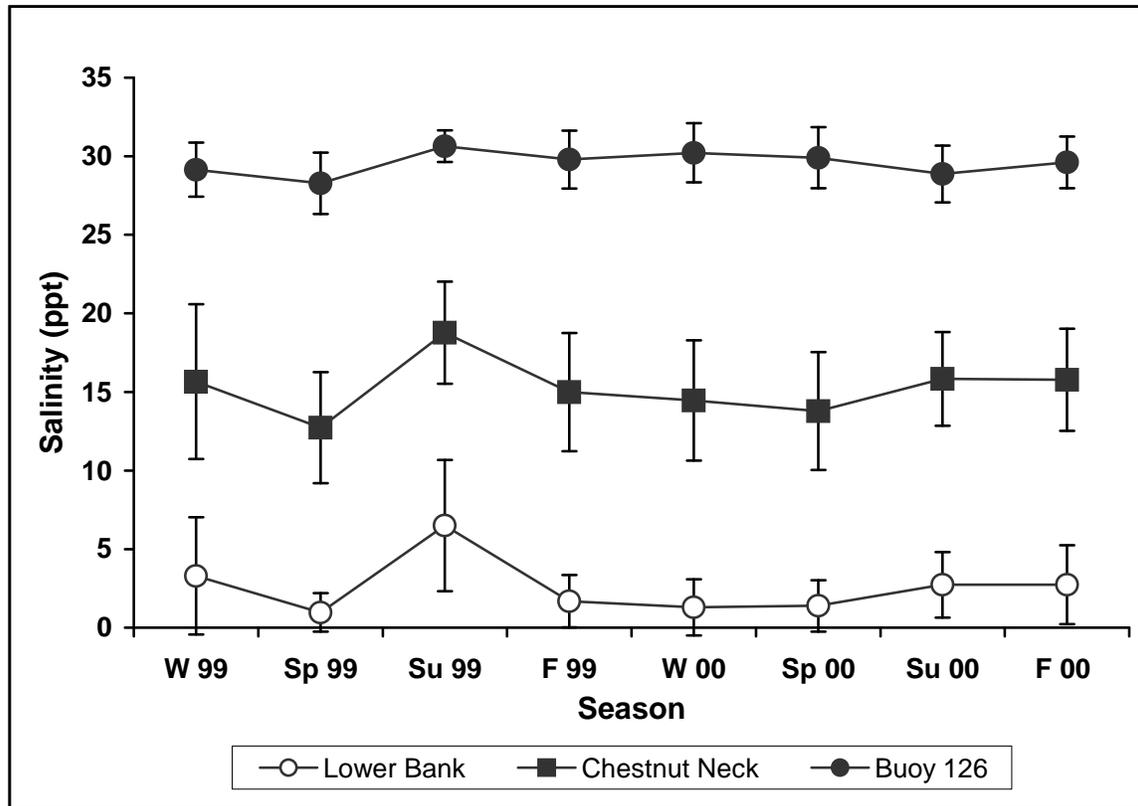


Figure 20. Mean seasonal salinity and standard deviation values at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

Lowest salinities at the SWMP sites during the two-year study period were recorded during spring 1999, with mean seasonal values amounting to 0.98‰ at Lower Bank, 12.73‰ at Chestnut Neck, and 28.27‰ at Buoy 126. Highest salinities, in turn, were observed during summer 1999 when drought conditions persisted throughout New Jersey. Mean salinities at this time were 6.49‰ at Lower Bank, 18.77‰ at Chestnut Neck, and 30.63‰ at Buoy 126 (Figure 20). Mean salinities at the three monitoring sites were significantly different ( $P < 0.05$ ) for both 1999 and 2000. Using standard statistical

tests, the mean salinity at Buoy 126 was shown to be significantly greater ( $P < 0.05$ ) than that at Chestnut Neck and Lower Bank, and the mean salinity at Chestnut Neck was shown to be significantly greater ( $P < 0.05$ ) than that at Lower Bank. Substantial differences in the salinity levels exert a major controlling influence on the composition, abundance, and distribution of estuarine organisms at these three SWMP sites.

The mean salinity at Buoy 126 was not significantly different ( $P > 0.05$ ) between years (1999 and 2000). However, it was significantly different ( $P < 0.05$ ) between years (1999 and 2000) at Chestnut Neck and Lower Bank. Variable runoff and freshwater input to the Mullica River between years may be responsible for the observed differences at the Mullica River sites.

### **Dissolved Oxygen**

Consistently high dissolved oxygen levels were documented at the SWMP sites in 1999 and 2000, and hypoxia was not observed. Seasonal variation of dissolved oxygen was conspicuous, with highest values observed during the winter and lowest values during the summer (Figure 21). The highest dissolved oxygen concentrations for both years were registered at Buoy 126, with mean values being 9.63 mg/l and 9.51 mg/l for 1999 and 2000, respectively. Lowest dissolved oxygen levels were measured at Lower Bank in 1999 (mean = 8.98 mg/l) and at Chestnut Neck in 2000 (mean = 8.64 mg/l).

Mean dissolved oxygen concentrations were significantly different ( $P < 0.05$ ) among the three SWMP sites for both 1999 and 2000. Standard statistical tests applied to these data revealed that the mean dissolved oxygen concentration at Chestnut Neck was significantly lower ( $P < 0.05$ ) than that at Lower Bank and Buoy 126 in 1999. The mean

dissolved oxygen levels at the latter two sites were also significantly different ( $P < 0.05$ ). During 2000, the mean dissolved oxygen concentration was significantly higher ( $P < 0.05$ ) at Buoy 126 than at Lower Bank and Chestnut Neck. The mean dissolved oxygen level at Lower Bank was significantly higher ( $P < 0.05$ ) than at Chestnut Neck

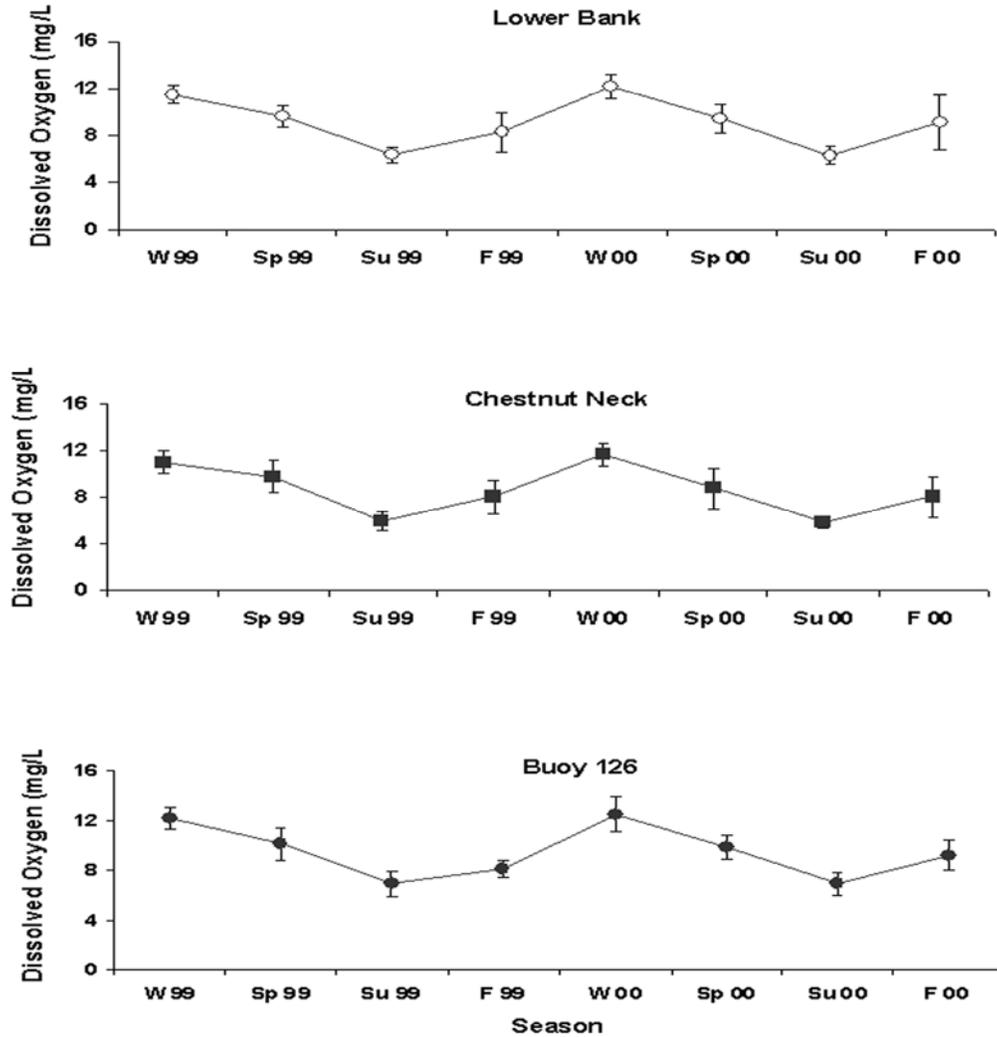


Figure 21. Mean seasonal dissolved oxygen concentrations (mg/l) at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

There was no significant difference ( $P > 0.05$ ) in the mean dissolved oxygen (mg/l) concentration between the years 1999 and 2000 at Buoy 126. However, a significant difference ( $P < 0.05$ ) in mean dissolved oxygen concentration between years was evident at Chestnut Neck and Lower Bank. The mean dissolved oxygen concentration was high both years, averaging 9.54 mg/l in 1999 and 9.51 mg/l in 2000.

Seasonal averages of dissolved oxygen (% saturation) for the three SWMP sites typically ranged from ~80-120% (Figure 22). Highest dissolved oxygen % saturation values were recorded at Buoy 126. Here, mean dissolved oxygen commonly exceeded 100% saturation. Supersaturation was periodically observed at all the SWMP sites during the summer and fall seasons.

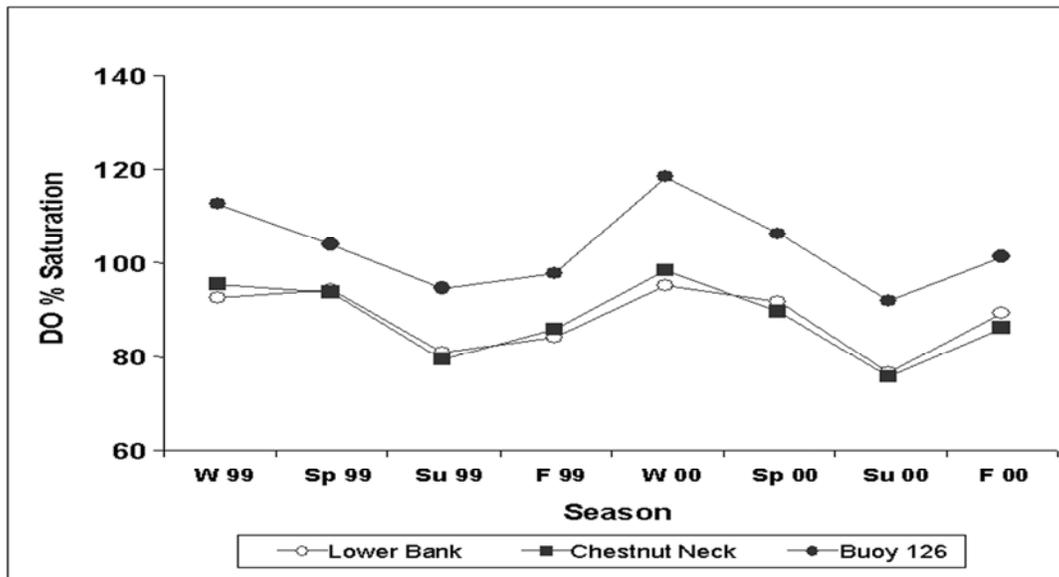


Figure 22. Mean seasonal dissolved oxygen levels (% saturation) at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

## pH

Salinity and dissolved oxygen concentrations influence pH levels. High concentrations of tannins and humic acids in the Mullica River also affect pH. As a result, pH values at Lower Bank and Chestnut Neck are substantially lower than those at Buoy 126 (Figure 23). The pH values progressively increase from upriver areas to the open waters of Great Bay.

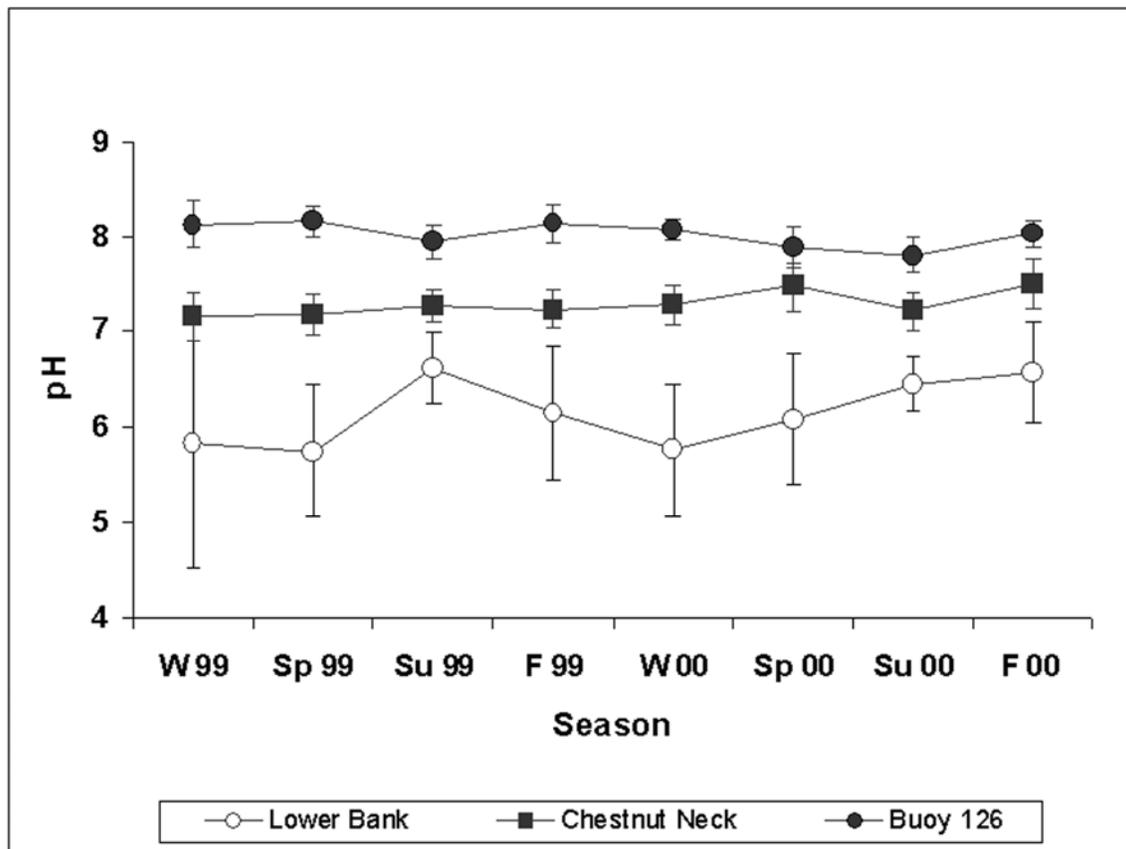


Figure 23. Mean seasonal pH and standard deviation values at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

In 1999, the mean values of pH recorded at the three SWMP sites were as follows: Lower Bank, 6.14; Chestnut Neck, 7.20; and Buoy 126, 8.10. In 2000, the mean values of pH registered at the three SWMP sites were as follows: Lower Bank, 6.24; Chestnut Neck, 7.37; and Buoy 126, 7.95. The mean pH values were significantly different ( $P < 0.05$ ) among the three SWMP sites for both years of the study. Using standard statistical tests, the mean pH levels at Buoy 126 were found to be significantly greater ( $P < 0.05$ ) than those at Lower Bank and Chestnut Neck for 1999 and 2000. At Chestnut Neck, the mean pH levels were also significantly greater ( $P < 0.05$ ) than those at Lower Bank for both years.

The mean pH measurements at Lower Bank were not significantly different ( $P > 0.05$ ) between years (1999 and 2000). However, the mean pH measurements were significantly different ( $P < 0.05$ ) between years at both Buoy 126 and Chestnut Neck.

### **Turbidity**

Mean turbidity levels at the SWMP sites were less than 35 NTU during the 1999 and 2000 study period. The highest annual mean turbidity values of 25.04 NTU and 24.27 NTU were documented at Lower Bank in 1999 and 2000, respectively (Figure 24). The mean turbidity measurements at the three sites typically ranged from 6-32 NTU. The mean turbidity levels were significantly different ( $P <$



0.05) among the three SWMP sites for both 1999 and 2000. Standard statistical tests applied to these data indicate that the mean turbidity values at Lower Bank were significantly greater ( $P < 0.05$ ) than those at Buoy 126 and Chestnut Neck for both 1999 and 2000. Similarly, the mean turbidity values at Buoy 126 were significantly greater ( $P < 0.05$ ) than those at Chestnut Neck for both years. In addition, the mean turbidity levels were significantly different ( $P < 0.05$ ) between years (1999 and 2000) at each of the SWMP sites.

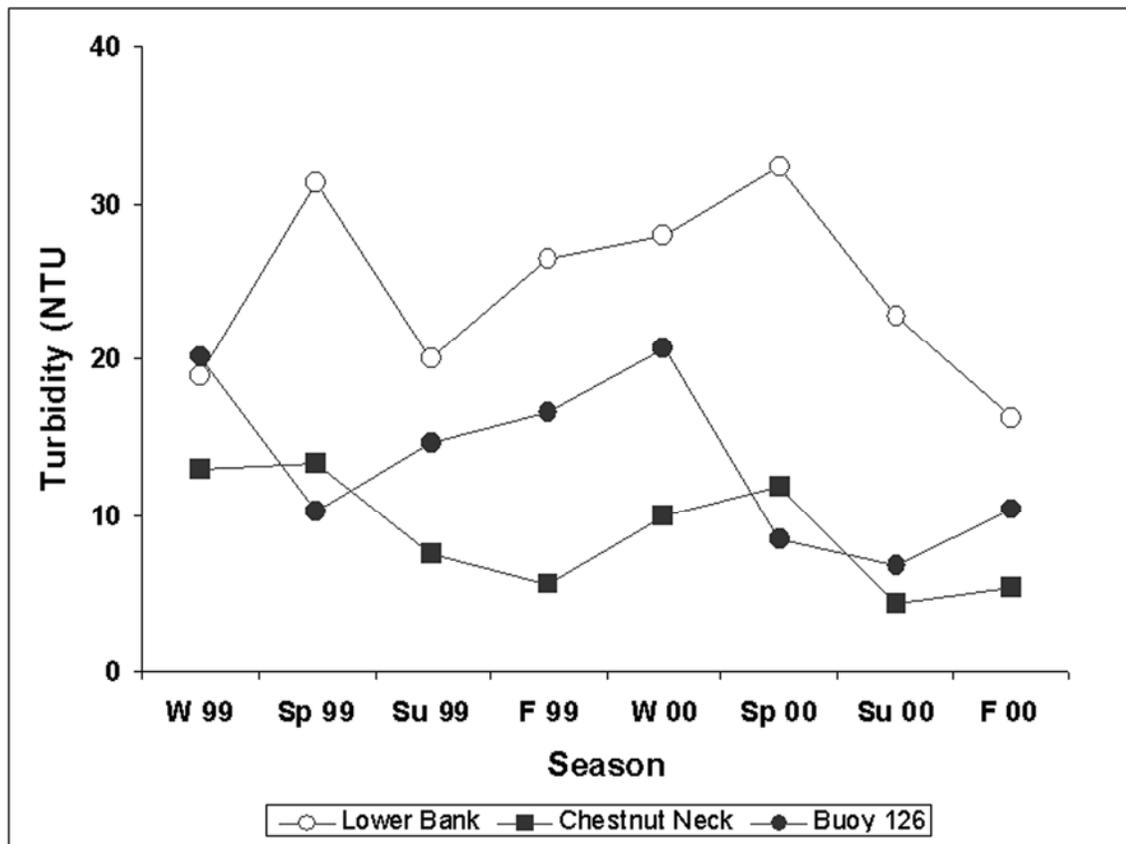


Figure 24. Mean seasonal turbidity values at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

## **Depth**

Figure 25 shows water depths recorded at the three SWMP sites during 1999 and 2000. Water depths were greatest at Buoy 126, with mean values of 2.83 m and 3.05 m in 1999 and 2000, respectively. Water depths were more than 1 m shallower at Chestnut Neck and Lower Bank. At Buoy 126, mean depths were significantly greater ( $P < 0.05$ ) than those at Chestnut Neck and Lower Bank for both years. At Lower Bank, the water depth was significantly greater ( $P < 0.05$ ) than that at Chestnut Neck in 1999, but there was no significant difference ( $P > 0.05$ ) in the mean water depths at both sites in 2000.

The mean depth at Chestnut Neck and Lower Bank was not significantly different ( $P > 0.05$ ) between years (1999 and 2000). However, it was significantly different ( $P < 0.05$ ) between years at Buoy 126.

## **Water Quality Discussion**

Appendix 11 and Appendix 12 summarize results of ANOVAs for environmental parameters monitored at the three JCNERR SWMP sites. ANOVAs were run by year, 1999 (Appendix 11) and 2000 (Appendix 12), using data derived from semi-continuous recordings of 6-series data loggers. Data gaps in the database are mainly due to malfunctioning instruments (e.g., probe failure) and adverse weather conditions (e.g., icing problems). The most statistically significant differences are those related to salinity and pH.

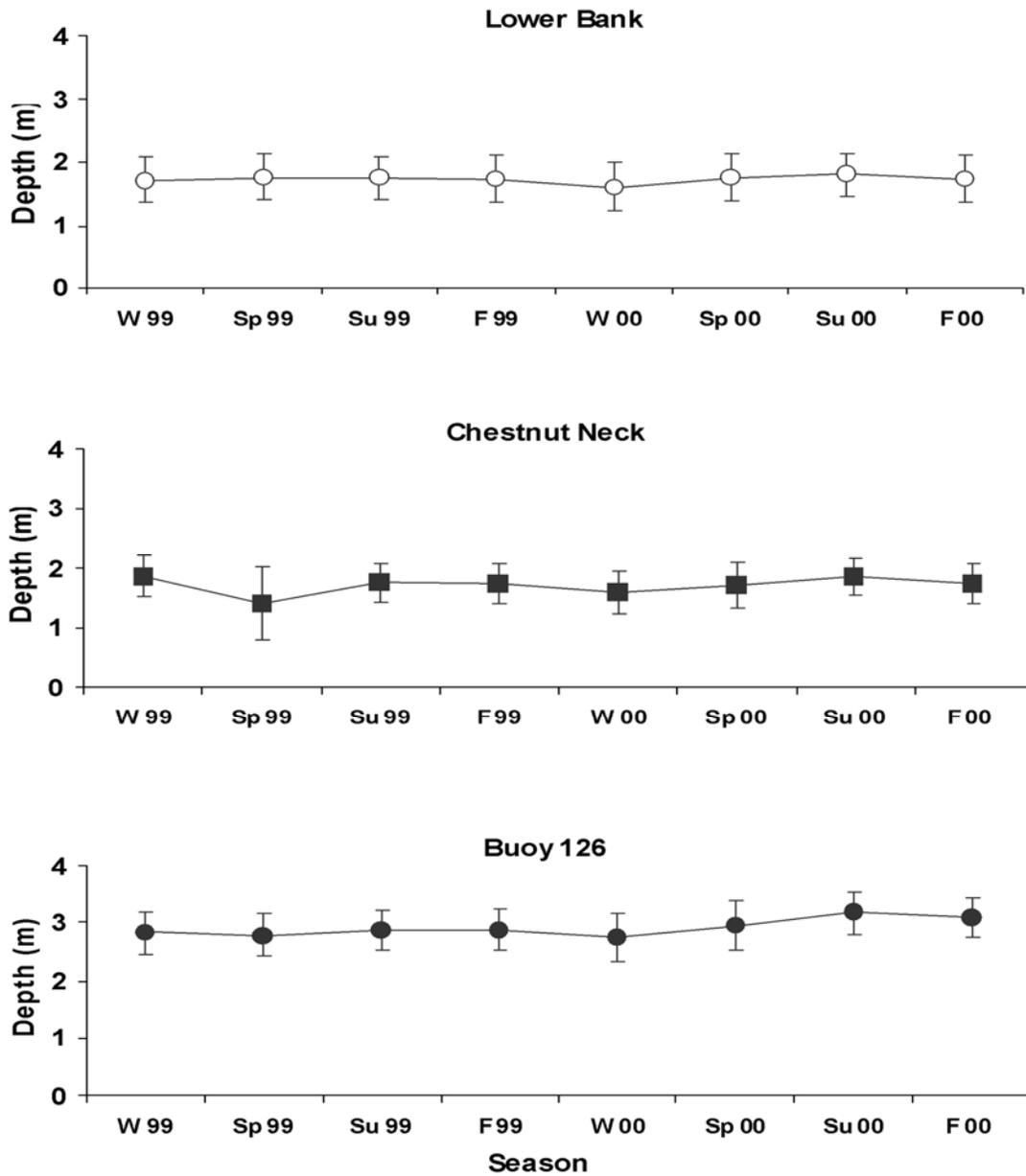


Figure 25. Mean seasonal depth and standard deviation values at three System-wide Monitoring Program sites in the Jacques Cousteau National Estuarine Research Reserve during the 1999 and 2000 monitoring period. From Kennish, M. J. (Ed.). 2003. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida.

## **Temperature**

Because of the shallow depths in Great Bay, water temperatures closely follow air temperatures. Lowest water temperatures ( $< 0^{\circ}\text{C}$ ) typically occur in late January and February, and highest temperatures ( $> 25^{\circ}\text{C}$ ) in July and August. Seasonal temperatures are similar in the bay and river as is evident from data logger recordings at Buoy 126, Chestnut Neck, and Lower Bank. Freezing of the river and bay has been occasionally reported in late December, January, and February. During cold winters, the entire bay has been frozen.

From February to mid-June, water temperature generally increases linearly from  $\sim 1^{\circ}\text{C}$  to  $\sim 20^{\circ}\text{C}$ . Similarly, water temperature typically decreases linearly from  $\sim 25^{\circ}\text{C}$  in August to  $\sim 1^{\circ}\text{C}$  in January. According to Durand and Nadeau (1972), little thermal stratification exists in most areas of the system.

Wenner (2001), employing scatter plots, documented strong fluctuations ( $1\text{-}2^{\circ}\text{C}$ ) in daily water temperature at Buoy 126 and Lower Bank. Even stronger temperature fluctuations ( $3\text{-}10^{\circ}\text{C}$ ) were delineated over bi-weekly intervals at these sites. Harmonic regression analysis ascribed 60% of the temperature variance at both sites to 12.42-hour cycles and an additional 23% of the temperature variance to 24-hour cycles.

## **Salinity**

The SWMP sites at Lower Bank, Chestnut Neck, and Buoy 126 lie along a well-defined salinity gradient of the Mullica River-Great Bay system. Lower Bank, which marks the upper end of the estuary  $\sim 25$  km upstream from the head of Great Bay, is characterized by oligohaline conditions. Limnetic waters occur immediately upstream of

Lower Bank. Mesohaline salinities predominate at Chestnut Neck. Polyhaline conditions are found at Buoy 126. Salinity differences among these three sites are statistically significant ( $P < 0.05$ ).

Salinity from Lower Bank to Deep Point at the mouth of the Mullica River varies in response to tidal action, frequency and intensity of precipitation, evaporation, and freshwater inflow. At Buoy 126, the principal factors affecting salinity levels are proximity to Little Egg Inlet, tidal currents, and winds. SWMP sites in the JCNERR experience semidiurnal tides, and hence salinities vary in response to tidal cycles. Other factors (e.g., spring-neap tidal cycles and freshwater pulses) account for much of the salinity variation at the time scale of days to weeks. Episodic events, which can cause marked changes in salinity within a short time span, include major storms and storm surges, floods, and periodic upwelling events. Seasonal variations in salinity are primarily ascribed to seasonal changes in precipitation and freshwater discharge as well as seasonal shifts in wind direction and velocity. During the period from December 1998 to November 1999, salinity at Buoy 126, Chestnut Neck, and Lower Bank ranged from 22.20-32.35‰, 2.89-26.80‰, and 0.0-18.5‰, respectively. During the period from December 1999 to November 2000, salinity at Buoy 126, Chestnut Neck, and Lower Bank ranged from 22.50-33.30‰, 4.10-26.90‰, and 0.0-11.20‰, respectively.

Salinity fluxes associated with episodic events can be substantial, approaching the annual variation in mean salinity. Durand (1988) recorded salinities as low as 1‰ in the Deep Point area near the mouth of the Mullica River after protracted periods of heavy rainfall. However, salinities as high as 25-27‰ were also observed at this site during dry periods in the summer months. Wenner et al. (2001) showed that salinity fluctuations

exceeded 10‰ at the SWMP sites during episodic events in August and December 1996, March and May 1997, and from March to December 1998. Using harmonic regression analysis, they ascribed 82% of salinity variance at the sites to 12.42-hour cycles, 10% of salinity variance to 24-hour cycles, and 8% of salinity variance to interaction between 12.42-hour and 24-hour cycles.

Freshwater enters the Mullica River via surface runoff and groundwater influx from the Mullica River Basin, as well as from direct precipitation on the water surface. A positive correlation exists between periods of high river flow and reduced salinity levels at Lower Bank and Chestnut Neck sites. High river discharges also reduce salinities in upper Great Bay and along the southern perimeter. Salinity at Buoy 126 usually exceeds 25‰ because ocean water enters at Little Egg Inlet and flows along the northern part of the bay, directly affecting conditions at this monitoring site. While the predominant flow during flood tide is in the northern part of the bay, accounting for higher salinities in this area, the predominant flow during ebb tide is in the southern part of the bay. This current pattern creates a counterclockwise gyre in the central portion of the bay (Durand, 1988). Strong tidal currents and the shallowness of the bay produce well-mixed conditions, resulting in relatively uniform salinities in the water column.

Salinity differences between the three SWMP sites are not only statistically significant but also biologically significant. Planktonic, benthic, and nektonic communities differ considerably along the salinity gradient of the Mullica River, as well as in areas of Great Bay where salinity differences can be substantial (Durand and Nadeau, 1972; Durand, 1988). Salinity is a major factor affecting the species composition, abundance, and distribution of aquatic organisms in the system.

## **Dissolved Oxygen**

The health of estuarine systems is closely coupled to dissolved oxygen concentrations. Oxygen depletion caused by organic loading and excessive biochemical oxygen demand can lead to hypoxia or anoxia and reduced habitat availability, greater susceptibility of organisms to disease and predation, and increased mortality (Pihl et al., 1992; Winn and Knott, 1992; Borsuk et al., 2001). The impacts of oxygen deficiency are often most conspicuous on benthic communities and habitats (Dauer et al., 1992; Diaz and Rosenberg, 1995). Aside from major shifts in the distribution and abundance of estuarine organisms attributable to severe oxygen depletion, more subtle effects may be manifested by altered behavioral, physiological, and reproductive activity of biota (Summers et al., 1997; Wenner et al., 2001). In addition to the biochemical oxygen demand, several other factors influence the severity of oxygen depletion in the bottom waters of estuaries, notably exchange of oxygen with the surface layer, vertical density stratification, and the intensity and frequency of mixing (Borsuk et al., 2001).

Oxygen deficiency is becoming a more serious problem in many estuaries due to greater loading of organic matter from nearby watersheds, as well as accelerated nutrient-driven phytoplankton and benthic algal production in embayments (Paerl et al., 1998). As a result, coastal resource programs in many states are emphasizing more intense monitoring of dissolved oxygen in estuarine and coastal marine waters. At NERRS sites nationwide, dissolved oxygen is the target of year-round monitoring efforts.

Oxygen deficiency was never a problem at the JCNERR during the monitoring period from August 1996 to December 2000, a condition that has continued through

December 2008. This is attributed primarily to the relatively strong currents, well-mixed condition, and general lack of thermal stratification of river and bay waters in the system. The mean dissolved oxygen values typically ranged from 85-105% saturation during the study period. A distinct seasonal cycle was apparent, with the highest mean % saturation (100-125%) occurring in winter and the lowest mean % saturation (75-100%) taking place in summer. Supersaturation was observed periodically during all seasons of the year.

Absolute values of dissolved oxygen (mg/l) were relatively high in the JCNERR, with annual mean dissolved oxygen levels exceeding 8.5 mg/l at the three SWMP sites. Highest dissolved oxygen values (mean > 11.0 mg/l) were registered during the winter, and lowest dissolved oxygen values (mean = 6.0-7.0 mg/l) during the summer.

Various factors affect the dissolved oxygen content of riverine and estuarine waters. Included here are temperature, organic carbon loading, salinity, turbulence, and atmospheric pressure. In the JCNERR, higher temperatures and greater loading of organic matter during summer depress dissolved oxygen levels due to accelerated microbial respiration associated with organic degradation processes. Lower temperatures and diminished loading of organic matter result in significantly higher dissolved oxygen levels in winter because chemical and biological oxygen consumption coupled to the decomposition of organic matter declines appreciably.

Although hypoxia has not been observed in the JCNERR, episodes of supersaturation may be a cause of concern. The formation of reactive oxygen species during supersaturation events may have a toxic effect on biota of the system (Dalton,

1995). However, supersaturation events in the reserve are characteristically ephemeral, and therefore their biotic effects are likely to be small.

Analysis of SWMP data from the JCNERR indicates that this reserve has not experienced the dissolved oxygen problems of many other estuarine systems in the U.S. Dissolved oxygen concentrations in the reserve, which are consistently above 6.0 mg/l, reflect the generally high water quality conditions in the system. However, monitoring must continue in order to assess seasonal variations of dissolved oxygen, which may be considerable.

### **pH**

When proceeding along a salinity gradient from upriver areas to the open waters of Great Bay, pH progressively increases. The pH not only varies with salinity but also with dissolved oxygen concentrations. In addition, large amounts of tannins and humic acids in the Mullica River depress pH levels. Hence, the mean pH levels at Lower Bank and Chestnut Neck for the 1999-2000 period were significantly less ( $p < 0.05$ ) than the mean pH values at Buoy 126 for the same time period. No significant seasonal trends in pH values were evident at the SWMP sites.

Zampella and Laidig (1997) and Dow and Zampella (2000) showed that there is an association between increases in pH and nutrient enrichment and watershed disturbance in the Pinelands due to agricultural land use, residential development, and wastewater flow. More specifically, pH is positively correlated with concentrations of  $\text{NO}_3^-$ ,  $\text{NH}_4^+$ , total P,  $\text{Ca}^{2+}$ , and  $\text{Mg}^{2+}$ , and all of these variables parallel a Pinelands watershed disturbance gradient. Dow and Zampella (2000) proposed that pH is a

potential indicator of Pinelands watershed disturbance and subsequent ecological effects that follow disturbance. Such effects may be manifested as major changes in the species composition, abundance, and distribution of organisms in the Mullica River.

### **Turbidity**

Durand and Nadeau (1972) reported considerably greater water transparency in Great Bay than in the Mullica River. They also observed the highest degree of transparency in the bay during the summer and early fall. Areas upriver exhibited maximum



transparency in the winter and minimum transparency in the summer. Reduced input of tannins, humic compounds, and particulate matter from the Pinelands in the winter causes greater transparency in the Mullica River during the colder months of the year.

Results of seasonal turbidity measurements by the JCNERR corroborate, in part, the findings of Durand and Nadeau (1972). For example, the highest annual mean turbidity among the SWMP sites in 1999 (25.04 NTU) and 2000 (24.27 NTU) occurred at Lower Bank. Chestnut Neck had the lowest annual mean turbidity in 1999 (9.69 NTU) and 2000 (7.85 NTU). Durand and Nadeau (1972) noted more turbid waters in the bay during winter apparently due to increased sediment loading, a condition supported by SWMP data of the reserve, which show highest mean turbidity levels at Buoy 126 during

the winter of 1999 (20.09 NTU) and 2000 (20.64 NTU). The lowest seasonal mean turbidity (6.69 NTU) at Buoy 126 was reported in the summer of 2000. At Lower Bank, in turn, the lowest seasonal mean turbidity measurements were registered during the winter of 1999 (18.85 NTU) and fall of 2000 (16.13 NTU). The highest seasonal mean turbidity values at Lower Bank in both 1999 (31.30 NTU) and 2000 (32.39 NTU) were found in the spring. At Chestnut Neck, the seasonal mean turbidity was highest for both the spring of 1999 (13.25 NTU) and 2000 (11.77 NTU). The lowest seasonal mean turbidity at this site was documented in the fall of 1999 (5.54 NTU) and the summer of 2000 (4.28 NTU).

As is evident from the water quality database of the JCNERR, turbidity values vary seasonally and from year to year. Highest turbidity occurs in the Mullica River at Lower Bank based on the 1999 and 2000 database. Although the turbidity is seasonally variable, some trends are evident. Higher turbidity levels generally occur in the bay during winter and in the bay tributaries during summer. However, episodic events such as hurricanes, other major storms, and upwelling events can produce unusually high turbidity levels of relatively short duration, which can leave significant spikes in the database during any season.

Spatial variation in turbidity levels can also be substantial in the bay. Turbid waters discharging from the mouth of the Mullica River, for example, concentrate along the southern part of the bay. Clearer ocean water, in turn, can often be traced along the northeast perimeter. This spatial distribution of turbidity is a consequence of the cyclonic circulation pattern in the bay.

## **Depth**

Tidal action accounted for much of the variation in depth at the SWMP sites. For example, Wenner et al. (2001) attributed 86% of the depth variance at Buoy 126 between August 1996 and November 1998 to 12.42-hour cycles. Only 7% of the depth variance at this location during the same period was ascribed to both 24-hour cycles and interaction between 12.42-hour and 24-hour cycles. Similar numbers were obtained at Lower Bank. Here 85% of depth variance between August 1996 and November 1998 was ascribed to 12.42-hour cycles. Only 6% of depth variance at this location was attributed to 24-hour cycles, and 9% of depth variance was ascribed to interaction between 12.42-hour and 24-hour cycles. According to Wenner et al. (2001), therefore, depth is an important factor for evaluating and interpreting temporal variability in parameters associated with tides.

## **Meteorological Monitoring**

As part of the System-wide Monitoring Program, the JCNERR has a weather station located on Nacote Creek that collects data on air temperature, wind speed and direction, relative humidity, barometric pressure, rainfall and photosynthetically active radiation (PAR). Weather conditions can have a strong influence on water quality. For example, rainfall influences salinity in estuaries and can increase runoff of sediment and organic material that in turn may influence other parameters such as dissolved oxygen, turbidity, pH, and temperature.

## HABITATS

### Watershed

#### Overview

The JCNERR contains a wide range of terrestrial and aquatic habitats. These include upland pine-oak forests, lowland Atlantic white cedar swamps, freshwater marshes, salt and freshwater tidal marshes, barrier islands (including sandy beaches and dune habitats), shallow bays, and the coastal ocean.

Upland forest areas in the JCNERR support two major vegetation types, namely pine-oak forest and oak-pine forests. The dominant tree is the pitch pine (*Pinus rigida*). In no other region in North America does the pitch pine cover such an extensive area. Other abundant species include short-leaf pine and oaks of several species: scrub, blackjack, black, red, white, and chestnut. The most common oak species north of the Mullica River is the black oak; in the south, the scarlet oak becomes prominent. The understory of these forests is a variety of shrubs, mostly of the oak and heath family, such as lowbush blueberry and black huckleberry. Typical ground cover includes lichens, mosses, bracken fern and members of the heath family (bearberry and teaberry).



Lowland forest areas of the JCNERR are composed of Atlantic white cedar, red maple, pitch pine, black gum, gray birch, sassafras, and sweetbay magnolia. Pitch pine lowlands are characterized by a dense canopy of pitch pine, often occurring in

depressions and as narrow bands along stream and swamp banks. Secondary trees typically include red maple, blackgum and sweet bay magnolia.

Lowland forest understory growth tends to be more varied than upland growth, with sheep laurel, stagger-bush, dangleberry, black huckleberry, and sweet pepperbush as prominent shrubs. Sheep laurel is especially abundant in



these areas, while leather-leaf occupies the margins of standing water. Ground cover layers are also quite diverse and well developed, with bracken ferns, teaberry, and moss lichen vegetation. Cedar swamps and sphagnum bogs are scattered throughout the pine lowlands, with the dominant tree being the Atlantic white cedar.

Salt marshes occur near the coast and along the lower Mullica River, consisting primarily of salt meadow grass (*Spartina patens*) and saltwater cordgrass (*Spartina alterniflora*), as well as spike grass (*Distichlis spicata*). High marsh areas that are flooded less regularly are characterized by salt meadow grass, spike grass, and black grass (*Juncus gerardii*). Species characteristic of salt pannes area include Bigelow's glasswort (*Salicornia bigelovii*), common glasswort (*S. europea*), and perennial glasswort (*S. virginica*), as well as marsh spearscale (*Atriplex patula*) and annual salt marsh fleabane (*Pluchea purpurascenes*).

Vegetation of the barrier islands include dune grass (*Ammophila*), which anchors the sand in the foredunes, and a mix of bayberry, heather and marsh elder dominating the back dune. The few freshwater pockets around the islands, are occupied by typical grasses, sedges, and flowering plants.

## Upland Forests

A complex mosaic of contiguous forest and wetland vegetation occurs in the Pinelands, with discrete patches or corridors of cedar and hardwood swamps growing amidst a background matrix of upland pine and oak forests (Forman, 1998). In the uplands, a continuous gradient of forested vegetation is evident in some areas, from pure pitch pine (*Pinus rigida*) stands on one end grading into pure oak trees (*Quercus* spp.) at the other end (McCormick, 1998). Pitch pine (*P. rigida*) dominates in pine-oak forests,

with various oak trees (i.e., scarlet oak, *Quercus coccinea*; white oak, *Q. alba*; black oak, *Q. velutina*; and chestnut oak, *Q. prinus*) playing a subsidiary role. In contrast, oak trees dominate in oak-pine forests and can account for more than 75% cover. Scrub oak (*Q. ilicifolia*),



blueberries (*Vaccinium* spp.), huckleberry (*Gaylussacia* spp.), mountain laurel (*Kalmia latifolia*), inkberry (*Ilex glabra*), sweet fern (*Comptonia peregrina*) and other heath plants generally dominate the understory vegetation in these forests. Progressing toward lowland habitats, the upland forests gradually grade into pitch pine lowland forests.

The Wharton State Forest, Penn State Forest, Bass River State Forest, and Clarks Landing provide excellent examples of upland and lowland forests in the system. Pine-

oak (*Pinus-Quercus*) trees form the predominant upland forest canopy, while Atlantic white cedar (*Chamaecyparis thyoides*) and various swamp hardwoods (e.g., *Acer*, *Magnolia*, *Nyssa*) colonize water courses and other poorly drained areas (McCormick, 1998; Tedrow, 1998). Pitch pine (*Pinus rigida*) colonizes ~50-80% of the uplands, and shortleaf pine (*P. echinata*) is also relatively abundant. Several species of oak trees are present, notably black oak (*Quercus velutina*), blackjack oak (*Q. marilandica*), southern red oak (*Q. falcata*), chestnut oak (*Q. prinus*), post oak (*Q. stellata*), scrub oak (*Q. ilicifolia*), white oak (*Q. alba*), and scarlet oak (*Q. coccinea*). Among these species, black oak is most common north of the Mullica River, and southern red oak, most common to the south (McCormick, 1998).

In pine-oak forests, pitch pine covers 30% or more of the ground, contributes 50% or more of the tree stems 2.5 cm or more in diameter, and constitutes 50% or more of the basal area. In contrast, larger treeform oaks dominate in oak-pine forests, covering 40% or more of the ground, contributing 50% or more of the stems, and comprising 35% or more of the basal area. Although broadleaf trees predominate in oak-pine forests, pitch pine is found in nearly all stands (McCormick, 1998). Oak-pine, chestnut oak, and scarlet oak-shortleaf pine are the principal constituents of the upland canopy layer of the oak-pine forests. Pine-blackjack oak, pine-post oak, and pine-black oak represent the primary components of the upland canopy of pine-oak forests. Two shrub types also occur among these two broad groupings of upland canopy: (1) heath-type dominated by lowbush blueberry (*Vaccinium vacillans*) and black huckleberry (*Gaylussacia baccata*); and (2) scrub-oak type. The heath-type understory, with plants growing about 30-60 cm high, forms nearly continuous cover throughout the uplands (McCormick, 1998). The

scrub oak is ~1-5 m tall. Lichens, mosses, ferns, wintergreen (*Gaultheria procumbens*), and bearberry (*Arctostaphylos uva-ursi*) provide considerable ground cover in some upland forest areas. Cowwheat (*Melampyrum lineare*), goatsrue (*Tephrosia virginiana*), and several other herbs occur sporadically (McCormick, 1998).

Frequent fires and repeated cutting have played a significant role in determining the composition and physical structure of upland vegetation. Fires have occurred at a periodicity of ~10-30 years, and cutting was common during the first half of the 20<sup>th</sup> century. Pitch pine is more tolerant of fire than are oaks, and areas experiencing reduced fire frequency shift to oak-dominated habitats. However, both types of trees can resprout from dormant buds lying beneath the soil surface subsequent to fires. This enables the trees to recover; however, the rate of recovery varies among species. Species differences in resistance to fire damage, in shade tolerance, and in reproductive strategies are responsible for the selective action of fire observed on various types of plant species in the Pinelands.

Areas of the Pine Barrens subjected to frequent fires are dominated by low growing, dwarf pitch or pygmy pine (*Pinus rigida*) < 3 m high, and scrub oaks (*Quercus marilandica* and *Q. ilicifolia*). Species dominating the shrub and herb layers include



mountain laurel (*Kalmia latifolia*), sheep laurel (*K. angustifolia*), sweet fern (*Comptonia*

*peregrina*), and sand myrtle (*Leiophyllum buxifolium*), with ground covers comprised largely of bearberry (*Arctostaphylos uva-ursi*), broom crowberry (*Corema conradii*), trailing arbutus (*Epigaea repens*), and wintergreen (*Gaultheria procumbens*). There are three areas of pygmy pine in the Pine Barrens, which collectively cover ~4,950 ha (Good et al., 1998). These dwarf pitch pine communities are the most extensive in the world (U.S. Fish and Wildlife Service, 1996).

### **Lowland Vegetation**

McCormick (1998) provided a detailed description of lowland vegetation in the Pinelands region. Ground water levels in lowland forests are near the surface, resulting in soil saturation for prolonged periods, which influences the vegetation patterns year-round. Wetland forests in the Pine Barrens consist primarily of Atlantic white cedar (*Chamaecyparis thyoides*), black gum (*Nyssa sylvatica*), and trident red maple (*Acer rubrum*). Pitch pine (*Pinus rigida*), gray birch (*Betula populifolia*), sweetbay magnolia (*Magnolia virginiana*), and sassafras (*Sassafras albidum*) are also present in many stands. In addition, basket oak (*Quercus michauxii*), fin oak (*Q. palustris*), willow oak (*Q. phellos*), water oak (*Q. nigra*), and sweet gum (*Liquidambar styraciflua*) grow on the periphery.

Six types of plant communities occur in the lowlands, forming swamp forests or relatively small freshwater marshes. These include: (1) Atlantic white cedar swamp forests; (2) broadleaf swamp forests; (3) herbaceous wetland communities; (4) shrubby wetland communities; (5) pitch pine lowland forests; and (6) pine transition forests (McCormick, 1998). Of these communities, Atlantic white cedar swamp forests and

broadleaf swamp forests are most extensive. The Atlantic white cedar constitutes the principal canopy in the cedar swamp forests, along with sweetbay magnolia (*Magnolia virginiana*), black gum (*Nyssa sylvatica*), and trident red maple (*Acer rubrum*). Dangleberry (*Gaylussacia frondosa*), bayberry (*Myrica pensylvanica*), fetterbush (*Leucothoe racemosa*), swamp azalea (*Rhododendron viscosum*), sweet pepperbush (*Clethra alnifolia*), and several other shrubs form the understory. Among herbaceous ground cover are *Sphagnum* mosses, curly grass ferns (*Schizaea pusilla*), pitcherplants (*Sarracenia purpurea*), sundew (*Drosera* spp.), partridgeberry (*Mitchella repens*), and swamp pink (*Helonias bullata*).

Trident red maple (*Acer rubrum*) serves as the principal canopy in broadleaf forests. Pitch pine (*Pinus rigida*) and Atlantic white cedar (*Chamaecyparis thyoides*) are locally important components of the canopy. Secondary trees include black gum (*Nyssa sylvatica*), gray birch (*Betula populifolia*), sweetbay magnolia (*Magnolia virginiana*), and sassafras (*Sassafras albidum*). The shrub layer consists of black huckleberry (*Gaylussacia baccata*), dangleberry (*Gaylussacia frondosa*), fetterbush (*Leucothoe racemosa*), sheep laurel (*Kalmia angustifolia*), leatherleaf (*Chamaedaphne calyculata*), and swamp azalea (*Rhododendron viscosum*). Mosses and lichens provide the primary ground cover.

Pitch pine (*Pinus rigida*) is the dominant species in pitch pine lowland forests, comprising 90% of the canopy. Black gum (*Nyssa sylvatica*), trident red maple (*Acer rubrum*), and gray birch



(*Betula populifolia*) are of secondary importance. The undergrowth consists of more than 20 species of shrubs and woody vines; dangleberry (*Gaylussacia frondosa*), black huckleberry (*Gaylussacia baccata*), leatherleaf (*Chamaedaphne calyculata*), and sheep laurel (*Kalmia angustifolia*) are the predominant species. Wintergreen (*Gaultheria procumbens*), bracken fern (*Pteridium aquilinum*), turkeybeard (*Xerophyllum asphodeloides*), and *Sphagnum* mosses grow as ground cover over nearly 30% of the forest floor.

Pine transition communities are found between the broadleaf swamp forests or Atlantic white cedar swamp forests and upland forests. In these transition forests, pitch pine (*Pinus rigida*) is the dominant species of the canopy above an understory of smaller black gum (*Nyssa sylvatica*), trident red maple (*Acer rubrum*), and gray birch (*Betula populifolia*). Dominant species of the well-developed shrub layer include dangleberry (*Gaylussacia frondosa*) and sheep laurel (*Kalmia angustifolia*), with winterberry (*Ilex verticillata*), grouseberry (*Gaylussacia dumosa*), black huckleberry (*Gaylussacia baccata*), and bayberry (*Myrica pensylvanica*) also occupying this layer. Among the herbs and shrubs are bracken fern (*Pteridium aquilinum*), cinnamon fern (*Osmunda cinnamomea*), turkeybeard (*Xerophyllum asphodeloides*), wintergreen (*Gaultheria procumbens*), and *Sphagnum* mosses. The herbs and shrubs cover only ~2% of the ground in the pine transition forests.

Herbaceous wetland communities proliferate along the margins of ponds and streams in the Pine Barrens. As noted by McCormick (1998), white water lilies (*Nymphaea odorata*), bullhead lilies (*Nuphar variegatum*), spatterdocks (*Nuphar advena*), bladderworts (*Utricularia spp.*), and other submerged or floating leaf plants

occur near pond margins and in stream coves. Sedges (*Carex* spp.), rushes (*Juncus* spp.), pipeworts (*Eriocaulon* spp.), chain ferns (*Woodwardia* spp.), other emergent plants, and *Sphagnum* mosses inhabit areas along the shore.

Zampella and Laidig (1997) and Zampella et al. (2001) reported on stream vegetation surveys conducted in the Mullica River Basin for the Pinelands Commission. They recorded a total of 305 vascular plants at 72 stream sites, including 232 herbaceous species and 73 woody species (Appendix 14). Twenty-nine species were deemed to be disturbance-indicator species in this basin (Table 7).

In flood plains of Pine Barrens streams, grass- and sedge-dominated wet meadow communities (savannas) commonly proliferate. Among the dominant vegetation in these communities are coast sedge (*Carex exilis*), button sedge (*Carex bullata*), golden crest (*Lophiola aurea*), Torrey's dropseed (*Muhlenbergia torreyana*), and lowland broomsedge (*Andropogon virginicus* var. *abbreviatus*). Savannas in the Pine Barrens cover a total area less than 400 ha. Through succession, they are replaced by shrub and forest swamps.



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Table 7. Disturbance-indicator plant species.

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|                                  |                                |
|----------------------------------|--------------------------------|
| <i>Asclepias incarnata</i>       | swamp milkweed                 |
| <i>Bidens connata</i>            | purple-stemmed beggar ticks    |
| <i>Bidens frondosa</i>           | beggar ticks                   |
| <i>Boehmeria cylindrica</i>      | false nettle                   |
| <i>Callitriche heterophylla</i>  | large water starwort           |
| <i>Carex lurida</i>              | sallow sedge                   |
| <i>Cinna arundinacea</i>         | wood-reed                      |
| <i>Cyperus strigosus</i>         | straw-colored cyperus          |
| <i>Dioscorea villosa</i>         | common wild yam                |
| <i>Echinochloa muricata</i>      | American barnyard grass        |
| <i>Erechtites hieracifolia</i>   | pilewort                       |
| <i>Eupatorium dubium</i>         | eastern joe-pye weed           |
| <i>Galium tinctorium</i>         | stiff marsh bedstraw           |
| <i>Impatiens capensis</i>        | spotted touch-me-not           |
| <i>Lindernia dubia</i>           | short-stalked false pimpernel  |
| <i>Lobelia cardinalis</i>        | cardinal flower                |
| <i>Ludwigia palustris</i>        | water purslane                 |
| <i>Microstegium vimineum</i>     | eulalia or japanese stiltgrass |
| <i>Mikania scandens</i>          | climbing hempweed              |
| <i>Panicum clandestinum</i>      | deertongue grass               |
| <i>Polygonum arifolium</i>       | halberd-leaved tearthumb       |
| <i>Polygonum hydropiperoides</i> | mild water pepper              |
| <i>Polygonum punctatum</i>       | dotted smartweed               |
| <i>Polygonum sagittatum</i>      | arrow-leaved tearthumb         |
| <i>Potamogeton epihydrus</i>     | Nuttall's pondweed             |
| <i>Potamogeton pusillus</i>      | small pondweed                 |
| <i>Sambucus canadensis</i>       | common elder or elderberry     |
| <i>Thelypteris palustris</i>     | marsh fern                     |
| <i>Typha latifolia</i>           | broad-leaved cattail           |

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From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

Vernal ponds (coastal plain intermittent ponds) are characterized by seasonally saturated soils and markedly fluctuating water levels. In addition to sedges (*Carex* spp., *Cladium mariscoides*, *Eleocharis microcarpa*, and *Scleria reticularis*), panic and muhly grasses (*Panicum capillare*, *P. mattamuskeettense*, *P. verrucosum*, and *Muhlenbergia torreyana*) commonly dominate vernal pond plant communities, although rare herbaceous species typically occur here as well. Some of the other plant species identified at vernal ponds in the Pinelands are the knotted spikerush (*Eleocharis equisetoides*), Pine Barrens boneset (*Eupatorium resinosum*), dwarf white bladderwort (*Utricularia olivacea*), awned meadow beauty (*Rhexia aristosa*), Long's bulrush (*Scirpus longii*), drowned beaked-rush (*Rhynchospora inundata*), Boykin's lobelia (*Lobelia boykinii*), Wright's panic grass (*Panicum wrightianum*), slender water-milfoil (*Myriophyllum tenellum*), rose tickseed (*Coreopsis rosea*), short-beaked bald-rush (*Rhynchospora nitens*), and floating heart (*Nymphoides cordata*). St. James Pond, Bill Henry Pond, Odd Pond, Chatsworth Goose Pond, and Woodbine Pond are examples of vernal ponds in the Pinelands (U.S. Fish and Wildlife Service, 1996).

Shrubby wetland communities have also been delineated in the channels of intermittent streams and along pond margins. Highbush blueberry (*Vaccinium corymbosum*) and leatherleaf (*Chamaedaphne calyculata*) are common, and staggerbush (*Lyonia mariana*) and sheep laurel (*Kalmia angustifolia*) also grow here. *Sphagnum* mosses provide extensive ground cover.

*Sphagnum* and cranberry bogs, as well as cedar swamps, are irregularly distributed throughout the pine lowlands. The Atlantic white cedar (*Chamaecyparis thyoides*) is the dominant tree in these areas, typically growing in dense stands along

stream banks and locally within the broader lowlands. The *Sphagnum* mats are inhabited by various shade- and acid-tolerant herbaceous plants, including swamp azalea (*Rhododendron viscosum*), fetterbush (*Leucothoe racemosa*), dangleberry (*Gaylussacia frondosa*), and highbush blueberry (*Vaccinium corymbosum*). The herbaceous plants are best established in openings of the forest cover. Mosses (*Sphagnum* spp.) form the principal ground cover along with pitcher plants (*Sarracenia purpurea*), sundews (*Drosera* spp.), and bladderworts (*Utricularia* spp.).

Ponds, lakes, bogs, and streams serve as habitat for many species of algae, both benthic and planktonic forms (Appendix 15). The acidic waters of the Pine Barrens strongly influence the composition of the algal flora. Moul and Buell (1998) identified



more than 350 algal taxa in the Pine Barrens, with green algae (Chlorophyta), yellow-green algae (Chlorophyta), and euglenoids (Euglenophyta) being well represented. Diatoms are particularly abundant.

In summary, several wetland complexes occur in lowland areas of the Pine Barrens, notably Atlantic white cedar swamps, hardwood swamps, pitch pine lowland forests, and Pine Barrens savannas. Bass River, Oswego River, Batsto River, and the West Branch of the Wading River exhibit well-developed wetland complexes. Rare plants found in these complexes are the Pine Barrens boneset (*Eupatorium resinosum*),

Pine Barrens gentian (*Gentiana autumnalis*), Pine Barrens reedgrass (*Calamovilfa brevipilis*), Pine Barrens smoke grass (*Muhlenbergia capillaris*), Barratt's sedge (*Carex barrattii*), Pickering's reedgrass (*Calamagrostis pickeringii*), Pickering's morning-glory (*Stylisma pickeringii* var. *pickeringii*), New Jersey rush (*Juncus caesariensis*), bog asphodel (*Narthecium americanum*), false asphodel (*Tofieldia racemosa*), sandplain fax (*Linum intercussum*), sand yellow-eyed grass (*Xyris caroliniana*), sheathed panic grass (*Panicum scabriusculum*), Canby's lobelia (*Lobelia canbyi*), yellow fringeless orchid (*Platanthera integra*), reversed bladderwort (*Utricularia resupinata*), curly grass fern (*Schizaea pusilla*), pale beaked-rush (*Rhynchospora pallida*), and Knieskern's beaked-rush (*Rhynchospora knieskernii*). Although relatively few species dominate forest wetlands in lowland areas of the Pine Barrens (e.g., Atlantic white cedar, black gum, pitch pine, red maple, and sweetbay), the understory may consist of 20 or more shrub species (e.g., blueberries, *Vaccinium* spp.; swamp azalea, *Rhododendron viscosum*; and sweet pepperbush, *Clethra alnifolia*). The unique wetland vegetation in the Pinelands includes various rare or endangered species (e.g., swamp pink, *Halonias bullata*; and Knieskern's beaked-rush, *Rhynchospora knieskernii*). The wetland complexes support a wide diversity of animal populations.

## **Marshes**

### **Freshwater and Brackish Marshes**

Freshwater tidal marshes occupy zones of tidal influence in the upper reaches of the Mullica and Wading Rivers. Three distinct zones of freshwater intertidal wetland vegetation are evident based on the degree of tidal influence. The low tidal marsh,

characterized by sparsely vegetated intertidal flats, is exposed only at low tide. Plant species commonly found in this zone are the grass-leaved arrowhead (*Sagittaria graminea*), stiff arrowhead (*S. rigida*), and Hudson arrowhead (*S. subulata*), Parker's pipewort (*Eriocaulon parkeri*), bluntscale bulrush (*Scirpus smithii* var. *smithii*), and riverbank quillwort (*Isoetes riparia*). In the mid-tidal zone, the following species are encountered: arrow arum (*Peltandra virginica*), dotted smartweed (*Polygonum punctatum*), pickerel-weed (*Pontederia cordata*), spatterdock (*Nuphar advena*), three-square bulrush (*Scirpus pungens*), water hemp (*Amaranthus cannabinus*), and wild rice (*Zizania aquatica*). Cattails (*Typha angustifolia* and *T. glauca*) dominate the upper tidal zone. Other plants observed in this zone include the orange jewelweed (*Impatiens capensis*), sweet flag (*Acorus calamus*), arrowheads (*Sagittaria* spp.), rose mallow (*Hibiscus moscheutos* var. *moscheutos*), smooth bur-marigold (*Bidens laevis*), halberd-leaved tearthumb (*Polygonum arifolium*), sensitive fern (*Onoclea senibilis*), swamp rose (*Rosa palustris*), button bush (*Cephalanthus occidentalis*), knob-styled dogwood (*Cornus amomum*), purple loosestrife (*Lythrum salicaria*), and common reed (*Phragmites australis*).

Brackish tidal marshes occur along spatially restricted stretches of the Mullica River, Wading River, Bass River, Nacote Creek, and Landing Creek. Narrow-leaved cattail (*Typha angustifolia*), big cordgrass (*Spartina cyosuroides*), Olney three-square bulrush (*Scirpus americanus*), and common reed (*Phragmites australis*) dominate these marshes. Submerged aquatic vegetation reported in brackish tidal reaches typically consist of slender pondweed (*Potamogeton pusillus*), redhead grass (*P. perfoliatus*), horned pondweed (*Zanniuchellia palustris*), water celery (*Vallisneria americana*), naiad

(*Najas flexilis*), and widgeon grass (*Ruppia maritima*). Common submerged aquatic vegetation in freshwater tidal reaches are arrowheads (*Sagittaria latifolia*, *S. engelmanniana*, and *S. spatulata*), bulrush (*Scirpus* spp.), American mannagrass (*Glyceria grandis*), and Nuttall's pondweed (*Potamogeton epihydrus*).

### **Salt Marshes**

Extensive salt marshes border Little Egg Harbor and Great Bay. Salt marshes also extend up the Mullica River to Lower Bank, and they occur along the perimeter of the lower Wading River. These salt marshes are characteristic of those in the northeastern U.S., being dominated by *Spartina alterniflora* (short form) and *Spartina patens* (salt-meadow cordgrass) (Rountree and Able, 1992). Salt marsh vegetation covers nearly 9,000 ha of wetland habitat in the Mullica River-Great Bay Estuary. Most salt marshes surrounding Great Bay occur in the Brigantine portion of the Forsythe National Wildlife Refuge and the Great Bay Boulevard Wildlife Management Area. In the Little Egg Harbor area, most of the salt marsh habitat occurs in the Barnegat portion of the Forsythe National Wildlife Refuge, the Holgate Unit of the Forsythe National Wildlife Refuge (located at the southern extremity of Long Beach Island), and the northern perimeter of the Great Bay Boulevard Wildlife Management Area. A series of bay islands in the southern portion of Little Egg Harbor also harbors considerable salt marsh habitat. Among these sites are West Sedge Island, East Sedge Island, Middle Sedge Island, Barrell Island, Bunting Sedge Island, Blake Whale Island, Goosebar Sedge Island, Johnny Sedge Island, Middle Island, Hither Island, Hester Sedge Island, Drag Sedge Island, Story Island, Goodluck Sedge Island, and Parker Island. A similar, albeit smaller,

complex of salt marsh islands exists along the northeastern part of Great Bay in close proximity to RUMFS.

Smooth cordgrass (*Spartina alterniflora*) dominates low marsh areas inundated daily by the tide. The tall-form dominates along tidal creeks, and the short-form predominates in other low marsh areas (Smith and Able, 1994). Salt-meadow cordgrass (*Spartina patens*), spike grass (*Distichlis spicata*), and black grass (*Juncus gerardii*) predominate in high marsh areas flooded less regularly. Typical species encountered in salt pannes are saltwort grass (*Salicornia bigelovii*), perennial glasswort (*S. virginica*), samphir (*S. europea*), orach (*Atriplex patula*), and marsh fleabane (*Pluchea purpurascens*). Characteristic species along the marsh-upland border include *S. patens*, annual salt marsh pink (*Sabatia stellaris*), seaside goldenrod (*Solidago sempervirens*), marsh elder (*Iva frutescens*), and the common reed (*Phragmites australis*). The common reed is an invasive species which has totally replaced *S. alterniflora* and other species on the marsh surface in some areas (Able and Hagen, 2000). The effect of this invasion on natural marsh systems is a cause of concern and the subject of considerable controversy (Weinstein and Kreeger, 2000).



## Barrier Islands

As noted above, Long Beach Island is heavily developed except for the Holgate Unit of the Forsythe National Wildlife Refuge, which is designated as a wilderness area. The North Brigantine State Natural Area is also



protected, with the undeveloped land consisting of relatively remote and undisturbed habitat. Along the developed portions of the barrier island complex, the dune scrub/shrub and woodland communities fronting the estuary have been largely destroyed or substantially altered. The natural dunes have been decimated in many areas, leading to the demise of dune grass and shrub vegetation. This habitat-forming vegetation is extremely important because it stabilizes the dunes and protects beaches against wind and wave erosion. It also provides stopover habitat for numerous species of migrating birds flying along the Atlantic Coastal Flyway.

The undeveloped portions of the barrier islands are typified by extensive sand beaches and well-developed primary and secondary dune systems along the ocean side. Salt marshes and tidal flat habitats occur along backbarrier areas (U.S. Fish and Wildlife Service, 1996). The barrier beaches are typified by barren foredunes, and a primary dune plant community dominated by American beach grass (*Ammophila breviligulata*); the

beach pea (*Lathyrus maritimus*), Japanese sedge (*Carex kobomugi*), seaside goldenrod (*Solidago sempervirens*), and sea rocket (*Cakile edentula*) are also observed here. Representative species identified in the secondary dune plant community include beach heather (*Hudsonia tomentosa*), bayberry (*Myrica pensylvanica*), beach plum (*Prunus maritima*), salt spray rose (*Rosa rugosa*), and pineweed (*Hypericum gentianoides*). Some rare species, such as the seabeach knotweed (*Polygonium glaucum*), inhabit the barrier beaches as well. In areas to the north (i.e., Island Beach State Park), well-developed thicket, edge, and freshwater wetland communities proliferate on the barrier (Kennish, 2001a).

In undisturbed areas of the barrier island system (e.g., Island Beach Northern Natural Area), an extensive coastal dune woodland community, or maritime forest, occurs behind the secondary dunes. In addition to the dominant red cedar (*Juniperus virginiana*), other trees comprising this community are the southern red oak (*Quercus falcata*), willow oak (*Quercus phellos*), black cherry (*Prunus serotina*), serviceberry (*Amelanchier canadensis*), sassafras (*Sassafras albidum*), and American holly (*Ilex opaca*). Sweet pepperbush (*Clethra alnifolia*), bayberry (*Myrica pensylvanica*), blueberries (*Vaccinium* spp.), hackberry (*Celtis occidentalis*), and multiflora rose (*Rosa multiflora*) form the secondary plant community. Open woodlands dominated by pitch pine exist in other areas. Trees associated with pitch pine are the Atlantic white cedar (*Chamaecyparis thyoides*), oak trees, and scattered holly. Sheep laurel (*Kalmia angustifolia*) and highbush blueberry (*Vaccinium corymbosum*) dominate the shrub layer (U.S. Fish and Wildlife Service, 1996).

Little Beach Island, located within the Brigantine National Wildlife Refuge, has vegetation typical of barrier beaches. American beach grass (*Ammophila breviligulata*) dominates the dune surface, with a mix of bayberry (*Myrica pensylvanica*), heather (*Calluna vulgaris*), marsh elder (*Iva frutescens*), and several other species concentrating in back dune areas. Various grasses, sedges, and flowering plants proliferate in low lying, freshwater pockets. The island is a major nesting, migration, and wintering area for waterfowl, marsh birds, and shorebirds.

### **Open Water**

The Mullica River-Great Bay Estuary is characterized by a strong salinity gradient from limnetic conditions at its headwaters to full seawater at the LEO-15 site in the nearshore ocean. As a result, a wide array of freshwater, estuarine, and marine organisms inhabits this unique system, utilizing pelagic and benthic habitats. These organisms comprise complex planktonic, benthic, and nektonic communities.

Great Bay and Little Egg Harbor support numerous phytoplankton and zooplankton populations.

Durand and Nadeau (1972) identified nearly 150 benthic invertebrate species in Great Bay alone. They showed that the benthic community here was dominated by the amphipod,



*Ampelisca abdita*. Benthic organisms inhabit both bare bottom habitats as well as areas covered by submerged aquatic vegetation (SAV). Vascular plants, notably seagrasses (e.g., eelgrass, *Zostera marina*), form important SAV habitat in Little Egg Harbor. Great Bay is essentially devoid of seagrass, while benthic macroalgae (e.g., sea lettuce, *Ulva lactuca*; hollow green weed, *Enteromorpha* sp.; and rockweed, *Fucus* sp.) are relatively abundant in some areas. Benthic infauna, epifauna, and fouling organisms are well represented in Little Egg Harbor, Great Bay, backbays to the south, and tributary systems.

More than 60 finfish species have been reported in the Mullica River-Great Bay Estuary. Other nektonic organisms observed here include sea turtles (e.g., Kemp's Ridley turtle, *Lepidochelys kempii*; leatherback turtles, *Dermochelys coriacea*; and green sea turtles, *Chelonia mydas*), snakes, and marine mammals (seals, whales, and porpoises). Several threatened or endangered nektonic species utilize the estuary at various times.

Many birds use the open water habitats and adjoining lands for feeding and other life processes. Both Little Egg Harbor and Great Bay are major migratory stopover and wintering areas for numerous waterfowl, shorebirds, and raptors. Water bird nesting colonies are common, such as those of terns (*Sterna* spp.), skimmers (*Rynchops* spp.), and egrets (*Casmerodius* spp.).

The following section provides a detailed description of the biotic communities of the estuarine and watershed areas in the JCNERR. These communities are generally characterized by having high species richness and abundance. The shelter and large food supply afforded by the backbarrier lagoon system support teeming concentrations of animal and plant life.

## Barnegat Bay-Little Egg Harbor Estuary

Shallow lagoonal estuaries in New Jersey are subject to ongoing multiple anthropogenic impacts from an expanding population in adjoining coastal watersheds. Eutrophication poses the most serious threat to the long-term health and function of these



systems, impacting essential habitats (e.g., seagrass and shellfish beds) as well as finfish nursery areas. Nutrient and organic carbon loading in the Barnegat Bay-Little Egg Harbor Estuary has been linked to an array of cascading environmental problems such as increased micro- and macroalgal growth, harmful algal blooms (HABs), bacterial and viral pathogens, high turbidity/benthic shading, altered benthic invertebrate communities, and impacted harvestable fisheries (Kennish et al., 2007a, b). These problems are causing the deterioration of sediment and water quality, loss of biodiversity, and disruption of ecosystem health and function. Human uses of estuarine resources are also being



impaired. The net insidious effect of progressive eutrophication may be the permanent alteration of biotic communities and habitats in the system.

The Barnegat Bay-Little Egg Harbor Estuary is classified as a highly eutrophic system based on application of NOAA's National Estuarine Eutrophication Assessment model (Kennish et al., 2007a). Because the Barnegat Bay-Little Egg Harbor Estuary is shallow, poorly flushed, and bordered by highly developed watershed areas, it is particularly susceptible to nutrient loading. Most of this load (~54%) derives from surface water inflow, but substantial fractions also originate from atmospheric deposition (~34%), and direct groundwater discharges (~12%) (Kennish, 2001a).

Other adverse effects on these estuarine waters include nonpoint source inputs of chemical contaminants, as well as the physical alteration of habitat due to bulkheading, diking and ditching, dredging, and lagoon construction. Power-plant (Oyster Creek Nuclear Generating Station) point-source impacts (i.e., biocidal releases, thermal discharges, impingement, and entrainment) have increased mortality of estuarine and marine organisms in Barnegat Bay. Human activities in watershed areas, notably deforestation and infrastructure development, partition and disrupt habitats while also degrading water quality and altering biotic communities. Ongoing land development (~35% of the Barnegat Bay watershed is now developed) raises turbidity and siltation levels in tributaries of the estuary, creating benthic shading problems. Management actions, including the purchase of open space, improved stormwater controls, and smart development are being pursued to remediate some of the aforementioned insidious effects and restore vital estuary functions; however, evidence indicates that remediation efforts have not resulted in significant mitigation of ecosystem impacts.

Significant data gaps exist in the Barnegat Bay-Little Egg Harbor Estuary. Hence, the following studies are recommended for the estuarine waters in the JCNERR.

- Seagrasses are key indicators of water quality and condition of the Barnegat Bay-Little Egg Harbor Estuary. Therefore, the monitoring of seagrass abundance, shoot density, biomass, areal cover, and distribution in this system must be conducted consistently at regular intervals to establish a reliable bioassessment program and track the effects of nutrient enrichment.
- The development of a seagrass nutrient pollution indicator is strongly recommended to identify the early stages of eutrophication in the system. Because detailed surveys of SAV beds are labor intensive, costly, and time consuming, the development of an innovative nutrient pollution indicator based on assessment of nitrogen levels in seagrass tissues would be extremely useful for this system. By applying this indicator in the estuary, management mediated intervention could be significant in mitigating nutrient impacts on SAV beds.
- There is an indication of significant loss of seagrass beds in the estuary since the mid-1970s, although differences in mapping methods make it difficult to unequivocally establish the occurrence of a major dieback and loss of eelgrass area. Results of a GIS

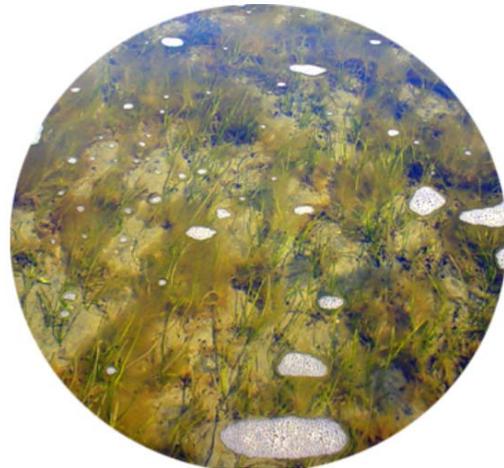


spatial comparison analysis of SAV surveys reported by Lathrop et al. (2001a) and Lathrop and Bognar (2001) showed that there appears to have been loss of eelgrass in the deeper waters of the estuary culminating in the contraction of the beds to shallower subtidal flats (< 2 m depth) during the period between the 1960s and 1990s. The loss appears to have been most severe in Barnegat Bay north of Toms River and in southern Little Egg Harbor.

- A two-pronged seagrass monitoring and assessment program is recommended. This entails the application of aerial photography, airborne digital scanning systems, or satellite-based remote sensing to map and monitor the seagrass beds, in conjunction with *in situ* sampling to corroborate the aerial observations. Airborne scanning systems yield high spatial resolution imagery, and analog aerial photography enables investigators to visually interpret and map expanses of the beds. Groundtruthing efforts in concert with this remote sensing work should consist of establishing a series of sampling transects, with an array of quadrat, core, and hand sampling sites. These field applications should be conducted at least every five years and preferably at greater frequency.
- Seagrasses are also excellent bioindicators of estuarine sediment quality, as well as overall ecosystem health. By monitoring the distribution and abundance of seagrasses in the Barnegat Bay-Little Egg Harbor Estuary and establishing quantitative measures of acceptable limits as biocriteria, effective bioassessment of estuarine condition can be conducted. A major goal is to establish nutrient criteria and TMDL's that will remediate the impacts of nutrient enrichment in the estuary. This can only be achieved through careful monitoring and assessment of

seagrass habitat in the system. Delineating the distribution and abundance of seagrasses in this lagoon-type, coastal-bay system to track escalating eutrophic impacts is highly recommended. Since changes in seagrass distribution and abundance can occur over periods as short as weeks or months, rapid and cost effective tools are needed to accurately determine seagrass condition within seasonal constraints and to quantify cause-and-effect relationships.

- Chlorophyll diagnostic photopigment analysis is needed for identifying and quantifying phytoplankton functional groups. Phytoplankton community composition is an effective indicator of phytoplankton activity/response, including blooms, that has been linked to nutrient enrichment and other environmental stressors.
- Regular surveys of algal blooms (both phytoplankton and macroalgae) must be conducted in the estuary to identify key autotrophic responses to nutrient stressors. Surveys for brown tide (*Aureococcus anophagefferens*) are a primary target of phytoplankton bloom surveys.
- Benthic community studies must be conducted to determine if significant changes have occurred over time. The last comprehensive investigation of the benthic community in the estuary was conducted by Robert Loveland and his students at Rutgers University from 1968 to 1974. By re-sampling the same areas of the



estuary, it will be possible to compare the benthic community 40 years after the Loveland investigations. Data that must be collected to assess the benthic community include species composition, abundance, biomass, diversity, and evenness. Metrics recorded on the benthos will be used to document changes in the benthos over the period from low development to high development in the coastal watershed.

- The development of indices of benthic community condition is another valuable tool in bioassessment of estuarine ecosystems. In estuarine systems impacted by nutrient enrichment and bottom-up effects, such as the Barnegat Bay-Little Egg Harbor Estuary, the application of benthic index development for seagrass as well as other benthic habitats in the system is thus strongly recommended for effective biotic assessment. Metric measurements of targeted benthic assemblages will be used to effectively discriminate anthropogenically-stressed assemblages from non-stressed assemblages. These measurements can be used to generate numeric scores and indices of biotic integrity that can be important for developing biocriteria for this estuarine system. These data are necessary for accurate evaluation of ecosystem health useful for management decision making and resource protection. Benthic community sampling must be conducted at regular intervals (~five-year periods) to document changes in benthic condition through time.
- Shellfish stock assessment surveys must be conducted in the estuary, most notably targeting the hard clam (*Mercenaria mercenaria*) resource. The last hard clam

stock surveys in Little Egg Harbor and Barnegat Bay were completed in 2001 and 1986, respectively.

- Population surveys are necessary to document the distribution and abundance of sea nettles (*Chrysaora quinquecirrha*) in the estuary. Population eruptions of sea nettles in the estuary have occurred in several years since 2000.

## FAUNAL COMMUNITIES

### Overview



### Mullica River-Great Bay Estuary

Great Bay is a major migratory stop and wintering area for many waterfowl, shorebirds and raptors. During the winter, the waterfowl population in the area is over 70,000 individuals. There are at least 44 distinct water bird nesting colonies for 15 different species. These include egrets, gulls, terns, and skimmers. Other birds of the reserve include herons, egrets, ospreys, eagles, owls, hawks, warblers and sparrows.



The Mullica River-Great Bay area also supports numerous species of finfish. Major anadromous fish include striped bass, alewife, and blueback herring which spawn in tributaries. Shellfish populations are also extensive in the form of clams, mussels, and oysters (historically more abundant). Amphibians of the reserve include the elusive and protected Pine Barrens treefrog, and several other frog and salamander species. A diversity of reptiles are found within the reserve, represented by a variety of terrestrial and aquatic turtles, and several lizard and snake species, including the northern pine snake and the timber rattlesnake.

## **Watershed Faunal Communities**

The Pinelands provide valuable habitat for numerous terrestrial organisms, notably reptiles, amphibians, mammals, birds, and insects. In addition, several fish species are relatively abundant in Pine Barrens streams and creeks, although the species richness is low. Many animal populations are characteristic of the Pine Barrens, and some of them are of recreational or commercial importance (e.g., ruffed grouse, *Bonasa umbellus*; eastern cottontail, *Sylvilagus floridanus*; and white-tailed deer, *Odocoileus virginianus*).

### **Amphibians and Reptiles**

Conant (1998) reported that eight species of amphibians and reptiles only occur within the boundaries of the Pine Barrens, including the carpenter frog (*Rana virgatipes*), Pine Barrens treefrog (*Hyla andersonii*), rough green snake (*Opheodrys aestivus*), northern scarlet snake (*Cemophora coccinea*), northern red-bellied snake (*Storeria occipitomaculata occipitomaculata*), corn snake (*Elaphe guttata guttata*), eastern kingsnake (*Lampropeltis getulus getulus*), and northern pine snake (*Pituophis melanoleucus melanoleucus*). Other species observed in the Pine Barrens are widely distributed across southern New Jersey. In total, nearly 60 species of herpetofauna have been identified in the Pine Barrens, with most of them also found outside of its borders. Among these species are 11 salamanders, 14 frogs and toads, 11 turtles, 3 lizards, and 19 snakes (Table 8). Other widely distributed species include the Fowler's toad (*Bufo woodhousii fowleri*), southern leopard frog (*Rana utricularia*), northern water snake (*Natrix sipedon sipedon*), spotted turtle (*Clemmys guttata*), common snapping turtle (*Chelydra serpentina*), and the red-bellied turtle (*Chrysemys rubriventris*).

Table 8. Status of amphibians and reptiles in the New Jersey Pine Barrens.

| Group                  | Species Name                  | Status in Pine Barrens   |
|------------------------|-------------------------------|--------------------------|
| <b>Salamanders</b>     |                               |                          |
|                        | Spotted salamander            | Uncertain                |
|                        | Marbled salamander            | REL, locally common      |
|                        | Eastern tiger salamander      | BOR, endangered          |
|                        | Red-spotted newt              | REL, few records         |
|                        | Northern dusky salamander     | BOR, rare                |
|                        | Red-backed salamander         | Abundant                 |
|                        | Slimy salamander              | Uncertain                |
|                        | Four-toed salamander          | REL, numerous records    |
|                        | Eastern mud salamander        | Uncertain                |
|                        | Northern red salamander       | Abundant                 |
|                        | Northern two-lined salamander | BOR, rare                |
| <b>Toads and Frogs</b> |                               |                          |
|                        | Eastern spadefoot             | Locally common           |
|                        | Fowler's toad                 | Abundant                 |
|                        | Northern cricket frog         | BOR, scattered records   |
|                        | Pine Barrens treefrog         | PBO, declining           |
|                        | Cope's gray treefrog          | PER, not present         |
|                        | Northern spring peeper        | Abundant                 |
|                        | Barking treefrog              | INT, possibly extirpated |
|                        | Gray treefrog                 | BOR, scattered records   |
|                        | New Jersey chorus frog        | BOR, numerous records    |

|                       |                        |
|-----------------------|------------------------|
| Bullfrog              | BOR, scattered records |
| Green frog            | Abundant               |
| Pickerel frog         | BOR, few records       |
| Wood frog             | BOR, few records       |
| Southern leopard frog | Abundant               |
| Carpenter frog        | PBO, common            |

### **Turtles**

|                                  |                                   |
|----------------------------------|-----------------------------------|
| Common snapping turtle           | Common                            |
| Stinkpot                         | Abundant                          |
| Eastern mud turtle               | Numerous records                  |
| Spotted turtle                   | Abundant records<br>but declining |
| Wood turtle                      | BOR, few records,<br>threatened   |
| Bog turtle                       | BOR, endangered                   |
| Eastern box turtle               | Numerous records<br>but declining |
| Northern diamondback<br>terrapin | PER, not present                  |
| Map turtle                       | PER, not present                  |
| Eastern painted turtle           | Abundant                          |
| Red-bellied turtle               | Common                            |
| Eastern spiny softshell          | INT, at western edge only         |

### **Lizards**

|                       |                  |
|-----------------------|------------------|
| Northern fence lizard | Abundant         |
| Ground skink          | PBO, uncommon    |
| Five-lined skink      | REL, few records |

### **Snakes**

|             |                  |
|-------------|------------------|
| Queen snake | PER, not present |
|-------------|------------------|

|   |                                  |
|---|----------------------------------|
| Northern water snake  | Abundant                         |
| Northern brown snake  | Scattered records                |
| Northern red-bellied snake  | PBO, numerous records            |
| Eastern ribbon snake  | Numerous records<br>but uncommon |
| Eastern garter snake  | Numerous records                 |
| Eastern earth snake   | Uncertain                        |
| Eastern hognose snake   | Locally common<br>but declining  |
| Northern-southern ringneck<br>snake                                     | Scattered                        |
| Eastern worm snake  | REL, common                      |
| Northern black racer  | Locally common<br>but declining  |
| Rough green snake   | PBO, common                      |
| Corn snake  | PBO, scattered records           |
| Black rat snake   | Locally common                   |
| Northern pine snake   | PBO, locally common              |
| Eastern king snake  | PBO, locally common              |
| Eastern milk snake - scarlet<br>king snake (intergrading<br>population) | Numerous records                 |
| Northern scarlet snake  | PBO, scattered records           |
| Timber - canebrake rattlesnake<br>(integrating population)              | PBO, threatened                  |

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PBO, Pine Barrens only; BOR, border entrant; REL, relict in Pine Barrens; PER, peripheral to Pine Barrens; INT, introduced.

From Conant, R. 1998. A zoogeographical review of the amphibians and reptiles of southern New Jersey, with emphasis on the Pine Barrens. In: R. T. T. Forman, Ed., *Pine Barrens: Ecosystem and Landscape*. Rutgers University Press, New Brunswick, pp. 467-488.

Amphibian and reptilian species, which are common or abundant in the upland region, include the Pine Barrens tree frog (*Hyla andersonii*), eastern tiger salamander (*Ambystoma tigrinum tigrinum*), northern pine snake (*Pituophis melanoleucus melanoleucus*), timber rattlesnake (*Crotalus horridus horridus*), and wood turtle (*Clemmys insculpta*). In the lowland forest region, the eastern mud salamander (*Pseudotriton montanus montanus*), long-tailed salamander (*Eurycea longicauda longicauda*), and bog turtle (*Clemmys muhlenbergii*) are frequent inhabitants. Broad, undisturbed areas of the Pine Barrens serve as ideal habitat for many herpetofaunal species.

Zampella et al. (2001) identified 12 anuran species in the Mullica River Basin (Table 9). Bunnell and Zampella (1999) and Zampella et al. (2001), investigating 14 acid water ponds within publicly owned forest lands along the northwestern boundary of the Mullica River Basin, classified anurans (frogs and toads) in three groups: (1) forms restricted to the Pinelands, notably the Pine Barrens treefrog (*Hyla andersonii*) and the carpenter frog (*Rana virgatipes*); (2) forms with a widespread distribution in southern New Jersey such as the northern spring peeper (*Pseudacris crucifer crucifer*), Fowler's toad (*Bufo woodhousii fowleri*), southern leopard frog (*Rana utricularia*), green frog (*Rana clamitans melanota*), eastern spadefoot toad (*Scaphiopus holbrooki holbrooki*);



and (3) those forms normally unable to enter the Pinelands except in habitats disturbed by human activities. The latter border-entrant species are exemplified by the gray treefrogs (*Hyla versicolor* and *H. chrysoscelis*), New Jersey chorus frog (*Pseudacris triseriata kalmi*), northern cricket frog (*Acris crepitans crepitans*), wood frog (*Rana sylvatica sylvatica*), pickerel frog (*Rana palustris*), and bullfrog (*Rana catesbeiana*). The border-entrant species occur less frequently in the Pinelands than do the Pine Barrens species and the wide-ranging forms. They normally occupy Pinelands habitat disturbed by anthropogenic activity, and avoid the low pH of surface waters in undisturbed areas (Zampella et al., 2001).

Table 9. Taxonomic list of anuran species found in the Mullica River Basin.

| Common Name            | Scientific Name                                    |
|------------------------|--|
| Northern cricket frog  | <i>Acris crepitans crepitans</i>                   |
| Pine Barrens treefrog  | <i>Hyla andersonii</i>                             |
| Gray treefrog          | <i>Hyla chrysoscelis</i><br><i>Hyla versicolor</i> |
| Fowler's toad          | <i>Bufo woodhousii fowleri</i>                     |
| Northern spring peeper | <i>Pseudacris crucifer crucifer</i>                |
| New Jersey chorus frog | <i>Pseudacris triseriata kalmi</i>                 |
| Bullfrog               | <i>Rana catesbeiana</i>                            |
| Green frog             | <i>Rana clamitans melanota</i>                     |
| Pickerel frog          | <i>Rana palustris</i>                              |
| Southern leopard frog  | <i>Rana utricularia</i>                            |

Wood frog

*Rana sylvatica*

Carpenter frog

*Rana virgatipes*

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Modified from Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

Zampella and Bunnell (2000) compared the distribution of anuran populations in the Wading River Basin to those in the more intensely developed and farmed Mullica River Basin. Four non-native Pinelands species (i.e., bullfrog, *Rana catesbeiana*; pickerel frog, *R. palustris*; northern cricket frog, *Acris crepitans crepitans*; and gray treefrog, *Hyla versicolor*) normally distributed outside the region were recorded only in the Mullica River system, where sites were associated with the presence of upland agriculture and developed land. In contrast, six native Pinelands species (i.e., Pine Barrens treefrog, *Hyla andersonii*; carpenter frog, *R. virgatipes*; southern leopard frog, *R. utricularia*; Fowler's toad, *Bufo woodhousii fowleri*; northern spring peeper, *Pseudacris crucifer crucifer*; and green frog, *R. clamitans melanota*) were widely distributed in both river systems. Bullfrogs generally occurred at sites devoid of the Pine Barrens treefrogs and carpenter frogs. The bullfrogs occurred in proximity to developed land and upland agriculture, whereas the carpenter frogs preferred unaltered sites.

Zampella et al. (2001, p. 86) discussed the use of anuran assemblages as indicators of watershed disturbance in the Pinelands. They concluded the following:

- The presence of individual border-entrant species and assemblages dominated by these species is associated with adjacent developed land and upland agriculture.

- The general absence of the two Pine Barrens species at sites with bullfrogs indicates that the presence of bullfrogs may adversely affect native anuran diversity.
- On-stream anuran communities may be better indicators of overall watershed conditions compared to off-stream communities because most of the sites that support border-entrant species are stream sites.

In a study of the nearby Barnegat Bay watershed, Zappalorti and Sykes (1998) identified nine anuran species that are generally widespread and stable. These include the northern spring peeper (*Pseudacris crucifer crucifer*), northern gray treefrog (*Hyla versicolor*), New Jersey chorus frog (*Pseudacris triseriata kalmi*), bullfrog (*Rana catesbeiana*), green frog (*Rana clamitans melanota*), wood frog (*Rana sylvatica*), southern leopard frog (*Rana utricularia*), pickerel frog (*Rana palustris*), and Fowler's toad (*Bufo woodhousii fowleri*). The status of two other anuran species in the watershed, the carpenter frog (*Rana virgatipes*) and northern cricket frog (*Aris crepitans crepitans*), is undetermined. One anuran species, the eastern spadefoot toad (*Scaphiopus holbrooki holbrooki*) is declining. The southern gray treefrog (*Hyla chrosocelis*) is a State endangered species. The Pine Barrens treefrog (*H. andersonii*), another problematic species, was removed from the State endangered species list in May 2003.

The acid water and low concentrations of dissolved solids in Pinelands streams and ponds unaffected by upland land uses create harsh conditions for many herpetofauna and thus influence their distribution and abundance. The low pH of streams and ponds in the Pinelands can adversely affect embryonic and larval development and survival of less tolerant anuran species (Freda and Dunson, 1986). The native anurans (i.e., *Hyla*

*andersonii* and *Rana virgatipes*) appear to be the species most tolerant of these conditions in the Pinelands. Other species residing in the Pine Barrens, but whose natural distribution is outside of this region, can successfully reproduce only in areas of the Pinelands that have been altered by human activity (Bunnell and Zampella, 1999). The Pine Barrens tree frog deserves special consideration because of its restrictive habitat requirements.

Three species of salamanders are relatively abundant in the Pine Barrens: the red-backed salamander (*Plethodon cinereus*), northern red salamander (*Pseudotriton ruber*), and four-toed salamander (*Hemidactylium scutatum*). In addition, the marbled salamander (*Ambystoma opacum*) is locally common. The northern two-lined salamander (*Eurycea bislineata*) and northern dusky salamander (*Desmognathus fuscus*) are rare, and the eastern tiger salamander (*Ambystoma tigrinum tigrinum*) is endangered. The amphibious salamanders breed in the water and usually inhabit moist areas beneath rotting stumps, logs, leaves, and other decaying debris.

Of the three species of lizards occupying Pine Barrens habitats, the most abundant is the northern fence lizard (*Sceloporus undulatus hyacinthinus*). The ground skink (*Scincella lateralis*) is uncommon. The five-lined skink (*Eumeces fasciatus*) represents the least abundant form, with only a few records of its occurrence in the Pine Barrens. While ground skinks inhabit open sandy wooded areas, fence lizards prefer open pine and pine-oak uplands where they are often observed on pine trees, wood piles, or fallen logs. Five-lined skinks, in turn, occupy moist or wet woodland areas such as hardwood swamps.

Most turtles in the Pine Barrens occur in brackish or freshwater habitats, the notable exception being the eastern box turtle (*Terrapene carolina*). Abundant species of turtles in the Pinelands are the stinkpot (*Sternotherus odoratus*) and eastern painted turtle (*Chrysemys picta*), with the snapping turtle (*Chelydra serpentina*), spotted turtle (*Clemmys guttata*), and red-bellied turtle (*Chrysemys rubriventris*) being common. Numerous records also exist for the eastern mud turtle (*Kinosternon subrubrum subrubrum*) and eastern box turtle (*T. carolina*). The wood turtle (*Clemmys insculpta*), a threatened species, and the bog turtle (*Clemmys muhlenbergi*), a State endangered and a federal threatened species, have also been recorded in the Pine Barrens.

The northern diamondback terrapin (*Malaclemys terrapin terrapin*) is found in the lower watershed, particularly in tidal salt marsh habitat. It nests on sandy uplands adjacent to tidal creeks and salt marshes (U.S. Fish and Wildlife Service, 1996; Hoden and Able, 2003). This year-round resident species has been declining in recent years. Various organisms prey on adult diamondback terrapins, particularly raccoons, bald eagles, and most notably, humans. Other predators attack the nests of diamondback terrapins (e.g., gulls, crows, muskrats, foxes, and skunks). Burger (1977) reported that 73% of terrapin nests on small islands in Barnegat Bay were destroyed within a single year by predators. Many individuals are also killed by vehicular traffic on roadways (Hoden and Able, 2003).

Several species of snakes occur in upland forest and wetland habitats of the Pine Barrens. Species commonly found in upland forests are the northern pine snake (*Pituophis melanoleucus melanoleucus*), eastern hognose snake (*Heterodon platyrhinos*), eastern worm snake (*Carphophis amoenus amoenus*), northern black racer (*Coluber*

*constrictor constrictor*), northern scarlet snake (*Cemophora coccinea*), rough green snake (*Opheodrys aestivus*), eastern garter snake (*Virginia valeriae valeriae*), and corn snake (*Elaphe guttata guttata*). Those observed in wetland areas are the eastern ribbon snake (*Thamnophis sauritus sauritus*), northern water snake (*Nerodia sipedon*), and eastern king snake (*Lampropeltis getula getula*). The endangered timber rattlesnake (*Crotalus horridus horridus*) requires both upland and wetland forest habitat during different times of the year. Both the timber rattlesnake and corn snake are listed as State endangered species, and the northern pine snake is listed as a State threatened species.

Timber rattlesnakes in the Pine Barrens hibernate along cedar streams. They commonly position themselves in underground flowing water at the base of cedar trees where the root systems afford protection (Zappalorti and Reinert, 1989). When emerging from hibernation, the snakes quickly migrate to upland foraging sites. Abundance of the timber rattlesnake has declined over most of the snake's range during the past several decades (Tynning, 1992).

Pine snakes hibernate in a group and often with other snake species, including black racers and corn snakes (Kennish, 2001a). The snakes inhabit hibernation chambers until the spring thaw when they emerge to pursue prey. Pine snakes and corn snakes are non-venomous constrictors that primarily feed on warm-blooded prey.

Habitat loss and alteration pose a threat to various reptilian and amphibian populations in the Mullica River and Barnegat Bay watersheds. The most serious threats are associated with habitat partitioning, degradation, and destruction in the more heavily developed Barnegat Bay watershed. Other factors that may be contributing to the decline of some herptiles in watershed habitats are pollution of wetland and upland habitats, road

mortality, illegal collecting and wanton killing by humans, as well as predation by domestic and feral animals.

### **Mammals**

Wolgast (1998) has described the land-dwelling mammals inhabiting the Pine Barrens. More than 30 species reside in various parts of this system. They have been grouped into three categories based on size: small, intermediate, and large species. Most of the mammalian species (n = 22) are small (adult body length, excluding tail, < 26 cm). Among the small-sized mammals are the masked shrew (*Sorex cinereus*), least shrew (*Cryptotis parva*), short-tailed shrew (*Blarina brevicauda*), eastern mole (*Scalopus aquaticus*), star-nosed mole (*Condylura cristata*), little brown myotis (*Myotis lucifugus*), big brown bat (*Eptesicus fuscus*), eastern pipistrelle (*Pipistrellus subflavus*), eastern chipmunk (*Tamias striatus*), gray squirrel (*Sciurus carolinensis*), red squirrel (*Tamiasciurus hudsonicus*), southern flying squirrel (*Glaucomys volans*), rice rat (*Oryzomys palustris*), white-footed mouse (*Peromyscus leucopus*), red-backed vole (*Clethrionomys gapperi*), meadow vole (*Microtus pennsylvanicus*), pine vole (*Microtus pinetorum*), southern bog lemming (*Synaptomys cooperi*), Norway rat (*Rattus norvegicus*), house mouse (*Mus musculus*), meadow jumping mouse (*Zapus hudsonius*), and long-tailed weasel (*Mustela frenata*).

The body lengths of intermediate-sized mammals range from 26-76 cm (excluding tail). Eleven species comprise this group, including the opossum (*Didelphis virginiana*), woodchuck (*Marmota monax*), eastern cottontail (*Sylvilagus floridanus*), beaver (*Castor canadensis*), muskrat (*Ondatra zibethicus*), red fox (*Vulpes vulpes*), gray

fox (*Urocyon cinereoargenteus*), raccoon (*Procyon lotor*), mink (*Mustela vison*), striped skunk (*Mephitis mephitis*), and river otter (*Lutra canadensis*). The white-tailed deer (*Odocoileus virginianus*) and humans (*Homo sapiens*) constitute the largest mammals (adult body size > 1 m).

The aforementioned mammalian species have a broad distribution, ranging beyond the boundaries of the Pine Barrens. They are well-established species, some of which are threatened or endangered. Many of the species have distinct habitat preferences (Wolgast, 1998).

Mammalian species which prefer wetland habitats and nearby waterways include the least shrew, southern log lemming, muskrat, beaver, river otter, and mink. While the river otter resides in tidal marshes, bay islands, and Pine Barrens streams, the beaver is restricted to freshwater areas of tributary systems. The muskrat occurs in both freshwater and brackish marshes. The red-backed vole is essentially confined to wetland forests and bogs. Mammals associated with shrubland and grassland habitats include the eastern cottontail, woodchuck, meadow vole, and meadow jumping mouse. Species of rodents that dwell in upland forests are the pine vole, white-footed mouse, southern flying squirrel, gray squirrel, red squirrel, and eastern chipmunk. Larger upland forest species consist of white-tailed deer, opossum, striped skunk, long-tailed weasel, raccoon, gray fox, and red fox.

### **Birds**

The JCNERR provides habitat for thousands of shorebirds, seabirds, songbirds, raptors, and waterfowl. The location of the reserve on the Atlantic Flyway enables

numerous migrating birds to utilize coastal habitats as staging and overwintering areas. As a result, the avifauna observed in the Pine Barrens also includes rare species of both southern and northern affinities.



Colonial nesting waterbirds censused within the reserve boundaries are beach nesting birds (e.g., black skimmers, *Rynchops niger*, and least terns, *Sterna antillarum*), long-legged wading birds (e.g., herons, egrets, and ibises) nesting among trees and shrubs, and gulls and terns nesting on salt marsh islands (U.S. Fish and Wildlife Service, 1996). The Holgate Unit is one of the most important locations in New Jersey for nesting least terns. Other species of terns observed in the area are the common tern (*Sterna hirunda*), Forster's tern (*S. forsteri*), and gull-billed tern (*S. nilotica*). Laughing gulls (*Larus atricilla*), herring gulls (*L. argentatus*), and great black-back gulls (*L. marinus*) comprise significant nesting bird colonies. Salt marshes and beach bars along the Great Bay Boulevard Wildlife Management Area and on bay islands (e.g., Tow Island, Fish Island, and Seven Islands) are favored nesting locations for terns, gulls, and other colonial nesting waterbirds. Surveys revealed as many as 200 black skimmers nesting on Tow Island in 1995.

Appendix 16 contains a list of nearly 170 species of birds that have been identified along an intertidal mudflat (39°31'N, 74°10'W) located at the end of Great Bay Boulevard near RUMFS. This 1.56-ha mudflat terminates at the entrance to Little Egg Inlet and the Atlantic Ocean. More than 700 censuses conducted on a weekly basis year-

round between November 1976 and August 1989 recorded a total of 28 species of shorebirds, gulls, and geese and nearly 185,000 individuals along Great Bay Boulevard and the open waters of the JCNERR. Overall abundance was greatest during the spring migration period, with a single peak in abundance occurring during mid-May, which averaged 1000 birds. Fall migration showed a significant peak in abundance during November. The mean number of species observed per week ranged from 14 in the spring, to four through the summer, and 11 during the fall migration. Total bird abundance did not change significantly over the 13-year study period. Only three species exhibited significant change in abundance over time: the American oystercatcher, sanderling, and yellowlegs.

Among the most commonly reported nesting long-legged wading birds are the black-crowned night heron (*Nycticorax nycticorax*), yellow-crowned night heron (*N. violaceus*), tri-colored heron (*Egretta tricolor*), little blue heron (*E. caerulea*), snowy egret (*E. thula*), great egret (*Casmerodius albus*), cattle egret (*Bubulcus ibis*), and glossy ibis (*Plegadis falcinellus*). A less conspicuous wading bird is the green-backed heron (*Butorides striatus*), a fish-eating species which nests in riparian habitats (Leck, 1998). Some bay islands, such as the Goosebar Sedge and Story Island, have supported significant heronies. In 1985, a small heronry existed on one of the Seven Islands; nesting birds consisted of cattle egrets, great egrets, black-crowned night-herons, and glossy ibises. A small great blue heron (*Ardea herodias*) heronry has been documented in the Pomona Woods in the eastern Pinelands (U.S. Fish and Wildlife Service, 1996).

Among the most abundant colonial waterbirds using the Brigantine Bay and marsh complex are gulls (laughing gulls, herring gulls, and great black-backed gulls) and

terns (common terns, Forster's terns, and gull-billed terns). Long-legged waders nesting in this complex, in descending order of abundance, include the snowy egret, glossy ibis, great egret, black-crowned night-heron, tri-colored heron, cattle egret, little blue heron, and yellow-crowned night-heron. Aerial colonial waterbird surveys conducted in the Barnegat Bay-Little Egg Harbor estuarine system registered 500 long-legged waders in seven heronies in 1989, and 435 waders in 14 heronies in 1995. The most abundant species of waders for both survey years, in declining order of abundance, were the snowy egret, great egret, glossy ibis, black-crowned night heron, little blue heron, tri-colored heron, and yellow-crowned night heron (U.S. Fish and Wildlife Service, 1996).

Burger et al. (2001) has investigated the colonial waterbirds of the Barnegat Bay-Little Egg Harbor Estuary (Table 10). She followed population trends of several species of colonial-nesting birds (i.e., common tern, Forster's tern, black skimmer, and herring gull) in the estuary based on yearly censusing from 1976 to 1999. Her data indicate a significant increase in the number of colonies of herring gulls and a significant decrease in the number of colonies of common terns and black skimmers over this time interval. Aerial surveys conducted in 1977, 1978, 1979, 1983, 1989, and 1995 revealed a significant decline in the number of colonies of least terns and a significant increase in the number of colonies of great black-backed gulls, great egrets, black-crowned night herons, and glossy ibises. The number of adult herring gulls



decreased from 1976 to 1999, as did the number of adult snowy egrets and least terns from 1977 to 1995. A few colonial waterbirds in the Barnegat Bay-Little Egg Harbor Estuary are listed as State endangered and threatened species. For example, the least tern and black skimmer are listed as State endangered, whereas the yellow-crowned night-heron is listed as State threatened.

Table 10. Colonial waterbirds of the Barnegat Bay-Little Egg Harbor Estuary.

| Group                           | Common Name             | Scientific Name           |
|---------------------------------|-------------------------|---------------------------|
| <b>Gulls, Terns, Skimmers</b>   |                         |                           |
|                                 | Common tern             | <i>Sterna hirundo</i>     |
|                                 | Least tern              | <i>Sterna antillarum</i>  |
|                                 | Forster's tern          | <i>Sterna forsteri</i>    |
|                                 | Roseate tern            | <i>Sterna dougalli</i>    |
|                                 | Caspian tern            | <i>Sterna caspia</i>      |
|                                 | Gull-billed tern        | <i>Sterna nilotica</i>    |
|                                 | Laughing gull           | <i>Larus atricilla</i>    |
|                                 | Herring gull            | <i>Larus argentus</i>     |
|                                 | Great black-backed gull | <i>Larus marinus</i>      |
|                                 | Black skimmer           | <i>Rhynchops niger</i>    |
| <b>Long-legged Wading Birds</b> |                         |                           |
|                                 | Great egret             | <i>Casmerodius albus</i>  |
|                                 | Snowy egret             | <i>Egretta thula</i>      |
|                                 | Cattle egret            | <i>Bubulcus ibis</i>      |
|                                 | Great blue heron        | <i>Ardea herodias</i>     |
|                                 | Green-backed heron      | <i>Butorides striatus</i> |
|                                 | Little blue heron       | <i>Egretta caerulea</i>   |

|                            |                              |
|----------------------------|------------------------------|
| Tri-colored heron          | <i>Egretta tricolor</i>      |
| Yellow-crowned night-heron | <i>Nycticorax violaceus</i>  |
| Black-crowned night-heron  | <i>Nycticorax nycticorax</i> |
| Glossy ibis                | <i>Plegadis falcinellus</i>  |

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From Burger, J., C. D. Jenkins, Jr., F. Lesser, and M. Gochfeld. 2001. Status and trends of colonially-nesting birds in Barnegat Bay. *Journal of Coastal Research*, Special Issue 32, pp. 197-211.

Many shorebirds also use the barrier beach-backbarrier lagoon system, as well as fringing habitat of the Mullica River-Great Bay Estuary, particularly during spring and fall migrations. They roost and forage in tidal salt marshes and feed on sandflats and mudflats of Great Bay and neighboring estuaries (U.S. Fish and Wildlife, 1996). Nesting species of note include the piping plover (*Charadrius melodus*), American oystercatcher (*Haematopus palliatus*), and willet (*Catoptrophorus semipalmatus*). All inhabit beaches and dunes, although oystercatchers and willets have broader habitat preferences and often frequent open marshes and marsh islands. The American oystercatcher, for example, nests on broad sand flats, open beaches, and sparsely vegetated areas of islands. A favored nesting area of the piping plover is the stretch of beach along the Holgate Unit, where an average of 13 pairs of piping plovers were documented from 1985 to 1995 (U.S. Fish and Wildlife Service, 1996). The piping plover typically nests in exposed or sheltered areas at the base of a clump of dune grass or other vegetation. Important natural predators are gulls (*Larus* spp.), crows (*Corvus* spp.), raccoons (*Procyon lotor*), and foxes (*Vulpes vulpes*) (Jenkins et al., 1998). Most of these shorebirds migrate from the region during the fall to overwinter along the southeast Atlantic, Gulf of Mexico, and Caribbean coasts (Kennish, 2001a). Aside from shorebirds, other groups of birds that use

the Atlantic coastal corridor as a major migratory route include passerines, raptors, and waterfowl.

Nearly 300 species of birds have been recorded at the Edwin B. Forsythe National Wildlife Refuge, with more than 100 of them found to be actively breeding during the past few years. Shorebird species consistently observed in the refuge are the dunlin (*Calidris alpina*), semipalmated sandpiper (*C. pusilla*), western sandpiper (*C. mauri*), least sandpiper (*C. minutilla*), white-rumped sandpiper (*C. fuscicolis*), short-billed dowitcher (*Limnodromus griseus*), semipalmated plover (*Charadrius semipalmatus*), greater yellowlegs (*Tringa melanolueca*), black-bellied plover (*Pluvialis squatorola*), lesser golden plover (*P. dominica*), marbled godwit (*Lemosa fedoa*), Hudsonian godwit (*L. haemastica*), ruddy turnstone (*Arenaria interpres*), willet (*Catoptrophorus semipalmatus*), and American oystercatcher (*Haematopus palliatus*). Other shorebirds found in the region are the sanderling (*Calidris alba*) and red knot (*Calidris canutus*) (U.S. Fish and Wildlife Service, 1996).

Rails (e.g., clapper rail, *Rallus longirostris*; Virginia rail, *Rallus limicola*; and sora rail, *Porzana carolina*) are common marsh-nesting birds. The Virginia rail, sora, and marsh wren breed in brackish and freshwater marshes along the Mullica and Wading Rivers. Human disturbance can greatly disrupt the breeding and nesting behavior of these birds.

A number of raptors utilize barrier beach and tidal marsh environments. Among these birds are the osprey (*Pandion haliaetus*), peregrine falcon (*Falco peregrinus*), merlin (*F. columbarius*), American kestrel (*F. sparverius*), northern harrier (*Circus cyaneus*), sharp-shinned hawk (*Accipiter striatus*), and short-eared owl (*Asio flammeus*).

The osprey, peregrine falcon, and northern harrier are the primary raptors. While the peregrine falcon and northern harrier nest year-round in the region, the osprey migrates to the Southeast U.S., Central America, and South America, where it overwinters. The peregrine falcon and the osprey are listed as a State threatened species. The northern harrier, in turn, is a State endangered species.

The osprey, peregrine falcon, and northern harrier all feed near the top of the estuarine food chain. The osprey primarily consumes fish. The peregrine falcon, in contrast, prefers other birds as prey such as shorebirds, small waterfowl, and gulls. Northern harriers also ingest small birds, but commonly hunt the marsh landscape for rodents and other small mammals (Kennish, 2001a).

The peregrine falcon and northern harrier nesting populations are relatively stable. The number of nesting ospreys, however, has increased dramatically during the past 25 years. Between 1975 and 1998, osprey nests increased more than five-fold, from 50 nests to over 250 nests statewide. In the study region, the osprey nests on platforms in salt marsh habitats. The northern harrier also utilizes salt marshes, as well as brackish marshes, for nesting and foraging. The merlin likewise feeds in the marshes. In recent years, the bald eagle has been observed nesting along the Mullica River as well as roosting and foraging in the tidal reaches of the Mullica and Wading Rivers (U.S. Fish and Wildlife Service, 1996). It is clearly evident that a range of habitats in the JCNERR are critically important to the health and viability of these raptor populations.

Other predatory birds are largely limited to upland forest habitats. Examples are the broad-winged hawk (*Buteo platypterus*), which nests in tall oak trees, as well as the eastern screech owl (*Otus asio*) and great horned owl (*Bubo virginianus*), which inhabit

oak-pine forests. Impressive flights of hawks (e.g., sharp-shinned hawk, *Accipiter striatus*) are occasionally observed in the Pinelands (Leck, 1998).

Barneгат Bay-Little Egg Harbor Estuary and the Mullica River-Great Bay Estuary serve as important migration and wintering habitat for waterfowl. Midwinter aerial surveys indicate that an average of more than 12,000 waterfowl occur in the estuarine system, with the most abundant species being, in descending order, the American black duck (*Anas rubripes*), brant (*Branta bernicla*), greater and lesser scaup (*Aythya marila* and *A. affinis*), mallard (*Anas platyrhynchos*), and bufflehead (*Bucephala albeola*). Less abundant species are the tundra swan (*Cygnus colombianus*), Canada goose (*Branta canadensis*), gadwall (*Anas strepera*), red-breasted merganser (*Mergus serrator*), common merganser (*M. merganser*), hooded merganser (*Lophodytes cucullatus*), common goldeneye (*Bucephala clangula*), oldsquaw (*Clangula hyemalis*), American widgeon (*Anas americana*), northern pintail (*Anas acuta*), canvasback (*Aythya valisneria*), and green-winged teal (*Anas crecca*) (U.S. Fish and Wildlife Service, 1996; Casttelli et al., 1997).

Peak numbers of waterfowl are found in the reserve during the winter, although wintering waterfowl species vary considerably in abundance from year to year. The severity of winter weather conditions, especially the amount of freezing, strongly influences waterfowl abundance. Winter flocks in the system have been historically dominated by the American black duck; however, the mallard has increased dramatically in recent years (Leck, 1998).

During harsh winters when extensive areas freeze, many waterfowl concentrate in areas near Little Egg Inlet. Sea ducks, for example, prefer the inlet area. Diving ducks

are mainly observed in open waters of Great Bay and Little Egg Harbor. Bufflehead and dabbling ducks utilize the shorelines and tidal creeks of the estuary. One of the largest wintering populations of tundra swans in the Mid-Atlantic region inhabits the Wading River, averaging as many as 2,500 individuals. The American black duck, mallard, Canada goose, and gadwall breed in the estuary. A breeding population of the American black duck also occurs in the Mullica River.

Mid-winter aerial surveys have revealed greater numbers of waterfowl in the Brigantine Bay and marsh complex, as well as the Barnegat Bay complex, than in the Mullica River-Great Bay estuarine system. For example, in the Brigantine Bay and marsh complex, mid-winter aerial waterfowl counts have documented an average of more than 70,000 birds. The most abundant species in these surveys are, in descending order, the brant, American black duck, snow goose (*Chen caerulescens*), greater and lesser scaup, Canada goose, bufflehead, scoters (*Melanitta* spp.), and mallard. These species are not evenly distributed in the complex. In the Barnegat Bay system, mid-winter aerial waterfowl counts average ~50,000 birds; the most abundant species are, in descending order, the greater and lesser scaup, brant, American black duck, bufflehead, canvasback, mallard, and Canada goose. The diversity of waterfowl frequenting the estuary in spring and fall is significant (Castelli et al., 1997; Table 11). These species are typically rafted in concentrated areas; thus, they are not evenly distributed in the system. The most abundant waterfowl species identified in fall (November) migrations are, in declining order, the brant, American black duck, scaup, mallard, bufflehead, Canada goose, and merganser (U.S. Fish and Wildlife Service, 1996). Because numerous waterfowl inhabit

the coastal bays of New Jersey, these water bodies and adjacent land areas are important waterfowl hunting areas (Nichols and Castelli, 1997).

A number of seabird populations migrate along the coast. Species of note include the northern gannet (*Sula bassanus*), cormorants (*Phalacrocorax* spp.), sooty shearwater (*Puffinus griseus*), loons (*Gavia* spp.), and Wilson's storm petrel (*Oceanites oceanicus*). Aerial surveys conducted in Cape May County documented more than 900,000 seabirds migrating along the coast during the period from July through December 1995 (U.S. Fish and Wildlife Service, 1996).

Many songbirds also feed, nest, and breed in the Pine Barrens. Abundant breeding songbird populations in the Pinelands include the rufous-sided towhee (*Pipilo erythrophthalmus*), a member of the sparrow family found throughout the Pinelands but particularly at upland sites in areas of scrubby undergrowth, and the gray catbird (*Dumetella carolinensis*), which commonly nests in dense thickets. The Carolina chickadee (*Parus carolinensis*), Carolina wren (*Thyrothorus ludovicianus*), and mockingbird (*Mimus polyglottus*) are southern bird species also conspicuous in upland areas (Leck, 1998).

Within oak-pine woodlands, the red-eyed vireo (*Vireo olivaceus*), black-and-white warbler (*Mniotilta varia*), and the ovenbird (*Seiurus aurocapillus*) are frequently observed. Insectivores tend to be more abundant among oak-dominated stands. Species showing a preference for mixed pine-oak vegetation include the pine warbler (*Dentroica pinus*) and prairie warbler (*D. discolor*). The pine warbler concentrates in tall pine woodlands, and the prairie warbler, in shrub undergrowth. Pine forests harbor the greatest diversity of breeding birds (U.S. Fish and Wildlife Service, 1996).

Table 11. Waterfowl species occurring by month in federal surveys of Barnegat Bay, 1985-1993 (excluding 1988).

| SPECIES             | Months |     |     |     |     |     |     |
|---------------------|--------|-----|-----|-----|-----|-----|-----|
|                     | OCT    | NOV | DEC | JAN | FEB | MAR | APR |
| Mallard             | x      | x   | x   | x   | x   | x   | x   |
| American black duck | x      | x   | x   | x   | x   | x   | x   |
| Gadwall             | -      | -   | -   | -   | 0   | 0   | x   |
| American wigeon     | -      | -   | 0   | +   | 0   | 0   | 0   |
| Green-winged teal   | x      | +   | x   | x   | x   | x   | x   |
| Blue-winged teal    | -      | 0   | 0   | -   | 0   | 0   | 0   |
| Northern shoveler   | 0      | 0   | -   | 0   | 0   | +   | +   |
| Northern pintail    | +      | +   | x   | x   | x   | x   | x   |
| Wood duck           | 0      | 0   | 0   | 0   | 0   | 0   | 0   |
| Redhead             | 0      | -   | 0   | 0   | 0   | 0   | 0   |
| Canvasback          | 0      | -   | -   | 0   | 0   | 0   | 0   |
| Scaup spp.          | +      | x   | x   | +   | x   | x   | +   |
| Ring-necked duck    | 0      | 0   | 0   | 0   | 0   | 0   | 0   |
| Goldeneye           | -      | x   | x   | +   | x   | x   | +   |
| Bufflehead          | +      | x   | x   | x   | x   | x   | x   |
| Ruddy duck          | -      | 0   | +   | -   | 0   | 0   | 0   |
| Merganser spp.      | +      | x   | x   | x   | x   | x   | x   |
| Common eider        | 0      | 0   | 0   | 0   | 0   | 0   | 0   |
| Scoters spp.        | 0      | 0   | -   | -   | 0   | 0   | 0   |
| Oldsquaw            | 0      | +   | x   | x   | x   | x   | +   |
| Atlantic brant      | x      | x   | x   | x   | x   | x   | x   |
| Greater snow geese  | -      | -   | -   | 0   | 0   | 0   | +   |
| Canada geese        | -      | +   | x   | x   | x   | x   | x   |
| Tundra swan         | 0      | 0   | -   | -   | 0   | 0   | 0   |
| Mute swan           | +      | +   | +   | +   | x   | x   | +   |

- x species observed every year
- + species observed > 50% of the time
- species observed < 50% of the time
- 0 species not observed

From Castelli, P. M., D. Olson, and V. Turner. 1997. Aerial surveys of Barnegat Bay and Little Egg Harbor, New Jersey 1956-1996. In: G. E. Flimlin and M. J. Kennish (eds.), *Proceedings of the Barnegat Bay Ecosystem Workshop*. Rutgers Cooperative Extension of Ocean County, Toms River, New Jersey, pp. 329-344.

Insectivorous species dominate in cedar swamp habitats of the Pine Barrens. Representative species are the eastern wood pewee (*Contopus virens*), gray catbird (*Dumetella carolensis*), wood thrush (*Hylocichla mustilina*), white-eyed vireo (*Vireo griseus*), northern parula warbler (*Parula americana*), yellow warbler (*Dendroica petechia*), yellowthroat (*Geothlypis trichas*), redstart (*Setophaga ruticilla*), and song sparrow (*Melospiza melodia*). These birds are mainly present in summer. Other species also observed along swamps, lakes, and other waterways include the red-winged blackbird (*Agelaius phoeniceus*), purple martin (*Progne subis*), and tree swallow (*Iridoprocne bicolor*) (Leck, 1998).

The seaside sparrow (*Ammospiza maritima*), sharp-tailed sparrow (*A. caudacuta*), and marsh wren (*Cistothorus palustris*) are three songbird species that nest and breed in tidal and freshwater marshes. The seaside sparrow and sharp-tailed sparrow build their nests in cordgrass and salt-meadow marshes at ground level and up to about a meter above the ground. The marsh wren, in turn, constructs nests above the ground level attached to the stems of emergent vegetation such as cordgrass, common reed, and cattails (Kroodsma and Verner, 1997).

Some 25 neotropical migrant species breed in forest and scrub-shrub habitats of the Barnegat Bay-Little Egg Harbor Estuary, and another 17 neotropical migrants of various habitat affinity breed in the system as well. These species belong to several landbird groups, notably tanagers, buntings, grosbeaks, New World sparrows, vireos, flycatchers, swallows, cuckoo, nightjars, swifts, and hummingbirds. Habitats in the Pine Barrens provide high quality migratory stopovers for foraging, nesting, and cover from

predators. Species generally occur on breeding grounds in watershed areas for three months or less (DeGraaf and Rappole, 1995; Kennish, 2001a).

### **Fish**

McCormick (1970) reported that 24 freshwater fish species occur in the Pine Barrens, although Hastings (1998) noted that only 16



of these species are indigenous to the acidic waters of the region (if peripheral and introduced forms are excluded). Hence, the fish fauna of the Pine Barrens is relatively depauperate. Five groups of Pine Barrens fish are recognized: (1) characteristic species; (2) peripheral species; (3) introduced species; (4) anadromous species; and (5) marine species. The distribution of Pine Barrens fish species depends on three principal factors: (1) the requirement for sluggish streams or standing water with dense vegetation; (2) competition from similar or related species; and (3) tolerance of highly acidic waters (Hastings, 1984, 1998).

Several species of sunfish are important characteristic forms commonly found in the Pine Barrens. Included here are the blackbanded sunfish (*Enneacanthus chaetodon*), banded sunfish (*E. obesus*), bluespotted sunfish (*E. gloriosus*), and the mud sunfish (*Acantharchus pomotis*). The swamp darter (*Etheostoma fusiforme*), ironcolor shiner (*Notropis chalybaeus*), pirate perch (*Aphredoderus sayanus*), and yellow bullhead (*Ameiurus natalis*) are also characteristic species. Other more widespread species which belong to this group include the redbfin pickerel (*Esox americanus*), chain pickerel (*Esox*

*niger*), American eel (*Anguilla rostrata*), brown bullhead (*Ameiurus nebulosus*), creek chubsucker (*Erimyzon oblongus*), eastern mudminnow (*Umbra pygmaea*), tessellated darter (*Etheostoma olmstedi*), and tadpole madtom (*Noturus gyrinus*).

Peripheral species are those forms relatively intolerant of acid waters, which typically occur in weakly acid or nonacid waters in marginal areas of the Pine Barrens. For example, in the lower reaches of the Mullica and Great Egg Harbor Rivers where saline waters buffer acid waters draining the Pinelands, the commonly occurring species are the yellow perch (*Perca flavescens*), white perch (*Morone americana*), white sucker (*Catostomus commersoni*), golden shiner (*Notemigonus crysoleucas*), spotted shiner (*Notropis hudsonius*), redbreasted sunfish (*Lepomis auritus*), mummichog (*Fundulus heteroclitus*), and banded killifish (*F. diaphanus*). Other species which may appear in peripheral waters of the Pine Barrens, but are relatively rare except in nonacid waters, are the comely shiner (*Notropis amoenus*), bridled shiner (*N. bifrenatus*), common shiner (*N. cornutus*), satinfin shiner (*N. analostanus*), gizzard shad (*Dorosoma cepedianum*), bluntnose minnow (*Pimephales notatus*), silvery minnow (*Hybognathus nuchalis*), margined madtom (*Noturus insignis*), fallfish (*Semotilus corporalis*), creek chub (*S. atromaculatus*), blacknose dace (*Rhinichthys atratulus*), and American brook lamprey (*Lampetra lamottei*).

A number of introduced species have also been documented in peripheral areas of the Pine Barrens. Examples are the black crappie (*Pomoxis nigromaculatus*), bluegill (*Lepomis macrochirus*), goldfish (*Carassius auratus*), carp (*Cyprinus carpio*), and largemouth bass (*Micropterus salmoides*). Three salmonid species, notably the rainbow trout (*Salmo gairdneri*), brown trout (*S. trutta*), and brook trout (*S. fontinalis*), also occur

in these peripheral areas. The channel catfish (*Ictalurus punctatus*), black bullhead (*I. melas*), and flathead minnow (*Pimephales promelas*) may have been stocked in past years in Pine Barrens streams (U.S. Fish and Wildlife Service, 1996).

Several marine species migrate into the Mullica River and its tributaries to spawn. Anadromous fishes recorded in these waters are the striped bass (*Morone saxatilis*), American shad (*Alosa sapidissima*), hickory shad (*A. mediocris*), blueback herring (*A. aestivalis*), and alewife (*A. pseudoharengus*). They are generally confined to the tidal portion of the rivers and creeks (Hastings, 1998). Spawning runs were more common in past years when fewer dams obstructed upstream movements. Anadromous fish spawning is now largely confined to the lower reaches of the rivers due to human obstructions. The installation of fish ladders (e.g., at Lake Pohatcong) is a strategy to mitigate these impacts.

Various estuarine and marine species have also been found in other Pine Barrens river basins. Examples are the bay anchovy (*Anchoa mitchilli*), Atlantic menhaden (*Brevoortia tyrannus*), hogchoker (*Trinectes maculatus*), two-spined stickleback (*Gasterosteus aculeatus*), three-spined stickleback (*Apeltes quadracus*), weakfish (*Cynoscion regalis*), kingfish (*Menticirrhus saxatilis*), and Atlantic croaker (*Micropogonias undulatus*) (Patrick et al., 1998). These species utilize a variety of habitats in the river basins.

Zampella et al. (2001) collected 22 fish species in streams and impoundments of the Mullica River Basin (Table 12). Based on the work of Hastings (1984), the native Pinelands species can be categorized as restricted-characteristic or widespread-characteristic forms. The restricted-characteristic species are those forms mostly limited

to the Pinelands and include the blackbanded sunfish (*Enneacanthus chaetodon*), banded sunfish (*Enneacanthus obesus*), mud sunfish (*Acantharchus pomotis*), pirate perch (*Aphredoderus sayanus*), yellow bullhead (*Ameiurus natalis*), and swamp darter (*Etheostoma fusiforme*). The widespread-characteristic species include those forms typically found in other parts of the state. This list includes the bluespotted sunfish (*Enneacanthus gloriosus*), chain pickerel (*Esox niger*), redbfin pickerel (*Esox americanus*), creek chubsucker (*Erimyzon oblongus*), ironcolor shiner (*Notropis chalybaeus*), tadpole madtom (*Noturus gyrinus*), eastern mudminnow (*Umbra pygmaea*), and American eel (*Anguilla rostrata*).

Zampella et al. (2001) observed that the most frequently encountered native species in Pinelands streams were the eastern mudminnow, chain pickerel, swamp darter, and banded sunfish. The most frequently occurring non-native forms in Pinelands streams were the pumpkinseed (*Lepomis gibbosus*), bluegill, tessellated darter, largemouth bass, brown bullhead, golden shiner, and yellow perch. The banded sunfish, blackbanded sunfish, and bluespotted sunfish were the native species that dominated the impoundment assemblages. There was greater relative abundance of three non-native species (largemouth bass, bluegill, and pumpkinseed) in the impoundments than in the streams (Zampella et al., 2001).

Fish species that typically inhabit the Pine Barrens are rather sedentary forms associated with abundant vegetation. They are also predominantly acid-tolerant forms (Hastings, 1998). Fishes of the Pine Barrens have become well adapted to the artificial lakes, mill ponds, cranberry bogs and other human-made impoundments occurring in this unique environment (U.S. Fish and Wildlife Service, 1996).

Table 12. Taxonomic list of fish collected in the Mullica River Basin.

| Common Name         | Scientific Name                |
|---------------------|--------------------------------|
| Mud sunfish         | <i>Acantharchus pomotis</i>    |
| Yellow bullhead     | <i>Ameiurus natalis</i>        |
| Brown bullhead      | <i>Ameiurus nebulosus</i>      |
| American eel        | <i>Anguilla rostrata</i>       |
| Pirate perch        | <i>Aphredoderus sayanus</i>    |
| Blackbanded sunfish | <i>Enneacanthus chaetodon</i>  |
| Bluespotted sunfish | <i>Enneacanthus gloriosus</i>  |
| Banded sunfish      | <i>Enneacanthus obesus</i>     |
| Creek chubsucker    | <i>Erimyzon oblongus</i>       |
| Redfin pickerel     | <i>Esox americanus</i>         |
| Chain pickerel      | <i>Esox niger</i>              |
| Swamp darter        | <i>Etheostoma fusiforme</i>    |
| Tessellated darter  | <i>Etheostoma olmstedii</i>    |
| Banded killifish    | <i>Fundulus diaphanus</i>      |
| Pumpkinseed         | <i>Lepomis gibbosus</i>        |
| Bluegill            | <i>Lepomis macrochirus</i>     |
| Largemouth bass     | <i>Micropterus salmoides</i>   |
| golden shiner       | <i>Notemigonus crysoleucas</i> |
| Tadpole madtom      | <i>Noturus gyrinus</i>         |
| Yellow perch        | <i>Perca flavescens</i>        |
| Black crappie       | <i>Pomoxis nigromaculatus</i>  |
| Eastern mudminnow   | <i>Umbra pygmaea</i>           |

From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

## Insects

Hundreds of insect species inhabit the Pine Barrens region, including a number of rare and threatened forms. Among the rare insect species in the Mullica River watershed are the rare skipper (*Problema bulenta*), occurring along Turtle Creek, and the precious underwing moth (*Catocala pretiosa pretiosa*) and Lemmer's pinion moth (*Lithophane lemmeri*), occupying areas along the upper tidal Mullica River. Other rare moth species observed in the Pinelands are the Pine Barrens underwing (*Catocala herodias gerhardi*), jair underwing (*Catocala jair* ssp. 2), Doll's merolonche (*Merolonche dolli*), coastal swamp metarranthis (*Metarranthis pilosaria*), spanworm moth (*Itame* sp. 1), notodontid moth (*Heterocampa varia*), and noctuid moths (*Ampharetra purpurea*, *Chytonix sensilis*, and *Zanclognatha* sp. 1). Two moth species, *Agrotis buchholzi* and *Crambus daeckellus*, are endemic to the Pine Barrens. Immediately upriver of the tidal influence in the Batsto watershed, numerous rare Lepidoptera (moths and butterflies) have been recorded (U.S. Fish and Wildlife Service, 1996).

Salt marshes in the JCNERR support a wide diversity of insects such as various species of aphids, beetles, leafhoppers, spiders, and mites. The northeastern beach tiger beetle (*Cincindela dorsalis dorsalis*), a federal threatened species, occupies parts of the Great Bay Boulevard Wildlife Management area and the Holgate Unit of the Forsythe National Wildlife Refuge. Wolf spiders (Lycosidae) are widespread in marsh and interior Pinelands zones (Boyd, 1991). Greenhead flies (*Tabanus nigrovittatus*), sand flies (*Culicoides* spp.), and stable flies (*Stomoxys calcitrans*) are ubiquitous pests in tidal salt marshes. Damselflies and dragonflies (*Odonata*) are also abundant in tidal wetland areas of the reserve. Five species of mosquitos breed in the coastal salt marshes, notably *Aedes*

*sollicitans*, *A. cantator*, *A. taeniorhynchus*, *Anopheles bradleyi*, and *Culex salinarius*. Among these species, *A. sollicitans* is most abundant (Kennish, 2001a).

Arthropods are the most numerous fauna in the Pinelands. Boyd and Marucci (1998) subdivided the arthropods of the Pine Barrens into seven major groups: (1) arthropods other than insects; (2) insects found on vegetation in pine and oak woods; (3) insects inhabiting shrub and semi-open areas with scattered vegetation; (4) insects of open, sandy areas; (5) insects more often heard than seen; (6) insects living under bark and in dead trees and old stumps; and (7) insects living in aquatic and semi-aquatic habitats.

Arthropods other than insects are comprised of a number of important groups, including spiders (Arachnida), wood ticks (Acarina), and harvestment or Daddy-Long-Legs (Phalangida). Other significant members are harvest mites, chiggers, or redbugs (Acarina); sowbugs and pillbugs (Isopoda); millipedes (Diplopoda); and centipedes (Chilopoda). These organisms are often seen searching for food and habitat on or under all types of vegetation.

Among the insects found on vegetation in pine and oak forests, seven major groups are recognized. These include the grasshoppers (Orthoptera), walking sticks (Orthoptera), long-horned beetles (Coleoptera), weevils or snout beetles (Coleoptera), pine sawflies (Hymenoptera), gall wasps (Hymenoptera), and moths (Lepidoptera). A wide variety of moths inhabit the Pine Barrens, notably gypsy moths, underwing moths, as well as giant silkworm and royal moths. Many provide forage for birds particularly during the nesting season.

Insects predominating in shrub and semi-open areas with scattered vegetation are grasshoppers (Orthoptera), leafhoppers (Homoptera), froghoppers or spittlebugs (Homoptera), plant bugs and stink bugs (Hemiptera), ladybird beetles and leaf beetles (Coleoptera), butterflies (Lepidoptera), ichneumons (Hymenoptera), leaf-cutting ants (Hymenoptera), social wasps (Hymenoptera), as well as honey bees (Hymenoptera), bumble bees, and carpenter bees. Bees, especially honey bees, play a significant role in the pollination of plants. While carpenter bees build nests by boring holes and tunnels in wooden structures, bumble bees construct nests in cavities in the ground, and honey bees occupy hives or may nest in hollow cavities in trees and other protected habitat.

Four major groups of insects prefer open, sandy areas. They are the antlions (Neuroptera), tiger beetles (Coleoptera), robber flies (Diptera), and velvet ants (Hymenoptera). Many of these insects are voracious predators (e.g., antlions and tiger beetles) consuming ants and other prey.

Insects more often heard than seen are the northern true katydid (Orthoptera), crickets (Orthoptera), and dog-day cicadas or harvestflies (Homoptera). All of these insects make acute audible sounds that can be heard over considerable distances. The katydids are most easily detected by the sounds they emit at night. Similarly, crickets are mainly noticed at night due to their high-pitched sounds. Cicadas, however, are commonly heard during the day by the loud and piercing sounds they emit from nearby shrubs or trees.

Wood cockroaches (Orthoptera), termites (Isoptera), ants (Hymenoptera), as well as click beetles and darkling or bark beetles (Coleoptera) are the main groups of insects found under bark and in dead trees and old stumps. Ants live in colonies of variable size,

and they are prey of various predaceous arthropods. Although termites cause considerable destruction of domestic wooden structures, they convert dead trees and other vegetation to humus and thus play an important role in the natural breakdown process of dead organic matter. Wood cockroaches, click beetles, and bark beetles congregate under the bark of dead trees, fallen logs, and old stumps.

Among the most important arthropods observed in the JCNERR are insects found in aquatic and semi-aquatic habitats. For example, mosquitoes, black flies, horse flies, and deer flies (all Diptera) are very abundant in the region, persistently annoying humans and other mammals. In addition, dragonflies and damselflies (Odonata); water boatmen, blackswimmers, water bugs, waterscorpions, and water striders (all Hemiptera); as well as predaceous diving beetles, water scavenger beetles, and whirligig beetles (all Coleoptera) are representative members of this group. These organisms are found in an array of watershed habitats such as white cedar swamps, hardwood swamps, *Sphagnum* bogs, abandoned cranberry bogs, streams, and lakes.

## **ESTUARINE BIOTIC COMMUNITIES**

Investigators from Rutgers University have periodically conducted studies of biotic communities in estuarine waters of the JCNERR since the 1950s. Studies by state and federal government agencies (e.g., New Jersey Department of Environmental Protection, U.S. Fish and Wildlife Service, and National Marine Fisheries Service), research laboratories (e.g., Academy of Natural Sciences of Philadelphia and Woods Hole Oceanographic Institution), and other academic institutions (Richard Stockton College) have augmented this work. Appendix 17 provides a list of publications,

technical reports, and theses dealing with research and monitoring activities as well as ancillary investigations in the reserve. The following discussion gives an overview of the structure and dynamics of the biotic communities based on this earlier work.

Estuarine waters within the JCNERR support rich and diverse communities of estuarine and marine organisms (nekton, plankton, benthic flora and fauna, and marine mammals). The composition and distribution



of these organisms in Great Bay, Little Egg Harbor, Little Bay, and contiguous waters are similar to those in other New Jersey coastal bays. The backbay systems of the JCNERR provide food, habitat, and shelter for hundreds of plant and animal species. Some of these species (e.g., blue crab, *Callinectes sapidus*; hard clam, *Mercenaria mercenaria*; bluefish, *Pomatomus saltatrix*; summer flounder, *Paralichthys dentatus*; winter flounder, *Pseudopleuronectes americanus*; weakfish, *Cynoscion regalis*; and white perch, *Morone americana*) are recreationally or commercially important. The following discussion details the floral and faunal communities inhabiting estuarine waters of the reserve.

## Phytoplankton

The principal primary producers of the open estuarine waters of the reserve system are microscopic, free-floating plants (i.e., phytoplankton) - unicellular, filamentous, or chain-forming species - dominated by diatoms (Bacillariophyceae) and dinoflagellates (Dinophyceae). Although Durand and Nadeau (1972) and Durand (1988) conducted numerous field measurements of phytoplankton production in the Mullica River-Great Bay Estuary during the 1960s and 1970s, most investigations of phytoplankton species composition have been completed in Little Egg Harbor and Barnegat Bay to the north (Martin, 1929; Mountford, 1965, 1967, 1969, 1971; Olsen, 1989; Olsen and Mahoney, 2001). However, seasonal phytoplankton surveys have also been performed in Great Bay (Olsen and Mahoney, 2001).

Martin (1929) identified 41 dinoflagellate species in Barnegat Bay, with the dominant forms being *Cymnodinium splendens*, *Prorocentrum micans*, and *P. triangulatum* (*P. minimum* var. *triangulatum*). Mountford (1967, 1969, 1971) reported 186 phytoplankton species in the Barnegat Bay-Little Egg Harbor Estuary, and he also documented red-tide blooms of *Gonyaulax spinifera* and *Prorocentrum triangulatum* in the system. Mountford (1971) noted that ultraplankton (spherical cells 2-4  $\mu\text{m}$  in diameter mainly consisting of *Nannochloris atomus*) dominated the phytoplankton community in his studies, with concentrations up to  $8 \times 10^5$  cells/ml in summer.

Olsen and Mahoney (2001) recorded a total of 132 phytoplankton species in the Barnegat Bay-Little Egg Harbor Estuary (including a supplementary sampling site in Great Bay) during seasonal phytoplankton surveys conducted between 1987 and 1998 (Table 13). Nonmotile coccoid picoplankters were numerically dominant. Aside from

*Nannochloris atomus*, the most widely distributed species within the embayment were *Skeletonema costatum*, *Cylindrotheca closterium*, *Nitzschia* spp., *Cyclotella* sp., *Prorocentrum minimum*, *Katodinium rotundatum*, *Heterosigma carterae*, *Euglena/Eutreptia* spp., *Chroomonas vectensis*, *C. amphioxiea*, *C. minuta*, *Pyramimonas* spp., *Calycomonas ovalis*, and *Chlorella* sp. Neritic or coastal forms predominated near inlet areas and primarily included centric diatoms (e.g., *Skeletonema*, *Thalassiosira*, *Cerataulina*, and *Chaetoceros* spp.) and the larger, thecate dinoflagellates (e.g., *Prorocentrum*, *Dinophysis*, *Protooperidinium*, and *Ceratium* spp.). Of the 132 phytoplankton species identified by Olsen and Mahoney (2001), 57 (~41% of the total) were dinoflagellates and 43 (31%) were diatoms. To date, 242 phytoplankton species have been chronicled in the estuary.

Table 13. List of phytoplankton species identified in the Barnegat Bay-Little Egg Harbor estuarine system from 1987 to 1998. An “X” before the species name indicates those not previously listed for the bay, by either Martin (1929) or Mountford (1971). Species followed by a slash (/) appeared frequently in low numbers, or were occasionally abundant. A plus (+) indicates those which were often abundant, attaining cell concentrations  $>10^3 \text{ ml}^{-1}$ , with occasional mild blooms. An asterisk (\*) denotes species which attained dominance or subdominance in seasonal blooms, exceeding  $10^4 \text{ cells ml}^{-1}$ . For *Nannochloris* and *Aureococcus* this criterion is an order of magnitude higher (to  $10^5$ ), since they typically appeared in substantially greater concentrations than other species. Two asterisks denote heavy blooms ( $>5 \times 10^5$ ). The order of taxa generally follows that presented in Olsen and Cohn (1979), after Hendy (1974) for Bacillariophyceae; Butcher (1961) for Euglenophyceae; and Parke and Dixon (1976) for the other classes. In cases of synonyms or nomenclatural changes, species names with former priority are indented in parentheses under the respective names currently in usage.

---

|   |   |
|---|---|
| CYANOPHYCEAE                            | HAPTOPHYCEAE                                  |
| X <i>Synechococcus</i> Nageli (sp.) (*) | X <i>Chrysochromulina</i> Lackey<br>(sp.) (/) |
| CHRYSOPHYCEAE                           | <i>C. minor</i> Parke and<br>Manton (+)       |

- Ochromonas* Wyssotzki (sp.)  
*Caylcomonas* Lohmann  
*C. gracilis* Lohmann (/)  
(C. *wulfi* Conrad and Kufferath)
- X *C. ovalis* Wulff (\*)  
X *Apedinella* Thronsen  
*A. radians* (Lohmann) Campbell  
*Distephanus* Stohr  
*D. speculum* (Ehrenbeg) Haeckel  
*Ebria* Borgert  
*E. tripartita* (Schumann Lemmermann)
- RAPHIDOPHYCEAE<sup>1</sup>
- X *Heterosigma* Ashakiwo  
*H. carterae* (+)<sup>2</sup> Hulbert  
(*Olisthodiscus luteus* Carter)  
(*Heterosigma ashakiwo* Hada)
- PELAGOPHYCEAE<sup>1</sup>
- X *Aureococcus* Hargraves et Sieburth (\*\*)  
*A. anophagefferens* Hargraves
- Cerataulina* Schütt  
*C. pelagica* (Cleve) Hendey (/)  
(C. *bergonii* (Peragallo) Schütt)  
*Chaetoceros* Ehrenberg (spp.) (/)  
*C. decipiens* Cleve  
X *C. sociale* Lauder
- X *Pavlova* Butcher (sp.)  
*P. gyrans* Butcher  
*P. lutheri* (Droop) Green  
(*Monochrysis lutheri* Droop)
- BACILLARIOPHYCEAE
- Melosira* Agardh (sp.)  
*Leptocylindrus* Cleve  
*L. danicus* Cleve (/)  
*L. minimus* Gran (+)  
*Skeletonema* Greville  
*S. costatum* (Greville) Cleve (+)  
*Cyclotella* (Kützing) DéBrebisson
- X *C. caspia* Grunow  
*C. meneghiniana* Kützing (+)  
*Thalassiosira* Cleve  
*T. gravida* Cleve (/)  
*T. nordenskioldii* Cleve (/)  
*T. rotula* Meunier  
*Coscinodiscus* Ehrenberg (spp.)
- Gyrosigma* Hassall (sp.)  
*Amphiprora* Ehrenberg (sp.)  
*Amphora* Ehrenberg (sp.)  
X *Phaeodactylum* Bohlin  
*P. tricornutum* Bohlin (/)

|   |  |
|---|--|
| <i>Rhizosolenia</i> Brightwell            | ( <i>Nitzschia closterium</i><br><i>forma</i> )      |
| <i>R. alata</i> Brightwell                | ( <i>Nitzschia minutissima</i><br>Allen & Nelson)    |
| <i>R. delicatula</i> Cleve (/)            | <i>Nitzschia</i> Hassall (spp.) (+)                  |
| <i>R. setigera</i> Brightwell             | X <i>N. elegans</i> Hustedt                          |
| <i>Guinardia</i> Peragallo                | X <i>N. longissima</i> (deBrébisson)<br>Ralfs        |
| <i>G. flaccida</i> (Castracane) Peragallo | X <i>N. proxima</i> Hustedt                          |
| <i>Ditylum</i> Bailey                     | <i>Pseudonitzschia</i> Cleve                         |
| <i>D. Brightwelli</i> (West) Grunow       | <i>P. seriata</i> (Cleve)<br>Peragallo               |
| ( <i>Triceratium brightwelli</i> West)    | ( <i>Nitzschia seriata</i><br>Cleve)                 |
| <i>Fragilaria</i> Lyngbye (sp.)           | <i>Cylindrotheca</i> Rabenhorst                      |
| <i>Synedra</i> Ehrenberg (sp.)            | <i>C. closterium</i> (Ehrenberg)<br>Leiman Lewis (+) |
| <i>Asterionella</i> Wm. Smith             | ( <i>Nitzschia closterium</i><br>Ehrenberg)          |
| <i>A. glacialis</i> Castracane (/)        | X <i>Minutocellus</i> Hasle <sup>3</sup>             |
| ( <i>A. japonica</i> Cleve and Müller)    | <i>M. polymorphus</i><br>Hargraves et Guillard (*)   |
| <i>Thalassiothrix</i> Cleve and Grunow    | CHLOROPHYCEAE  |
| <i>T. frauenfeldii</i> Grunow             | <i>Chlamydomonas</i> Ehrenberg<br>(sp.)              |
| <i>Thalassionema</i> (Grunow) Hustedt     | X <i>C. vectensis</i> Butcher (+)                    |
| <i>T. nitzschioides</i> Hustedt (/)       | X <i>Chlorella</i> Beijerinck (sp.)<br>(*)           |
| <i>Licmophora</i> Agardh (sp.)            | <i>Scenedamus</i> Meyen                              |
| <i>Achnanthes</i> Bory (sp.)              | <i>S. quadricauda</i> (Turpin)<br>de Brébisson       |

- Cocconeis* Ehrenberg (sp.) (/)  
*Navicula* Bory (spp.) (/)  
*Caloneis* Cleve (sp.)  
*Mastogloia* Thwaite (sp.)  
*Pleurosigma* Wm. Smith (sp.) (/)
- Bipedinomonas* Carter  
X *B. pyriformis* Carter (/)  
(*Heteromastix pyriformis* Carter)  
*Pyraminomonas* Schmarda (sp.) (+)  
X *P. grossii* Parke (/)  
X *P. micron* Conrad and Kufferath (+)  
X *Tetraselmis* Stein (/)  
*T. gracilis* (Kylin) Butcher  
*T. maculata* Butcher
- EUGLENOPHYCEAE  
*Eutreptia* Perty  
X *E. lanowii* Steuer (/)  
X *E. viridis* Perty (/)  
*Euglena* Ehrenberg (sp.)  
X *E. deses* Ehrenberg  
X *E. proxima* Dangeard (/)
- DINOPHYCEAE  
*Prorocentrum* Ehrenberg  
*P. aporum* (Schiller) Dodge  
(*Exuviella apora* Schiller)  
*P. lima* (Ehrenberg) Dodge (/)
- Nannochloris* Naumann  
*N. atomus* Butcher (\*\*)
- PRASINOPHYCEAE  
X *Pedinomonas* Korshikov  
*P. minor* Korshikov
- Dinophysis* Ehrenberg  
*D. acuminata* Claparède  
and Lachmann  
*D. acuta* Ehrenberg  
X *D. lachmanii* Paulsen  
*Amphidinium* Claparède and  
Lachmann (sp.)  
X *A. crassum* Lohmann  
*A. fusiforme* Martin (/)  
*Gymnodinium* Stein (spp.) (/)  
X *G. amplinucleum*  
Campbell  
X *G. danicans* Campbell (/)  
X *G. galesianum* Campbell  
X *G. gracilentum* Campbell  
X *G. lazulum* Hulburt  
*G. nelsoni* Martin (/)  
*G. punctatum* Pouchet  
*G. splendens* Lebour  
X *G. subroseum* Campbell  
X *G. transluciens* Campbell  
*Gyrodinium* Kofoid and  
Swezy (spp.)  
X *G. cf aureolum* Hulburt  
*G. dominans* Hulburt

|   |   |                                   |
|---|---|-----------------------------------|
| ( <i>E. marina</i> Cienkowski)                      | X | <i>G. estuariale</i> Hulburt (+)  |
| <i>P. micans</i> Ehrenberg (/)                      | X | <i>G. metum</i> Hulburt (/)       |
| <i>P. minimum</i> (Pavillard) Schiller (+)          |   | <i>G. pellucidum</i> Wulff (/)    |
| <i>P. minimum</i> var. <i>triangulatum</i> (Martin) |   | <i>Katodinium</i> Fott            |
| Hulbert (/)   | X | <i>K. asymmetricum</i>            |
|   |   | (Massart) Loeblich III            |
| ( <i>P. triangulatum</i> Martin)                    |   | ( <i>Massartia</i>                |
|   |   | <i>asymmetrica</i> (Massart)      |
| <i>P. scutellum</i> Schröder                        |   | Schiller)                         |
| <i>P. triestinum</i> Schiller (/)                   | X | <i>K. rotundatum</i> (Lohmann)    |
|   |   | Loeblich III (+)                  |
| ( <i>P. redfieldi</i> Bursa)                        |   | ( <i>M. rotundata</i>             |
|   |   | (Lohmann) Schiller)               |
| <i>Polykrikos</i> Bütschli                          |   | <i>G. scrippsae</i> Kofoid        |
| <i>P. kofoidii</i> Chatton                          |   | <i>G. spinifera</i> (Claparede    |
|   |   | and Lachmann)                     |
| <i>Diplopsalis</i> Meunier                          |   | Diesing (/)                       |
| <i>D. lenticula</i> Bergh                           | X | <i>Alexandrium</i> Halim (sp.)    |
| <i>Glenodinium</i> Ehrenberg                        |   | <i>A. tamarense</i> (Lebour)      |
|   |   | Balech                            |
| <i>G. danicum</i> Panslen                           |   | <i>Ceratium</i> Schrank           |
| <i>Heterocapsa</i> Stein                            |   | <i>C. fusus</i> (Ehrenberg)       |
|   |   | Dujardin                          |
| <i>H. triquetra</i> (Ehrenberg) Stein (/)           |   | <i>C. minutum</i> Jorgensen       |
| ( <i>Peridinium triquetrum</i> (Stein) Meunier)     |   | <i>C. tripos</i> (Muller) Nitzsch |
| <i>Oblea</i> Balech                                 |   | CRYPTOHYCEAE                      |
| <i>O. rotunda</i> (Lebour) Balech (/)               | X | <i>Hemiselmis</i> Parke           |
| ( <i>Peridiniopsis rotunda</i> Lebour)              |   | <i>H. virescens</i> Droop (/)     |
| <i>Protoperidinium</i> Bergh (spp.)                 |   | <i>Chroomonas</i> Hansgirg (sp.)  |
|   |   | (+)                               |

|   |   |   |   |
|---|---|---|---|
|   | ( <i>Peridinium</i> Ehrenberg)                | X | <i>C. amphioxiea</i> (Conrad and Kufferath) |
| X | <i>P. achromaticum</i> Levander               |   | Butcher (/)                                 |
|   | <i>P. brevipes</i> Paulsen                    |   | ( <i>Rhodomonas amphioxiea</i> Conrad)      |
| X | <i>P. aciculiferum</i> Lemmermann             | X | <i>C. caroliniana</i> Campbell (/)          |
|   | <i>P. excavatum</i> Martin                    | X | <i>C. minuta</i> (Skuja) Campbell (+)       |
|   | <i>Scrippsiela</i> Balech et Loeblich III     |   | ( <i>R. minuta</i> Skuja)                   |
|   | <i>S. trochoidea</i> (Stein) Loeblich III (/) | X | <i>C. vectensis</i> Carter (+)              |
|   | ( <i>Peridinium trochoideum</i> (Stein))      |   | <i>Cryptomonas</i> Ehrenberg (sp.) (/)      |
|   | <i>Gonyaulax</i> Diesing (sp.)                | X | <i>C. testacea</i> Campbell                 |
| X | <i>G. diacantha</i>                           |   |   |

<sup>1</sup> Taxa of uncertain position; these genera formerly included under Chrysophyceae

<sup>2</sup> *H. carterae* has been misidentified in the region as *O. luteus*

<sup>3</sup> Species of uncertain position

From Olsen, P. S. and J. B. Mahoney. 2001. Phytoplankton in the Barnegat Bay-Little Egg Harbor estuarine system: species composition and picoplankton bloom development. *Journal of Coastal Research*, SI 32: 115-143.

Olsen and Mahoney (2001) also described widespread and prolonged phytoplankton blooms in the Barnegat Bay-Little Egg Harbor Estuary between 1985 and 2000, with the greatest prevalence ( $> 10^6$  cells/ml) in the southern part of the system (i.e., Little Egg Harbor). *Nannochloris atomus* dominated these blooms. In addition, the coccoid picoplankter, *Aureococcus anophagefferens*, has been responsible for repeated

brown-tide blooms in Little Egg Harbor; concentrations of this organism have exceeded  $10^6$  cells/ml during some bloom events. Brown-tide blooms in the estuary were documented in 1995, 1997, and 1999-2002, and they may have adversely affected SAV and hard clam (*Mercenaria mercenaria*) beds (Mary Gastrich, NJDEP, personal communication, 2004).

Chronic phytoplankton blooms can adversely affect estuarine systems in several ways. In the Barnegat Bay-Little Egg Harbor Estuary, for example, phytoplankton blooms have reduced aesthetic water quality by discoloring the water a murky greenish and yellowish-brown hue in the summer as picoplankton numbers escalate. *Aureococcus* blooms inhibit the feeding

and growth of bivalves, notably the hard clam. Shading effects of the blooms may also be responsible for a decline in faunal habitat in some areas due to persistent light attenuation.



Moser (1997) showed that phytoplankton production in the estuary amounted to  $\sim 480$  g C/m<sup>2</sup>/yr, and phytoplankton biomass,  $\sim 10$  mg chlorophyll *a*/m<sup>3</sup>. Because nutrient inputs are highest in the more heavily developed northern estuary, phytoplankton production and biomass peak in this region. Nitrogen is the primary limiting nutrient to phytoplankton growth, with organic nitrogen being the dominant form. The highest

concentrations of organic nitrogen ( $\sim 40 \mu\text{M}$ ) occur during summer. Inorganic nitrogen forms are present in low concentrations. Mean ammonium levels are  $< 2.5 \mu\text{M}$ , and mean nitrate plus nitrite levels are  $\sim 2.0 \mu\text{M}$ . Highest ammonium concentrations occur in summer, whereas peak nitrate plus nitrite levels exist from late fall to spring. Total nitrogen levels in the estuary generally range from  $\sim 20$  to  $80 \mu\text{M}$ . Phosphate concentrations in the system are much lower, being  $< 1 \mu\text{M}$  (Seitzinger et al., 2001).

Durand and Nadeau (1972) discussed seasonal phytoplankton production in Great Bay. They noted that phytoplankton production peaks in the summer months, declines in the fall, and remains low until late winter (February-March) when a phytoplankton bloom develops. Phytoplankton production gradually increases from the spring into the summer.

Chlorophyll *a*, a measure of phytoplankton biomass, also attains highest levels during the summer. Chlorophyll *a* minima are evident during the winter when temperature, light intensity, and light duration decline dramatically. Intermediate chlorophyll *a* values usually take place during the spring and fall.

Durand (1984) examined the relationship between phytoplankton production, nitrogen supply, and light penetration/depth in the Mullica River-Great Bay system. He showed that highest concentrations of nitrate ( $1-7 \mu\text{g-at/L}$ ) and ammonium ( $\sim 10-30 \mu\text{g-at/L}$ ) in Great Bay and the backbays to the south occur in the late summer and fall. Appendix 18 provides measurements of gross primary productivity and phytoplankton nitrogen requirements at the lower end of the Mullica River in 6 m of water, at the head of the bay in 3 m of water, and at a down-bay site in 1.7 m of water. The productivity values are generally higher at the down-bay site, ranging up to  $1,362 \text{ mg C/m}^2/\text{day}$ . At

the head of the bay, productivity ranges from 419-958 mg C/m<sup>2</sup>/day. At the lower Mullica River site, productivity values range from 422-1,081 mg C/m<sup>2</sup>/day.

The Mullica River averages ~5-9 m in depth from its mouth to the Lower Bank site ~25 km upriver. Great Bay is shallower, averaging ~2 m in depth at mean low water. The compensation depth in the system averages ~1.5 m. However, turbidity is higher in the river due to tannins and humic compounds, which restricts phytoplankton production to only the upper ~25% of the water column. With much clearer conditions in the bay, phytoplankton production occurs throughout the water column. Nutrients are underutilized in the river because of the limited light penetration. The greater water clarity in the bay enables the phytoplankton to utilize the nutrients more effectively, thereby resulting in significantly higher production.

### **Zooplankton**

The zooplankton community consists of numerous diminutive species that drift passively in the water column due to limited capability of locomotion. They comprise the principal herbivorous component of estuaries in the reserve. As such, they represent important intermediate food-web constituents, consuming phytoplankton and serving as forage for numerous benthic and nektonic organisms. While most zooplankton consume phytoplankton, some species are carnivores, detritivores, and omnivores. Zooplankton ingest food principally via filter feeding, although raptorial feeding is also common.

Zooplankton communities in estuarine and coastal marine waters are often dominated by protozoans, cnidarians, mollusks, annelids, arthropods, echinoderms, chaetognaths, and chordates (Omori and Ikeda, 1984). Zooplankton may be classified by

three principle criteria: size, taxonomy, or length of planktonic life. On the basis of size, three zooplankton groups are recognized: (1) microzooplankton ( $< 64 \mu\text{m}$ ); mesozooplankton ( $64\text{-}250 \mu\text{m}$ ); and (3) macrozooplankton ( $> 250 \mu\text{m}$ ). On the basis of duration of planktonic life, zooplankton are subdivided into the following groups: (1) holoplankton (which spend their entire life in the plankton); (2) meroplankton (which occur in the plankton for only a portion of their life cycle); and (3) tychoplankton (which primarily include benthic organisms temporarily translocated into the water column by currents, behavioral activity, or other means).

Protozoans (e.g., foraminiferans, radiolarians, rotifers, and tintinnids) dominate the microzooplankton of estuaries. Among the mesozooplankton, the predominant forms are copepods, cladocerans, rotifers, and meroplankton of various taxa (e.g., bivalves, gastropods, polychaetes, barnacles, and cyphonautes). The macrozooplankton consists mainly of the jellyfish group (i.e., hydromedusae, comb jellies, and true jellyfishes) and crustaceans (i.e., amphipods, isopods, mysid shrimp, and true shrimp).

Durand and Nadeau (1972) conducted the most detailed study of the zooplankton community of the Mullica River-Great Bay system. Loveland et al. (1969), Mountford (1971, 1980), and Tatham et al. (1977, 1978) examined the zooplankton of the Barnegat Bay-Little Egg Harbor Estuary. Sandine (1984) and Kennish (2001b) provided an overview of zooplankton research in the Barnegat Bay-Little Egg Harbor system; most of this work has focused on Barnegat Bay, with the zooplankton community of Little Egg Harbor being largely uncharacterized.

Although Durand and Nadeau (1972) registered a large number of zooplankton species during a seasonal sampling period, only two or three forms dominated the

community in terms of absolute abundance, accounting for ~80% of all organisms collected. Species diversity was generally greater in the bay than at upriver sites due in large part to the influx of populations from the nearshore ocean, notably copepods. The total counts of zooplankton at the four sampling stations in the system (i.e., Lower Bank, French Point, Graveling Point, and RUMFS) peaked during the March through September period, averaging 6,371 organisms/100 L (Table 14). Much lower zooplankton abundance occurred during the October through February period, averaging 1,075 organisms/100 L or less. Minimum abundance was recorded in December and January. Fall and winter reduction in zooplankton abundance was greatest in the Mullica River. Highest zooplankton abundance was observed in the lower-river to mid-bay region.

Copepods were particularly important members of the zooplankton community. For example, copepod nauplii comprised 36.6-53.8% of the total zooplankton counts each year. In the lower river to mid-bay region, they constituted 50-70% of the total zooplankton numbers. Both calanoid and harpacticoid species were abundant, with nine calanoid and five harpacticoid species being identified. The most dominant copepod species in terms of total numbers appeared to be *Acartia tonsa*, *Eurytemora affinis*, and *Oithona similis*. Of these three species, *A. tonsa* dominated in the bay, and *E. affinis* dominated in the river. The coastal form, *O. similis*, reached highest concentrations near Little Egg Inlet. Other copepod species identified in the bay included *Paracalanus crassirostris*, *P. parva*, *Centropages hamatus*, *C. typicus*, *Temora longicornis*, *Pseudocalanus minutus*, *Pseudodiaptomus coronatus*, *Tortanus discaudatus*, and *Labidocera aestiva*.

Table 14. Monthly mean abundance of zooplankton in the Mullica River-Great Bay Estuary.<sup>1</sup>

| Month     | Lower <sup>2</sup><br>Bank | French <sup>3</sup><br>Point | Graveling <sup>4</sup><br>Point | Rutgers Marine Field Station <sup>5</sup> |
|-----------|----------------------------|------------------------------|---------------------------------|---|
| October   | --                         | 4.59                         | 2.71                            | 5.27                                      |
| November  | --                         | --                           | 3.12                            | 0.85                                      |
| December  | 12.29                      | 4.08                         | 0.18                            | 0.78                                      |
| January   | 1.46                       | 2.47                         | 1.27                            | 4.50                                      |
| February  | 5.17                       | 3.69                         | 6.78                            | --  |
| March     | 57.87                      | 10.93                        | 34.49                           | 13.49                                     |
| April     | 25.65                      | 335.44                       | 48.94                           | 24.50                                     |
| May       | 39.02                      | 54.06                        | 35.68                           | --  |
| June      | 126.28                     | 118.78                       | 33.60                           | 32.07                                     |
| July      | 82.42                      | 64.70                        | 41.72                           | 30.47                                     |
| August    | 214.52                     | 56.87                        | 36.08                           | 32.84                                     |
| September | 15.31                      | 46.60                        | 96.47                           | 45.28                                     |
| October   | 5.47                       | 19.39                        | 3.64                            | 39.00                                     |
| November  | 5.67                       | 7.62                         | 18.11                           | --  |
| December  | 11.06                      | 1.42                         | 0.35                            | --  |
| January   | 2.46                       | 1.95                         | 55.85                           | --  |
| February  | 1.90                       | 3.17                         | 23.20                           | --  |
| March     | 43.55                      | 14.18                        | 171.94                          | --  |
| April     | 53.72                      | 35.61                        | 102.56                          | 26.51                                     |
| May       | 517.45                     | 18.71                        | 42.77                           | --  |
| June      | 103.40                     | 9.51                         | 25.44                           | 4.73                                      |

<sup>1</sup>Number/liter

<sup>2</sup>25 km upriver

<sup>3</sup>Mouth of the Mullica River

<sup>4</sup>Head of Great Bay

<sup>5</sup>Near Little Egg Inlet

From Durand, J. B. and R. J. Nadeau. 1972. Water resources development in the Mullica River Basin. Part I. Biological evaluation of the Mullica River-Great Bay Estuary. Technical Report, New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey.

Rotifers and cladocerans attained maximum abundance at the Lower Bank site. Peak numbers of rotifers (> 4,000 organisms/100 L) occurred in March and highest numbers of cladocerans (19,000 organisms/100 L), in August. Very low abundances of cladocerans were registered at the other three sampling sites.

In previous studies of the Barnegat Bay-Little Egg Harbor Estuary, calanoid copepods (notably *Acartia tonsa*, *A. hudsonica*, and *Oithona colcarva*) dominated the microzooplankton. During the summer months, *A. tonsa* and *O. colcarva* were most abundant, and during the winter months, *A. hudsonica* predominated. Abundance of microzooplankton peaked during the spring and summer months, when maximum mean monthly densities exceeded  $1 \times 10^5/\text{m}^3$  (Tatham et al., 1977, 1978; Sandine, 1984; Kennish, 2001b).

Microzooplankton can attain very high abundances. For example, Tatham et al. (1977, 1978) documented maximum mean monthly densities of microzooplankton in the Barnegat Bay-Little Egg Harbor Estuary exceeding  $100,000/\text{m}^3$ . They reported the maximum density of rotifers ( $3.8 \times 10^5/\text{m}^3$ ) and tintinnids ( $1.6 \times 10^5/\text{m}^3$ ) during the September 1975 to August 1977 sampling period. Pulses of meroplankton added greatly

to the spring and summer microzooplankton maxima. Peak numbers of bivalve larvae were obtained during the spring, although the larvae occurred year-round. Highest reported monthly densities of bivalve larvae approached 20,000/m<sup>3</sup>. Gastropod larvae also occurred in the estuary year-round, with maximum mean monthly densities ranging from ~1,000-10,000/m<sup>3</sup> during the May through September period. The maximum mean monthly densities of both barnacle and polychaete larvae were recorded in the spring, when they exceeded 10,000/m<sup>3</sup>.

Various crustacean and coelenterate taxa dominate the macrozooplankton in the Barnegat Bay-Little Egg Harbor Estuary. Among the most abundant macrozooplankton are *Rathkea octopunctata*, *Neomysis americana*, *Neopanope texana*, *Panopeus herbstii*, *Crangon septemspinosa*, *Jassa falcata*, *Sarsia* spp., and *Sagitta* spp. For example, the hydromedusae, *R. octopunctata*, has attained maximum mean monthly densities greater than 200/m<sup>3</sup> (Tatham 1977, 1978; Sandine, 1984). During night sampling, *N. americana* has reached maximum densities of nearly 120/m<sup>3</sup> and *N. texana*, densities of nearly 58,000/m<sup>3</sup>.

Some macrozooplankton, such as arrow worms (*Sagitta* spp.) and ctenophores (*Mnemiopsis leidyi* and *Beroe* sp.), are major predators of other zooplankton (Mountford, 1980). For instance, *M. leidyi* consumes large numbers of microzooplankton, especially copepods, and reaches maximum densities above 100/m<sup>3</sup>. *Beroe* sp., in turn, preys heavily on *M. leidyi*.

Ichthyoplankton comprise a significant fraction of the total zooplankton in the Barnegat Bay-Little Egg Harbor Estuary. Eggs and larvae of bay anchovy (*Anchoa mitchilli*) and larvae of gobies (*Gobiosoma* spp.) are the most abundant ichthyoplankton

forms during the warmer months of the year from June through September. Sandine (1984) reported larval densities of bay anchovy and gobies amounting to 52/m<sup>3</sup> and 18/m<sup>3</sup>, respectively. Other relatively abundant ichthyoplankton observed during the warmer months of the year include larvae of the Atlantic menhaden (*Brevoortia tyrannus*), American eel (*Anguilla rostrata*), cunner (*Tautoglabrus adspersus*), hogchoker (*Trinectes maculatus*), and northern pipefish (*Syngnathus fuscus*) (Kennish, 2001b). Bay anchovy eggs are extremely abundant, accounting for more than 90% of all fish eggs sampled in the bay. During the January through April period, larvae of the winter flounder (*Pseudopleuronectes americanus*) and sand lance (*Ammodytes* sp.) dominate the ichthyoplankton. Significant winter flounder larval densities (> 60/m<sup>3</sup>) have been recorded in the estuary. Elvers of the American eel are also common during this winter-spring period (Sandine, 1984).

### **Benthic Communities**

The benthic communities of Great Bay, Little Egg Harbor, and the small back-bays to the south (i.e., Little Bay, Reeds Bay, and Absecon Bay) consist of a wide array of flora and fauna. Dominant benthic flora in estuarine waters of the reserve include eelgrass (*Zostera marina*), widgeon grass (*Ruppia maritima*), various species of macroalgae (e.g., *Ulva lactuca*, *Ceramium fastigiatum*, and *Gracilaria tikvahiae*), and microalgae (e.g., diatoms). In addition to their role as primary producers, benthic flora, particularly seagrasses, are important habitat formers in the system. Submerged aquatic vegetation (SAV), *Z. marina* and *R. maritima*, provides habitat for epibiota (on leaves and stems), infauna, and nekton. Some commercially important species (e.g., *Callinectes*

*sapidus*, *Argopecten irradians*, and *Tautoga onitis*) use seagrasses during early development or as adult habitat (Bologna et al., 2000). SAV serves as vital spawning, nursery, and feeding grounds for many estuarine organisms in the reserve.

Benthic invertebrates are classified taxonomically, and can also be differentiated on the basis of size, life habits, and adaptations, as well as mode of obtaining food. Based on taxonomy, most major phyla are represented by the estuarine benthos of the reserve, with members of the Mollusca, Annelida, Arthropoda, Echinodermata, Cnidaria, Ctenophora, and Chordata predominating. Based on size, four classes of benthic invertebrates are recognized: microfauna, meiofauna, macrofauna, and megafauna. Microfauna (mainly protozoans) are diminutive forms that pass through sieves of 0.04-0.1 mm mesh. Meiofauna (e.g., nematodes, ostracods, gastrotrichs, mystacocarids, tardigrades, and turbellarians) pass through 0.5 mm mesh, but are retained by sieves of 0.04-0.1 mm mesh. Larger invertebrates captured by sieves of 0.5-2 mm mesh constitute the macrofauna. The largest invertebrates (e.g., adult bivalves, gastropods, and crabs), most frequently collected by nets and dredges rather than bottom grab samplers, comprise the megafauna.

Although the most conspicuous members of the benthic invertebrate community are epibenthic and infaunal forms, many others are interstitial, boring, swimming, and commensal-mutualistic types. Four categories of benthic fauna are also delineated based on their mode of obtaining food. These are deposit feeders, suspension feeders, herbivores-scavengers, and parasites.

## Benthic Fauna

Durand and Nadeau (1972) conducted the most detailed investigations of the benthic invertebrate community in Great Bay, collecting samples throughout much of the bay in 1968 with a Petersen dredge and a modified oyster dredge (Figures 26 and 27). A large database exists on the benthic faunal and floral communities of Barnegat Bay as reported by Loveland and Vouglitois (1984), Loveland et al. (1984), and Kennish (2001a). However, most of this work was conducted during the 1969-1972 period. More recent studies of benthic organisms in the Barnegat Bay-Little Egg Harbor Estuary include those of McLain and McHale (1997), Moser (1997), Lathrop et al. (2001a, b), Wootton and Zimmerman (2001), Kennish et al. (2004a, b, 2007a, b, 2008). With exception to recent work on SAV, the benthic communities of Little Egg Harbor remain poorly characterized.

Much of the following discussion on the benthic fauna in Great Bay and Little Egg Harbor derives from the surveys of Durand and Nadeau (1972) and Moser (1997), respectively.



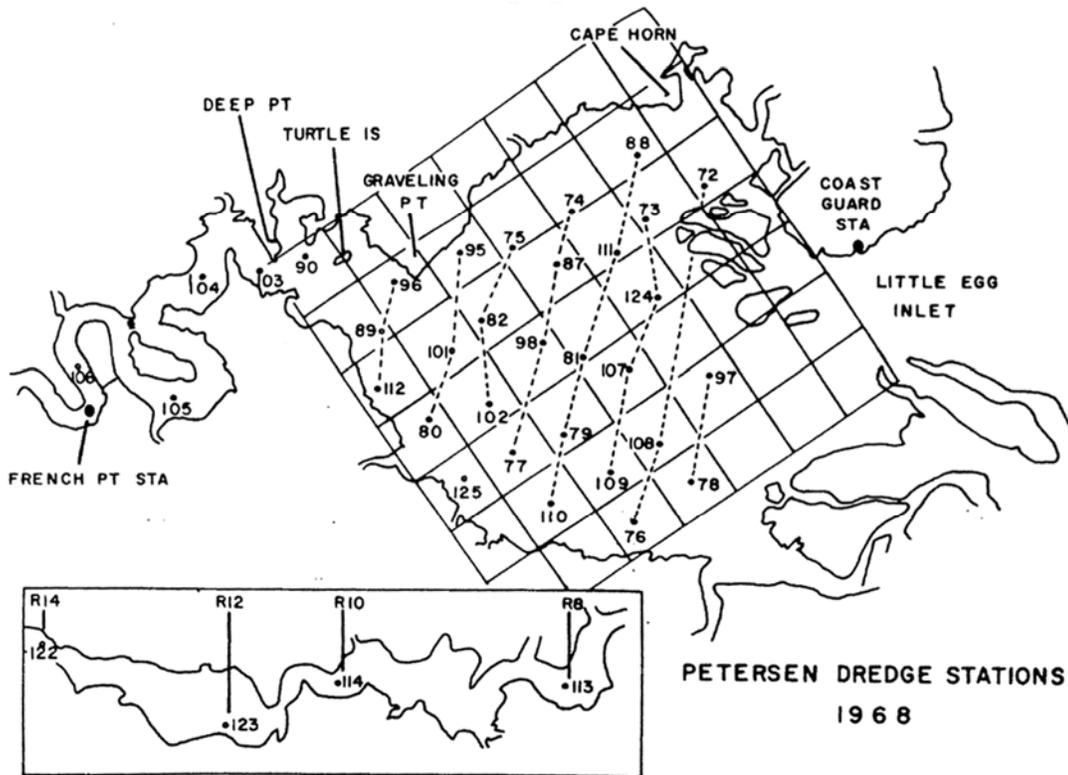


Figure 26. Benthic invertebrate sampling stations of Durand and Nadeau in the Mullica River-Great Bay Estuary. Modified from Durand, J. B. and R. J. Nadeau. 1972. Water Resources Development in the Mullica River Basin. Part I. Biological Evaluation of the Mullica River-Great Bay Estuary. Technical Report, New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey. 138 p.

Durand and Nadeau (1972) recorded 143 benthic invertebrate species in Petersen dredge samples collected in Great Bay (Appendix 19). This species list may be compared to the taxonomic list of benthic invertebrates reported for Barnegat Bay for the 1969 to 1973 period (Loveland and Vouglitois, 1984) (Table 15). It contains more than 200 benthic invertebrate species.

Table 15. Taxonomic list of benthic invertebrates found in Barnegat Bay.

---

Phylum Porifera

|                    |  |
|--------------------|--|
| Class Demospongiae | <i>Cliona celata</i> (Grant)                     |
|                    | <i>Halichondria bowerbanki</i> (Burton)          |
|                    | <i>Halichondria Panicea</i> (Pallas)             |
|                    | <i>Haliclona</i> sp.                             |
|                    | <i>Microciona prolifera</i> (Ellis and Solander) |

Phylum Cnidaria

Class Hydrozoa

|                |                                       |
|----------------|---------------------------------------|
| Order Athecata | <i>Hydractinia echinata</i> (Fleming) |
|                | <i>Pennaria tiarella</i> (Ayres)      |
|                | <i>Tubularia crocea</i> (L. Agassiz)  |
| Order Thecata  | <i>Campanularidae</i> sp.             |
|                | <i>Obelia commissuralis</i> (McCrary) |
|                | <i>Thuiaria argentea</i> (Linnaeus)   |

Class Anthozoa

Order Actiniaria      *Diadumene leucolena* Verrill

*Edwardsia elegans* Verrill

*Halcampoides* sp.

*Haliplanella luciae* Verrill

*Haloclava producta* (Stimpson)

*Metridium senile* (Linnaeus)

*Haliplanella luciae* (Verrill)

*Actinothoe modesta*(Verrill)

Order Ceriantharia      *Cerianthus americanus* Verrill

## Phylum Platyhelminthes

Class Turbellaria      *Euplana gracilis* (Girard)

*Stylochus ellipticus* (Girard)

## Phylum Nemertinea

Class Anopla      *Carinoma tremaphoros* (Leidy)

*Cerbratulus lacteus* (Leidy)

Phylum Sipunculida      *Golfingia improvisum* Theel

*Golfingia* sp.

Phylum Annelida

Class Polychaeta

Order Phyllodocida

- Family Phyllodocidae    *Eteone heteropoda* Hartman  
                                  *Eteone lactea* Claparede  
                                  *Eulalia viridis* (Linnaeus)  
                                  *Eumida sanguinea* (Oersted)  
                                  *Paranaitis speciosa* (Webster)  
                                  *Phyllodoce arenae* (Webster)  
                                  *Phyllodoce maculata* (Linnaeus)
- Family Polynoidae        *Harmothoe imbricata* (Linnaeus)  
                                  *Harmothos oerstedii* (Malmgren)  
                                  *Lepidonotus squamatus* (L.)
- Family Sigalionidae     *Stenelais boa* (Johnston)
- Family Chrysopetalidea   *Dysponetus pygmaeus* Levinsen
- Family Glyceridae        *Glycera americana* Leidy

*Glycera capitata* Oersted

*Glycera dibranchiata* Ehlers

Family Goniadidae

*Glycinde solitaria* Webster

*Goniada maculata* Oersted

*Ophioglycera gigantean* Verrill

Family Nephtyidae

*Nephtys incisa* Malmgren

*Nephtys picta* Ehlers

Family Syllidae

*Autolytus cornutus* (A. Agassiz)

Family Hesionidae

*Gyptis vittata* Webster and Benedict

*Podarke obsura* Verrill

Family Nereidae

*Nereis arenaceodonta* Moore

*Platynereis dumerilii* (Verrill)

*Nereis pelagica* Linnaeus

*Nereis succinea* (Frey and Leukart)

*Nereis virens* Sars

Order Capitellida

Family Capitellidae

*Capitella capitata* (Fabricius)

*Notomastus latericeus* Sars

Family Maldanidae     *Clymenella torquata* (Leidy)

*Clymenella zonalis* (Verrill)

*Maldane sarsi* Malmgren

*Maldinopsis elongata* (Verrill)

## Order Spionida

Family Spionidae     *Polydora ligni* Webster

*Scolecopides viridis* (Verrill)

*Scolelepis squamata* (O. F. Muller)

*Spio filicornis* (O. F. Muller)

*Spio setosa* Verrill

Family Chaetopteridae     *Spiochaetopterus oculatus* Webster

Family Sabellariidae     *Sabellaria vulgaris* Verrill

## Order Eunicida

Family Onuphidae     *Diopatra cuprea* (Bosc)

Family Eunicidae     *Marphysa sanguinea* (Montagu)

Family Arabellidae     *Arabella iricolor* (Montagu)

Family Dorvilleidae     *Stauronereis ruda* (Della Chiaje)

Order Ariciida

Family Orbiniidae     *Orbinia norvegica* (Sars)

*Scoloplos fragilis* (Verrill)

*Scoloplos robustus* (Verrill)

Order Cirratulida

Family Cirratulidae     *Cirratulus grandis* Verrill

*Tharyx acutus* Webster and Benedict

Order Terebellida

Family Pectinariidae     *Pectinaria gouldii* (Verrill)

Family Ampharetidae     *Asabellides oculata* (Webster)

Family Terebellidae     *Amphitrite cirrata* O.F. Muller

*Amphitrite johnstoni* Malmgren

*Amphitrite ornata* (Leidy)

*Pista cristata* (O.F. Muller)

*Pista palmata* (Verrill)

*Polycirrus eximius* (Leidy)

*Polycirrus medusa* Grube

*Terebellides stroemi* Sars

#### Order Flabelligerida

Family Flabelligeridae *Pherusa plumose* (O. F. Muller)

#### Order Sabellida

Family Sabellidae *Sabella crassicornis* Sars

*Sabella microphthalma* (Verrill)

Family Serpulidae *Hydroides dianthus* (Verrill)

#### Phylum Arthropoda

Class Xiphosurida *Limulus polyphemus* Linnaeus

Class Pycnogonida *Callipallene brevirostris* (Johnston)

*Tanystylum orbiculare* (Wilson)

Class Crustacea

Order Thoracica      *Balanus balanoides* (Linné)

*Balanus eburneus* (Gould)

*Balanus imprvisus* (Darwin)

Order Mysidacea      *Heteromysis formosa* (Smith)

*Neomysis americana* (Smith)

Order Cumacea      *Oxyurostylis smithi* (Calman)

Order Tanaidacea      *Leptochelia savignyi* (Kroyer)

Order Isopoda      *Cyathura polita* (Stimpson)

*Edotea triloba* (Say)

*Erichsonella attenuata* (Harger)

*Erichsonella filiformis* (Say)

*Idotea baltica* (Pallas)

*Lironeca ovalis* (Say)

Order Amphipoda

Family Lysianassidae      *Lysianopsis alba* Holmes

- Family Ampeliscidae    *Ampelisca abdita* Mills  
                                   *Ampelisca Macrocephala* Liljeborg  
                                   *Ampelisca vadorum* Mills  
                                   *Ampelisca verrilli* Mills
- Family Calliopiidae    *Calliopijs laeviusculus* (Kroyer)
- Family Gammaridae    *Elasmopus laevis* Smith  
                                   *Gammarus lawrencianu* Bousfield  
                                   *Gammarus mucronatus* Say  
                                   *Maera danae* Stimpson  
                                   *Melita nitida* Smith
- Family Bateidae        *Batea catharinensis* Muller
- Family Pontogeneidae    *Pontogeneia inermis* (Kroyer)
- Family Hyalidae        *Hyale* sp.
- Family Corophiidae    *Cerapus tubularis* Say  
                                   *Corophium tuberculatum* Shoe-maker  
                                   *Erichthonius* sp.

*Unciola irrorata* Say

Family Ampithoidae    *Ampithoe longimana* Smith 1873  
*Ampithoe rubricate* Montagu 1813  
*Cymadusa compta* Smith

Family Ischyroceridea    *Jassa falcatea* (Montagu) 1818  
*Isochyroceros anguipes* Kroyer 1838

Family Aoridae    *Lembos smithi* Holmes 1905  
*Microdeutopus gryllotal* Costa 1853

Family Caprellidae    *Aeginella longicornis* Kroyer  
*Caprella geometrica* Say  
*Caprella linearis* Say

Order Decapoda

Family Hippolytidae    *Hippolyte zostericola* (Smith)

Family Crangonidae    *Crangon septemspinosa* Say

Family Palaemonidae    *Palaemonetes pugio* Holthuis

*Palaemonetes vulgaris* (Say)

Family Majidae      *Libinia dubia* Milne-Edwards

Family Cancridae      *Cancer irroratus* Say

Family Xanthidae      *Eurypanopeus depressus* (Smith)

*Neopanope texana* (Smith)

*Panopeus herbstii* H. Milne-Edwards

*Rhithropanopeus harrisi* (Gould)

Family Portunidae      *Callinectes sapidus* Rathbun

*Carcinus maenus* (Linnaeus)

*Ovalipes ocellatus* (Herbst)

Family Paguridae      *Pagurus longicarpus* Say

*Pagurus pollicaris* Say

Phylum Mollusca

Class Gastropoda

Order Mesogastropoda      *Bittium alternatum* (Say)

*Crepidula convexa* Say

*Crepidula fronicata* (Linnaeus)

*Crepidula plana* Say

*Epitonium rupicola* Kurtz

*Littorina saxatilis* (Olivi)

*Polinices duplicatus* (Say)

*Triphora nigrocincta* (Adams)

Order Neogastropoda

*Anachis avara* (Say)

*Busycon canaliculatum* (Linnaeus)

*Busycon carica* (Gmelin)

*Eupleura caudata* (Say)

*Mitrella lunata* (Say)

*Ilyanassa obsoleta* (Say)

*Nassarius trivittatus* (Say)

*Nassarius vibex* (Say)

*Urosalpinx cinerea* (Say)

Order Cephalaspidea

*Acteon punstostriatus* (C. B. Adams)

*Haminoea solitaria* (Say)

*Turbonilla interrupta* (Totten)

*Acteocina canaliculata* (Say)

Order Nudobranchia     *Doridella obscura* (Verrill)  
*Doridella* sp.  
*Cratena pilata* (Gould)  
*Cratena* sp.  
*Cuthona concinna* (Alder and Hancock)

Class Bivalvia

Order Protobranchia     *Nucula proxima* Say  
*Solemya vellum* Say  
*Yoldia limatula* (Say)

Order Prionodontia     *Anadara ovalis* (Bruguiere)

Order Ptereoconchida     *Argopecten irradians* (Lamarck)  
*Crassostrea virginica* (Gmelin)  
*Geukensia demissa* (Dillwyn)  
*Modiolus modiolus* Linnaeus  
*Mytilus edulis* (Linné)

Order Heterodontida     *Chiona cingenda* Dillwyn  
*Ensis directus* Conrad  
*Gemma gemma* (Totten)

*Laevicardium mortoni* Conrad

*Macoma balthica* (Linné)

*Macoma tenta* (Say)

*Mercenaria mercenaria* (Linné)

*Mulinia lateralis* (Say)

*Mya arenaria* (Linné)

*Petricola pholadiformis* Lamarck

*Pita morrhuana* (Linsley)

*Spisula solidissima* (Dillwyn)

*Tagelus divisus* (Spengler)

*Tellina agilis* Stimpson

*Tellina versicolor* Dekay

Order Eudesmodontida    *Lyonsia hyalina* Conrad

Phylum Ecotopecta    *Amathia vidovici* (Heller)

*Bowerbankia gracilis* Leidy

*Bugula turrata* (Desor)

*Electra hastingsae* Marcus

*Membranipora* sp.

Phylum Echinodermata

Class Asteroidea    *Asterias forbesii* (Desor)

|                     |   |
|---------------------|---|
| Class Ophiuroidea   | <i>Amphipholis squamata</i> (Delle Chiaje)  |
| Class Echinoidea    | <i>Arbacia punctulata</i> (Lamarck)   |
| Class Holothuroid   | <i>Cucumaria pulcherrima</i> (Ayres)<br><i>Leptosynapta tenuis</i> (Ayres)<br><i>Leptosynapta roseola</i> (Verrill)<br><i>Thyone briareus</i> (Lesueur) |
| Phylum Hemichordata | <i>Saccoglossus kowalevskyi</i> (A. Agassiz)  |
| Phylum Chordata     |   |
| Class Ascidiacea    | <i>Botryllus schlosseri</i> (Pallas)<br><i>Molgula manhattensis</i> (Dekay)<br><i>Perophora viridis</i> Verrill   |
| Phylum Chaetognata  | <i>Sagitta elegans</i> Verrill  |

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From Loveland, R. E. and J. J. Vouglitois. 1984. Benthic fauna. In: M. J. Kennish and R. A. Lutz (eds.), *Ecology of Barnegat Bay, New Jersey*. Springer-Verlag, New York, pp. 135-170.

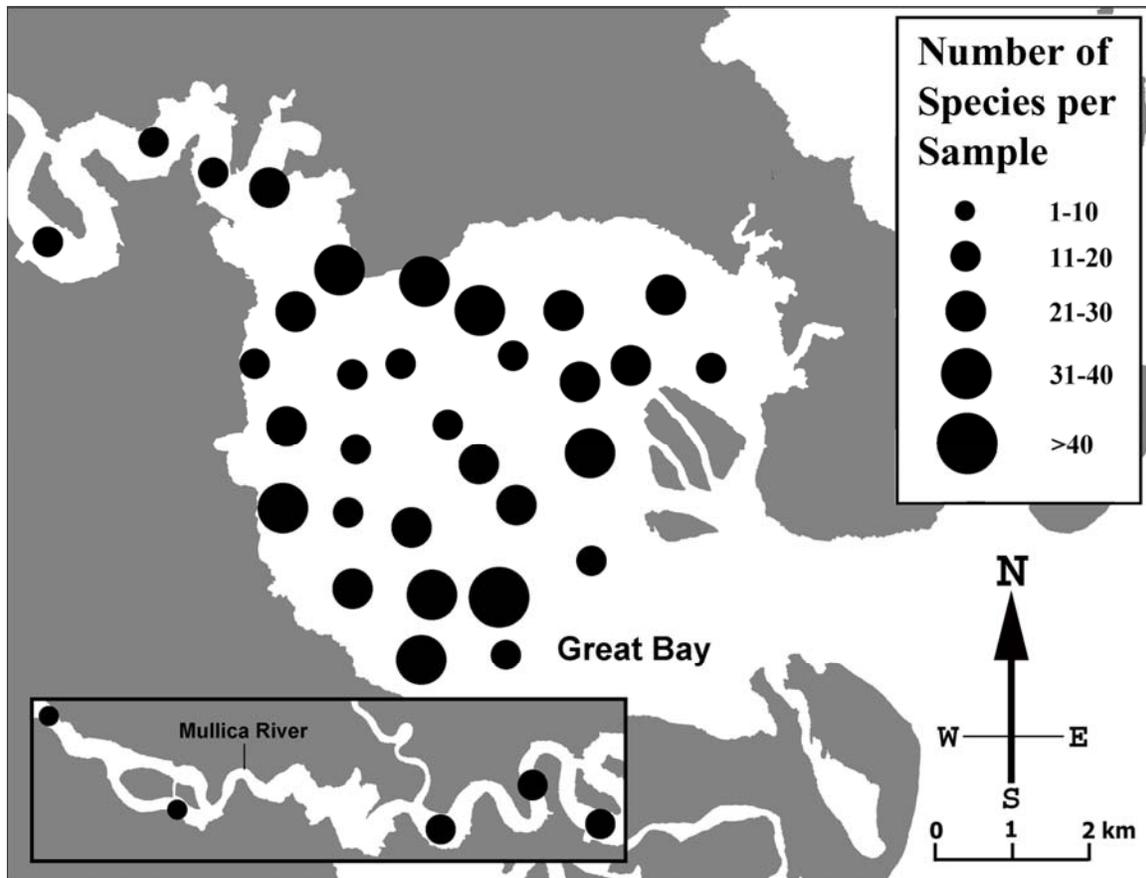


Figure 27. Species richness (number of species/sample) of benthic organisms collected by Petersen dredge in the Mullica River-Great Bay Estuary. Modified from Durand, J. B. and R. J. Nadeau. 1972. Water Resources Development in the Mullica River Basin. Part I. Biological Evaluation of the Mullica River-Great Bay Estuary. Technical Report, New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey. 138 p.

The benthic faunal communities of Great Bay and Barnegat Bay are similar in that most species belong to only a few phyla. For example, nearly 90% of the benthic fauna collected by Durand and Nadeau (1972) were about equally divided among the annelids, mollusks, and arthropods (Table 16). Species richness varied considerably across the bay (Figure 27). The most abundant organism collected was *Ampelisca abdita*,

a tube-forming amphipod that covered extensive areas of the estuarine bottom, reaching densities  $>5,000$  individuals/m<sup>2</sup> in some areas (Figure 28). The tubes produced by these amphipods stabilize fine sediments on the bay bottom. In addition, *A. abdita* is an important forage species for various benthic and nektonic organisms.

The benthic invertebrates in the estuary exhibit a distinct spatial distribution when proceeding from Lower Bank in the Mullica River to Little Egg Inlet. Four species types are recognized: (1) river-dominant forms; (2) bay-dominant forms; (3) lower-bay dominant forms; and (4) estuary-wide forms (Table 17). Seven species are considered to be true estuarine forms, occurring along the length of the estuary. Included here are *Ampelisca abdita*, *Corophium cylindricum*, *Cyathura polita*, *Notomastus latereus*, *Polydora ligni*, *Scoloplos robustus*, and *Turbonilla* sp. These seven species are not only widely distributed but also very abundant. Durand and Nadeau (1972) found that they comprised 71% of the total assemblage of benthic organisms collected at 75% of the sampling sites. The dominant forms in the estuary, therefore, can tolerate a rather wide salinity range.

The distribution of some benthic invertebrates appears to be closely linked to the amount of silt-clay in the bottom sediments. For example, Durand and Nadeau (1972) showed that *Acteocina canaliculata*, *Lumbrinereis tenuis*, *Maldinopsis elongata*, *Tellina agilis*, *Turbonilla* sp., and *Unciola irrorata* occurred only in sediments with more than 38% silt-clay. Other species (e.g., *Ampelisca verrilli*, *Ensis directus*, *Haustorius arenarius*, *Pygospio elegans*, and *Oxyurostylis smithi*) were observed only in sediments with less than 20% silt-clay. The bay exhibits marked bands of sediment with high percentages of sand (e.g., sand bars in the western bay) giving way to adjacent areas with

higher percentages of silt and clay (Figure 11). This sediment distribution clearly affects the spatial distribution of benthic invertebrates.

Table 16. Taxonomic breakdown of benthic invertebrates collected with a Petersen Dredge in the Mullica River-Great Bay Estuary.

|                 | Number of species | Cumulative % |
|-----------------|-------------------|--------------|
| Polychaeta      | 49                | 34.3         |
| Crustacea       | 45                | 65.7         |
| Gastropoda      | 20                | 79.7         |
| Bivalvia        | 14                | 89.5         |
| Ectoprocta      | 4                 | 92.3         |
| Coelenterata    | 4                 | 95.1         |
| Nemertea        | 3                 | 97.2         |
| Porifera        | 2                 | 98.6         |
| Platyhelminthes | 1                 | 99.2         |
| Ascidacea       | 1                 | 99.9         |

From Durand, J. B. and R. J. Nadeau. 1972. Water resources development in the Mullica River Basin. Part I. Biological evaluation of the Mullica River-Great Bay Estuary. Technical Report, New Jersey Water Resources Research Institute, Rutgers University, New Brunswick, New Jersey.

Table 17. Spatial distribution of benthic invertebrates along a salinity gradient of the Mullica River-Great Bay Estuary.

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**River-Dominant Forms**

*Cerebratulus lacteus*

*Chiridotea almyra*

*Gammarus locusta*

*Glycera dibranchiata*

*Hypaniola grayi*

*Lyonsia hyalina*

*Melita nitida*

*Neopanope texana*

*Nereis succinea*

*Ptilocherirus pinquis*

*Sagartia modesta*

*Scolecopides viridis*

*Scoloplos fragilis*

*Streblospio benedicti*

*Sympleustes glaber*

**Bay-Dominant Forms**

*Acteocina canaliculata*

*Ampelisca verrilli*

*Amphitrite cirrata*

*Arca pexata*

*Brania clavata*

*Crepidula convexa*

*Elasmopus laevis*

*Glycera americana*

*Glycinda solitaria*

*Leucon americanus*

*Lumbrineris tenuis*

*Maldinopsis elongata*

*Mulinia lateralis*

*Oxyurostylis smithi*

*Polycirrus eximus*

*Tellina agilis*

*Triphora nigrocincta*

*Unciola irrorata*

### **Lower-Bay Dominant Forms**

*Caprella geometrica*

*Cirratulus grandis*

*Crangon septemspinosa*

*Cylichna alba*

*Ensis directus*

*Haustorius arenarius*

*Idotea balthica*

*Nassarius vibex*

*Nephtys picta*

*Pagurus longicarpus*

*Pygospio elegans*

*Stenothoe cypris*

**Estuarine Forms (Entire Range)**

*Ampelisca abdita*

*Corophium cylindricum*

*Cyathura polita*

*Notomastus latereus*

*Polydora ligni*

*Scolopos robustus*

*Turbonilla* sp.

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From Kennish, M. J., S. M. Haag, G. P. Sakowicz, and J. B. Durand. 2004. Benthic macrofaunal community structure along a well-defined salinity gradient in the Mullica River-Great Bay Estuary. *Journal of Coastal Research*, SI 45: 209-226.

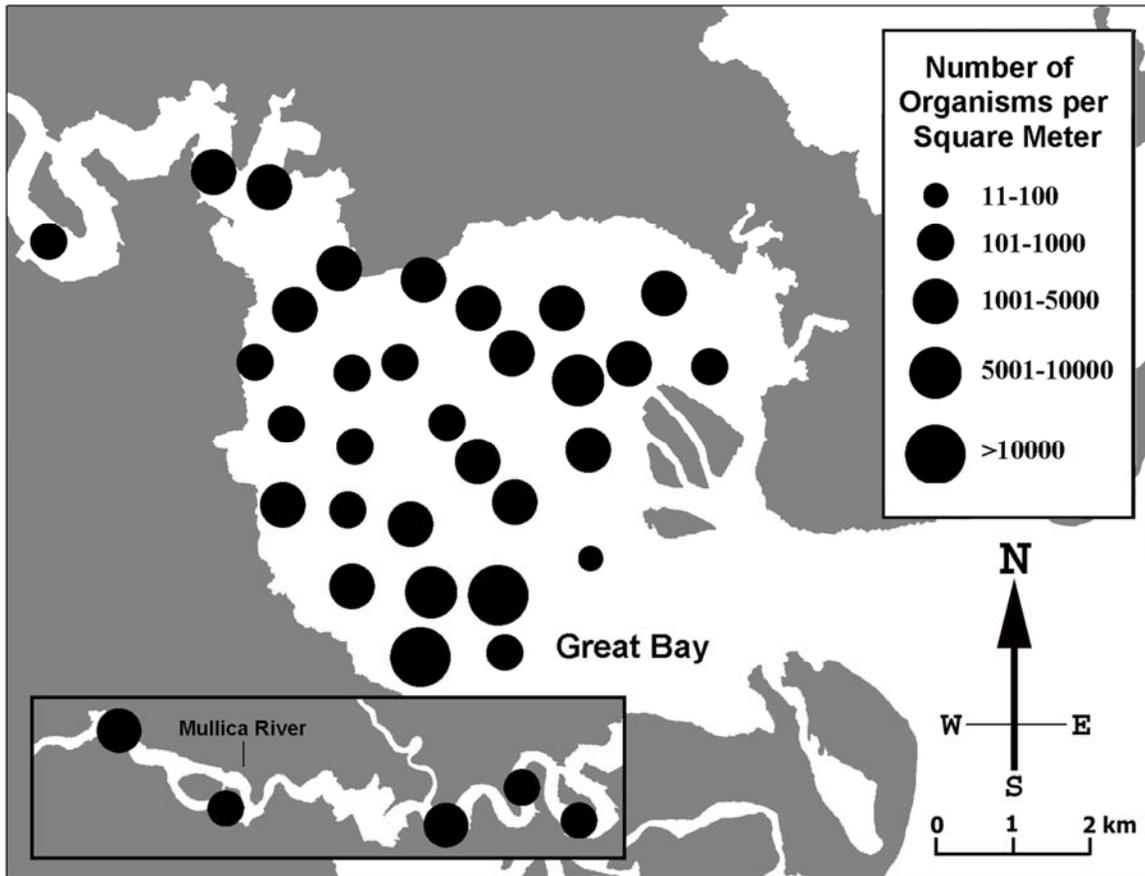


Figure 28. Density (number of organisms/m<sup>2</sup>) of benthic organisms collected by Petersen dredge in the Mullica River-Great Bay Estuary. From Kennish, M. J., S. M. Haag, G. P. Sakowicz, and J. B. Durand. 2004. Benthic macrofaunal community structure along a well-defined salinity gradient in the Mullica River-Great Bay estuary. *Journal of Coastal Research*, SI 45: 209-226.

While some benthic fauna were present in very low numbers in a patchy distribution, others exhibited a broader distribution across sections of the estuarine floor. For example, *Ampelisca verrilli* and *Gemma gemma* occurred in high abundances in the lower end of Great Bay. *Acteocina canaliculata* and *Glycinde solitaria* were only observed on the southwestern side of the bay. *Nassarius obsoletus* and *Unciola irrorata* attained peak numbers near the mouth of the Mullica River and the western perimeter of the bay. *Ptilocheirus pinquis* was common along the Mullica River bottom, but was

rarely found along the bay bottom. Salinity appears to be a major controlling factor restricting species to the riverine habitats.

Benthic faunal assemblages have also been investigated on Beach Haven Ridge (39°28'18"N, 74°15'10"W) at the site of the Long-term Ecosystem Observatory of Rutgers University on the inner continental shelf and nearby areas. Hales et al. (1995), using a 2-m beam trawl, examined the species composition of epibenthic invertebrate assemblages on Beach Haven Ridge, deeper waters of the inner continental shelf, and estuarine habitats of Great Bay. Viscido et al. (1997), also using a 2-m beam trawl, studied the abundance and spatial distribution patterns of epibenthic decapod crustacean assemblages along Beach Haven Ridge (i.e., landward of the ridge, on the ridge top, and seaward of the ridge) (Figure 29). Results of the investigation by Hales et al. (1995) indicate that echinoderms (i.e., sea urchins, *Arbacia punctulata*; sand dollars, *Echinarachnius parma*; and sea stars, *Asterias forbesi*) predominated at deeper sites on the inner continental shelf. Gastropods (*Busycon* spp., *Euspira heros*, and *Nevirita duplicata*), bivalves (*Spisula solidissima*), and polychaetes (*Diopatra cuprea*) were abundant around the Beach Haven Ridge. Other taxa (hard clams, *Mercenaria mercenaria*; American oysters, *Crassostrea virginica*; and grass shrimp, *Palaemonetes vulgaris*) occurred only in estuarine samples from Great Bay. Most of the aforementioned species attained peak abundance in summer and lowest abundance in winter.

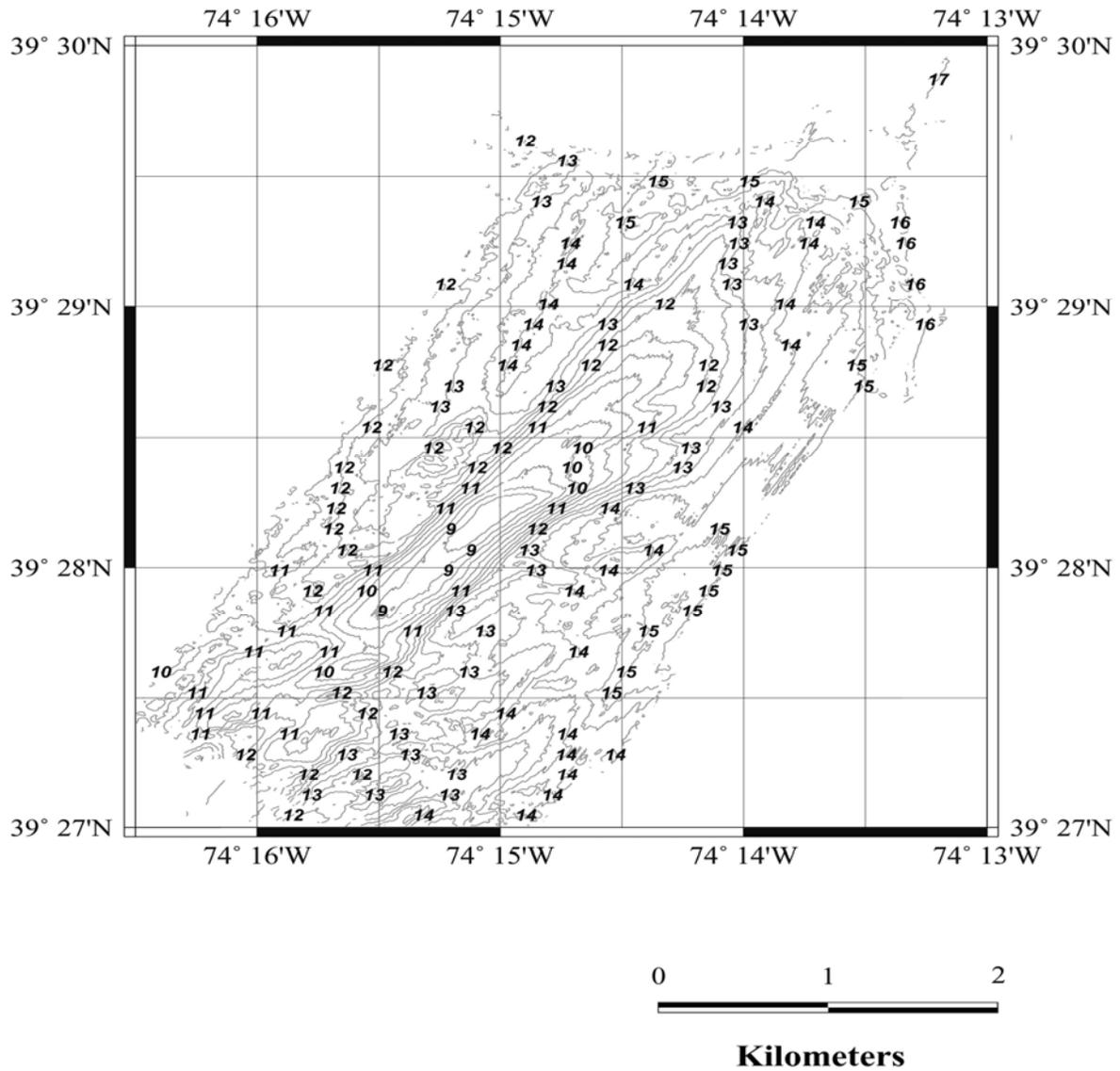


Figure 29. Topographic structure of the Beach Haven Ridge marking the location of the Long-Term Ecosystem Observatory (LEO-15) site of Rutgers University within the Jacques Cousteau National Estuarine Research Reserve. From Viscido, S. V., D. E. Stearns, and K. W. Able. 1997. Seasonal and spatial patterns of an epibenthic decapod crustacean assemblage in northwest Atlantic continental shelf waters. *Estuarine, Coastal and Shelf Science* 45:377-392.

Viscido et al. (1997) reported that nine principal species comprise the epibenthic decapod crustacean assemblage of the Beach Haven Ridge. Four of these species (i.e., Atlantic rock crab, *Cancer irroratus*; spider crab, *Libinia emarginata*; lady crab, *Ovalipes ocellatus*; and sevenspine bay shrimp, *Crangon septemspinosa*) numerically dominated the assemblage, accounting for more than 98% of all decapods collected. Among these species, *C. irroratus*, *L. emarginata*, and *C. septemspinosa* were much more abundant landward and seaward of the ridge. *Ovalipes ocellatus* was not as spatially variable as these three species. Together with *C. irrorata*, *O. ocellatus* reached maximum abundance in the summer. *Crangon septemspinosa* and *Libinia emarginata* attained peak abundance in spring and fall. Viscido et al. (1997) concluded that Beach Haven Ridge not only has a strong influence on the abundance and distribution of decapod crustaceans but also affects the structure of the entire community of marine benthic organisms in the area.

### **Benthic Flora**

Eelgrass (*Zostera marina*) and benthic macroalgae are important elements of the benthic floral community of the reserve. Eelgrass and widgeon grass (*Ruppia maritima*) are essentially confined to Little Egg Harbor and Barnegat Bay. Benthic macroalgae are more broadly distributed in the system, occurring in Little Egg Harbor, Great Bay, and the shallow back-bays to the south. Sea lettuce, *Ulva lactuca*, is an abundant macroalgal species in these bays. Other common benthic macroalgal forms include *Gracilaria tikvahiae*, *Ceramium fastigiatum*, and *Agardhiella subulata*.

Eelgrass and widgeon grass occur along the shallow margins of Little Egg Harbor primarily along the eastern side of the embayment in waters less than ~1.5 m (Figure 30). In past years, eelgrass has grown in dense beds along the margins of the estuary



to maximum depths of ~2 m, although the beds have become more spatially restricted in some areas in recent years. The abundance of eelgrass in a given year depends on the amount of seeds set the previous year and the successful germination of the seeds. The temporal and spatial shifts in the distribution of SAV in Little Egg Harbor may be the result of natural cycles (Loveland et al., 1984), although anthropogenic factors such as excessive nutrient loading, dredging, and prop scarring of motorized watercraft has been detrimental (Kennish 2001a).

Nutrient-induced phytoplankton blooms and excessive growth of benthic macroalgae can cause a decline in seagrass distribution. Wasting disease caused by *Labyrinthula zosterae* is also destructive during some years. McClain and McHale (1997) reported that wasting disease destroyed about 400 ha of eelgrass beds in Barnegat Bay during 1995. In addition, as much as 50% of the eelgrass leaves examined in 1996 exhibited evidence of wasting disease.

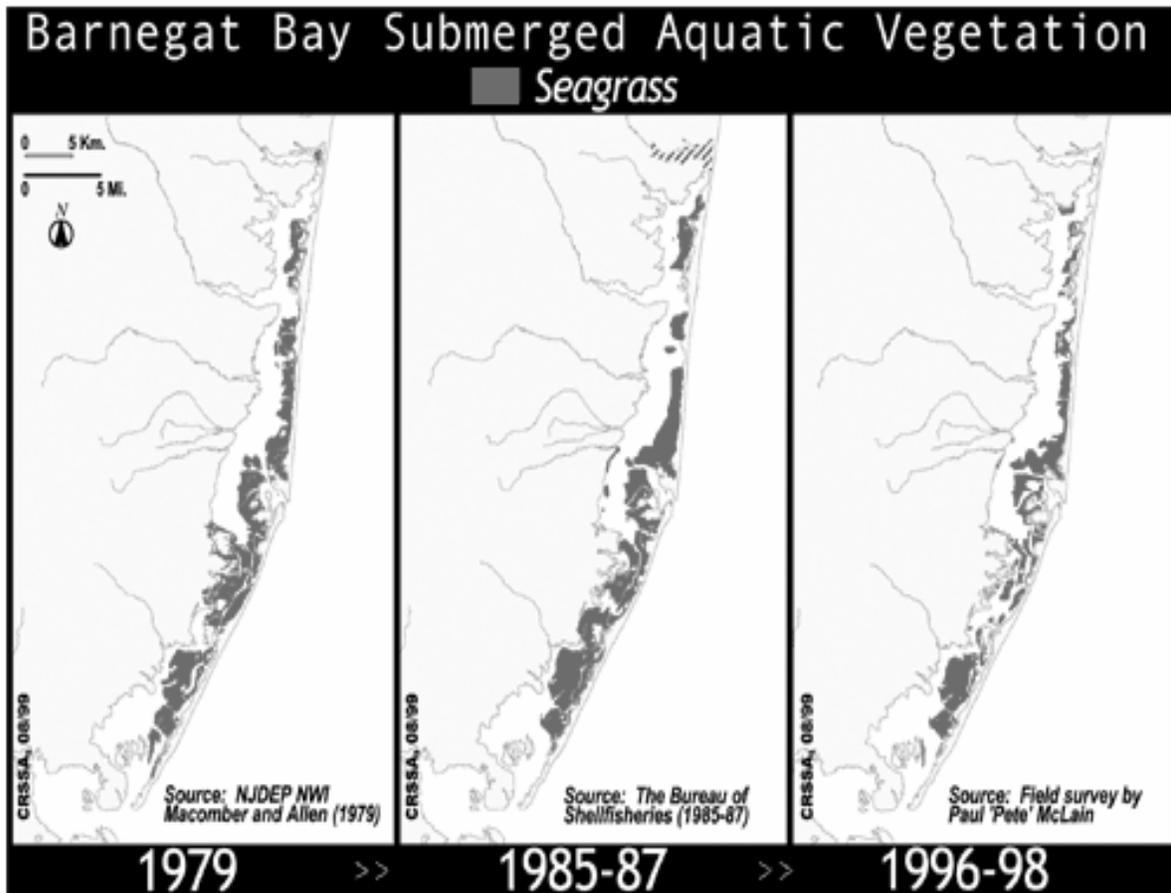


Figure 30. Seagrass distribution in the Barnegat Bay-Little Egg Harbor Estuary covering the period from the 1970s to the 1990s. From Richard G. Lathrop, Center for Remote Sensing and Spatial Analysis, Rutgers University, New Brunswick, New Jersey.

The loss of eelgrass beds during the past several decades may have been considerable, although different mapping techniques applied in past surveys have made data comparisons tenuous. Between the 1960s and 1990s, the overall decrease of areal coverage of eelgrass beds in the Barnegat Bay-Little Egg Harbor Estuary may have been as much as 3000 ha or nearly one-third of the total beds in the system. A GIS spatial

comparison analysis of SAV surveys by Lathrop (2001b) suggests a contraction of the eelgrass beds to shallow subtidal areas (< 2 m) during this period.

There has been clear evidence of the loss of beds in southern Little Egg Harbor. Bologna et al. (2000) revealed that the total SAV coverage in Little Egg Harbor decreased by 62% between 1975 and 1999, with the most significant reductions associated with the loss of *Zostera marina* beds. However, there was no significant change in the areal coverage of *Ruppia maritima* during this 25-year period. Wasting disease was present in less than 10% of *Z. marina* samples collected, and it was most prevalent in July and August. During these months, the effect of the wasting disease could have contributed substantially to the loss of some *Z. marina* beds in the estuary. Light attenuation may have been a more important factor in eelgrass decline. While there appears to have been appreciable reduction of *Z. marina* in Little Egg Harbor since the 1970s, evidence indicates that the recolonization of previous SAV habitat is taking place adjacent to the Sedge Islands in the southern part of the estuary.

There is great concern regarding the relatively recent decline of eelgrass beds in the coastal bays of New Jersey because of the significant functional roles that they play. For example, eelgrass beds provide refuge and food resources for many species.

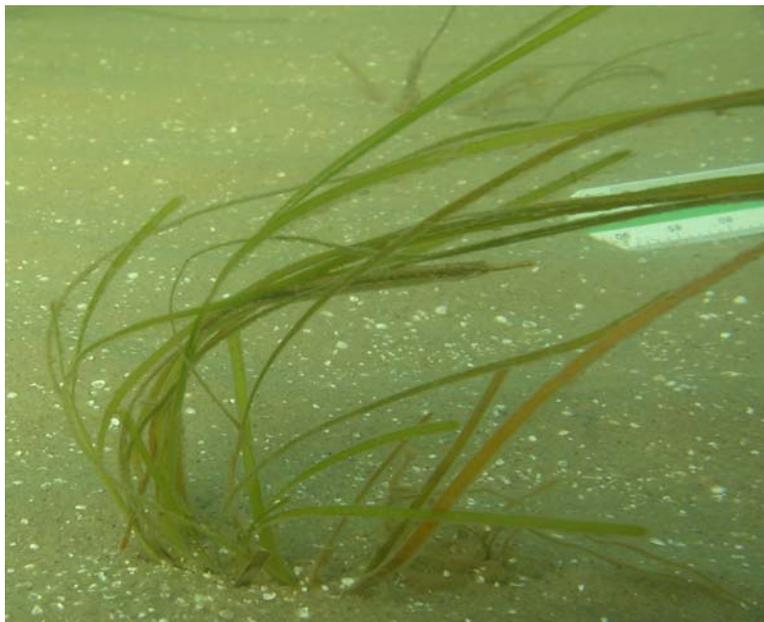


In addition, they stabilize the benthic habitat by baffling waves and currents and mitigating substrate erosion (Kennish, 2001a). Wootton and Zimmerman (2001) reported that aboveground biomass and belowground biomass values of eelgrass beds at Forked River, Sands Point, and Sedge Island sampling sites in Barnegat Bay during 1998 ranged from 8.73-141.23 g/m<sup>2</sup> and 58.33-270.58 g/m<sup>2</sup>, respectively. Maximum biomass occurred during summer, as it had for eelgrass biomass in Little Egg Harbor, when a peak biomass of 230 g FDW/m<sup>2</sup> was recorded (Bologna et al., 2000). Sogard and Able (1991) showed that sites where *Zostera marina* was the dominant vegetation in the JCNERR had higher densities of most fish species than did sites where *Ulva lactuca* was the dominant vegetation. However, *U. lactuca* was an important habitat for decapods in areas lacking *Z. marina*. Since eelgrass beds strongly influence the abundance and distribution of many benthic and nektonic organisms, the loss of the beds is a serious concern to the reserve program and the subject of ongoing biomonitoring investigations.

Benthic macroalgae provide refuge for amphipods, shrimp, and other estuarine organisms of the reserve. *Ulva lactuca* has been shown to reduce predation rates on blue crabs (*Callinectes sapidus*) in the system (Wilson et al., 1990). This green alga is part of a widely distributed drift community of macroalgal forms in Great Bay and other estuarine waters. The macroalgae are also important nursery habitat for certain species (e.g., *C. sapidus*).

Kennish et al. (2007b) conducted an estuary-wide investigation of seagrass abundance, biomass, and areal coverage during the 2004-2006 period. This investigation of the Barnegat Bay-Little Egg Harbor Estuary yielded a number of important findings. For example, the biomass of eelgrass beds in the Barnegat Bay-Little Egg Harbor Estuary

during the three-year study period exhibited important temporal and spatial patterns. The density as well as the aboveground and belowground biomass of eelgrass varied considerably during the spring to fall period, but was generally highest during the June-September period. This temporal pattern is attributed to more favorable light conditions during the late spring and summer. Aboveground and belowground biomass also varied spatially due to a wide range of physical-chemical conditions over small spatial scales, including marked differences in shading, light availability, macroalgae cover, and other factors. Of most concern is the low aboveground and belowground biomass of *Zostera marina* recorded along transects during 2006 compared to those in 2004 and 2005, indicating a 50-87.7% decline. Diminishing seagrass biomass and percent cover (also observed) in 2006 appear to signal an ecosystem problem in the estuary, likely coupled to ongoing nutrient enrichment.



Although considerable temporal and spatial variation of eelgrass biomass was observed, eelgrass blade length was very consistent across sampling sites and sampling periods. For example, in 2004 there was only a slight decrease in mean eelgrass blade length in Little Egg Harbor from June-July (34.02 cm), August-September (32.21 cm), and October-November (31.83 cm) despite the gradually declining photoperiod and

variable water temperature over the six-month study period. The maximum blade length did not vary substantially between the two different eelgrass beds. In 2005, the mean eelgrass blade length in Barnegat Bay was more variable, with the highest measurement (32.71 cm) obtained for the June-July period, the lowest measurement (25.89 cm) for the August-September period, and an intermediate measurement (28.47 cm) for the October-November period. In 2006, the mean eelgrass blade length was substantially lower, amounting to 19.37 cm in June-July, 18.65 cm in August-September, and 18.61 cm in October-November. The reduced eelgrass blade length also correlated with reduced aboveground biomass values.

The percent cover of seagrass decreased from 2004 to 2006 in concert with the decline of biomass. In 2004, there was decreasing cover of seagrass from spring to fall in Little Egg Harbor. The highest mean percent cover of seagrass in June-July (45%) was significantly greater than that in August-September (38%) and October-November (21%). In contrast, the percent cover of macroalgae was lower and more seasonally variable than the percent cover of seagrass. For example, the mean percent cover of macroalgae



increased from 13% in June-July to 21% in August-September and then declined to 14% in October-November. The highest percent cover of macroalgae in August-September probably reflects the greater growth and abundance of different algal species at this time.

In 2005, the percent cover of seagrass during June-July, August-September, and October-November sampling periods in Barnegat Bay amounted to 37%, 43%, and 16%, respectively. The percent cover by macroalgae during these periods was 14% (June-July), 7% (August-September), and 2% (October-November). Once again, the percent cover of both seagrass and macroalgae declined rapidly from summer into the fall.

The percent cover of seagrass was much reduced estuary-wide in 2006, concomitant with declining biomass measurements. It amounted to 32% in June-July, 23% in August-September, and 19% in October-November. The percent cover of macroalgae was similarly reduced in 2006, being 2% in June-July, 7% in August-September, and 7% in October-November. The percent cover of both seagrass and macroalgae in 2006, as well as in 2004 and 2005, was generally highest in interior areas of the seagrass beds than in marginal areas.

Most of the macroalgal species in the Barnegat Bay-Little Egg Harbor Estuary belong to a drift community. However, macroalgal blooms and patches that blanket the estuarine floor can be particularly detrimental to seagrass beds and associated benthic fauna. They hinder seagrass growth by shading or blocking sunlight and can render the estuarine floor unsuitable for regrowth of seagrass for extended periods. Hence, excessive growth of macroalgae in the estuary can be extremely damaging to seagrass habitat, a finding corroborated by studies conducted in other coastal bays in the Mid-Atlantic region and elsewhere.

In 2004, 32 macroalgal species were documented in the Little Egg Harbor survey area. Red algae (n = 19) accounted for 59% of the species collected, with green algae (n = 11) comprising



34% and brown algae only 6%. *Ulva lactuca* was the most common algal species, being found in 59% of the samples. Sheet-like species, such as *U. lactuca*, appear to pose the most serious threat to seagrass beds because they often form extensive patches that blanket and damage the seagrass plants. In 2005, 21 macroalgal species were recorded in Barnegat Bay with most species (16) being red algae. *Gracilaria tikvahiae* (present in 70% of samples), *Bonnemaisonia hamifera* (56%), *Spyridia filamentosa* (46%), and *Champia parvula* (19%) were the most abundant forms.

While brown tide (*Aureococcus anophagefferans*) blooms may be equally detrimental to seagrass beds due to their shading effects, no blooms were observed during the 2004 and 2005 sampling periods. The maximum cell counts of *A. anophagefferans* reported in the estuary during 2004 and 2005 amounted to  $4.9 \times 10^4$  cells  $\text{ml}^{-1}$  and  $4.7 \times 10^4$  cells  $\text{ml}^{-1}$ , respectively. These numbers are far less than those recorded during the bloom years of 2000-2002 ( $>1 \times 10^5$  cells  $\text{ml}^{-1}$ ). Thus, it is very unlikely that *A. anophagefferans* had any adverse impact on the eelgrass beds in the estuary during these two survey years.

The three-year SAV investigation (2004-2006) generated a large database on the demographic characteristics and habitat change of *Zostera marina* in the Barnegat Bay-Little Egg Harbor Estuary. It also yielded valuable information on the species composition, frequency of occurrence, and potential impacts of benthic macroalgae on the eelgrass beds in bay waters. Data collected in this study serve as a platform for further investigations of seagrass dynamics and restoration programs in this critically important coastal bay system.

## **Nekton**

### **Fish and Crabs**

The fish faunas of the Mullica River-Great Bay Estuary are among the most intensely studied of any estuary along the East Coast of the U.S., with particular focus on the life history and ecology of young-of-the-



year forms. This is largely attributed to the research efforts of RUMFS (Able et al., 1999). More than 60 finfish species have been documented in the estuary, and this assemblage is enriched by regular visitors and strays from more northern and (particularly) southern waters that use the estuary as a nursery and feeding area. Some

species that utilize the estuary as a nursery area include the Atlantic menhaden (*Brevoortia tyrannus*), weakfish (*Cynoscion regalis*), bluefish (*Pomatomus saltatrix*), and spot (*Leiostomus xanthurus*). Other species use the estuary for its spawning habitat. Among summer spawners are the bay anchovy (*Anchoa mitchilli*), Atlantic silverside (*Menidia menidia*), gobies (*Gobiosoma* spp.), northern pipefish (*Syngnathus fuscus*), and wrasses (*Labridae* spp.); examples of winter spawners are the winter flounder (*Pseudopleuronectes americanus*) and sand lance (*Ammodytes americanus*) (U.S. Fish and Wildlife Service, 1996). Jivoff and Able (2001) reported similar fish assemblages for Little Egg Harbor.

The oyster toadfish (*Opsanus tau*), fourspine stickleback (*Apeltes quadracus*), and winter flounder are resident species in estuarine waters of the JCNERR. Northern forms that occur are the threespine stickleback (*Gasterosteus aculeatus*) and the grubby (*Myoxocephalus aeneus*). Numerous species spawned in the southern Mid-Atlantic Bight and farther south can be abundant (e.g., northern puffer, *Sphoeroides maculatus*; butterflyfishes, *Chaetodon* spp., and spot). Other fishes are present during the summer as a result of inshore-offshore migrations (e.g., black sea bass, *Centropristis striata*; tautog, *Tautoga onitis*; and summer flounder, *Paralichthys dentatus*). Among the most common pelagic species are the bay anchovy, Atlantic silverside, and Atlantic herring (*Clupea harengus*). Major diadromous forms consist of the alewife (*Alosa pseudoharengus*) and blueback herring (*Alosa aestivalis*), which spawn in tributaries, and the American eel (*Anguilla rostrata*), which grows in the estuary but spawns in the Sargasso Sea. At the LEO-15 site, the typically dominant species are the bay anchovy, silver hake (*Merluccius*

*bilinearis*), spotted hake (*Urophycis regia*), smallmouth flounder (*Etropus microstomus*), and windowpane flounder (*Scophthalmus aquosus*).

Although more than 60 species of fish have been registered in the Mullica River-Great Bay Estuary, only 20 of these species have comprised more than 99.9% of all fish collected in field surveys (Durand and Nadeau, 1972). Forage species (e.g., bay anchovy and Atlantic silverside) are by far the most abundant forms. The absolute abundance of fish in the estuary is highest from May through November due to the arrival of warm-water migrants and recruitment from spawning populations in the estuary. In terms of relative abundance, the top ranked species recorded in fish surveys of the 1970s were the bay anchovy (*Anchoa mitchilli*), striped anchovy (*Anchoa hepsetus*), Atlantic silverside, northern puffer, silver perch, alewife, oyster toadfish, striped killifish (*Fundulus majalis*), sea herring (*Clupea harengus*), and white perch (*Morone americana*). In later trawl surveys of Great Bay and Little Egg Harbor, Szedlmayer and Able (1996) found that the bay anchovy was the dominant species (50.5% of the total number of fish), followed by spot (10.7%), Atlantic silverside (9.7%), fourspine stickleback (5.9%), blue crab (*Callinectes sapidus*) (4.6%), and northern pipefish (4.2%).

Some fish species are habitat specific. For example, Jivoff and Able (2001), in a habitat study of Little Egg Harbor, noted that the threespine stickleback, Atlantic menhaden, and naked goby (*Gobiosoma bosc*) preferred subtidal creek habitats. Four-spine stickleback, silver perch, and lizardfish (*Synodus foetens*) were associated with eelgrass. The small-mouth flounder,



windowpane, skate (*Raja eglanteria*), and hakes (*Urophycis* spp.) predominated in deep channels.

Finfish abundance in Little Egg Harbor is similar to that in the Mullica River-Great Bay Estuary, being highest from May through November. Far fewer individuals are present during the winter in both systems, although an increase in abundance is evident as early as March or April. Larvae and juveniles attain maximum numbers in the spring and summer months. Annual variations in absolute abundance of 50-100% are not unusual. Fluctuations in environmental conditions that influence reproductive success may be responsible for such large variations in abundance. More research must be conducted to address these uncertainties (Kennish, 2001a).

The community structure, seasonal patterns, and population trends of the finfish community in the Mullica River-Great Bay Estuary parallels that in the Barnegat Bay-Little Egg Harbor Estuary and other neighboring coastal bays. Forage fishes and juveniles numerically dominate these communities, utilizing the systems primarily as nursery areas. Adult marine forms spawn or feed in the bays, but typically inhabit oceanic waters. Warm-water and cool-water migrants appear seasonally, being occasionally present in greater numbers than resident species. Examples of warm-water migrants are the summer flounder, northern pipefish, black sea bass, and striped searobin (*Prionotus evolans*). The winter flounder is an example of a cool-water migrant. Warm-water migrants are more abundant than cool-water migrants and account for large numbers of fish in the bays from July through November. At this time, young of residents and warm-water migrants coexisting in the estuary reach maximum population sizes. The finfish community of the coastal bays, therefore, is characterized by: (1)

numerical dominance of a few species; (2) forage fishes and juveniles; (3) seasonal occurrence of warm-water and cool-water migrants; and (4) large fluctuations in abundance of populations (Tatham et al., 1984; Kennish, 2001a).

A species list of finfish compiled for Little Egg Harbor includes most of those species also found in the Mullica River-Great Bay Estuary and neighboring coastal bays to the south (Appendix 20) (Jivoff and Able, 2001). Able et al. (1996) noted that the fish fauna of Great Bay and Little Egg Harbor is phylogenetically diverse. They identified 58 species from 35 families and 11 orders represented across all estuarine shoreline habitats. In late summer, frequent visitors from southern regions (e.g., *Chaetodon ocellatus*, *Hypochamphus meeki*, and *Lutjanus griseus*) increase the faunal diversity. In late winter or early spring, visitors from more northern areas (e.g., *Myoxocephalus aeneus*) likewise increase the diversity.

More recently, Martino and Able (2003) studied the large-scale fish assemblage structure across the estuarine-ocean ecotone of the reserve. Their field collections over a 3-year study period showed that species richness and abundance appeared greatest in the nearshore ocean, decreased in Great Bay, and then increased again towards the uppermost stations in the Mullica River. Members of the Percichthyidae and Ictaluridae characterized the river assemblages, whereas representatives of the Triglidae and Stromateidae characterized the ocean and bay assemblages. Some species (e.g., *Anchoa mitchilli* and *Cynoscion regalis*) were found ubiquitously across the sampling area. Both small- and large-scale patterns were evident in the structure of the estuarine fish assemblage. The small-scale patterns, which are probably driven by foraging, competition, and/or predation, appear to be the result of habitat associations. The large-

scale patterns are primarily the result of the responses of individual species to dominate environmental gradients such as salinity.

A number of finfish species are of recreational or commercial importance in JCNERR waters. Included here are the American eel, alewife, blueback herring, bluefish, summer flounder, winter flounder, weakfish, white perch, black sea bass, spot, tautog, northern puffer, striped bass (*Morone saxatilis*), kingfish (*Menticirrhus saxatilis*), and Atlantic croaker (*Micropogonias undulatus*). Among shellish species, the blue crab is of paramount importance. A description of some of these species follows.

### **Recreational and Commercial Species**

#### *American eel (Anguilla rostrata)*

The American eel requires estuarine habitat to complete its life cycle. This species is catadromous, meaning spawning is in the ocean (in this case the Sargasso Sea, in midwinter), and later stages are found in estuaries or freshwater systems. The eggs hatch into leptocephali (ribbon-like, transparent larvae) that drift with ocean currents for a year or so toward the North American coast. As they approach coastal waters, the larvae metamorphose into “glass eels,” that have the typical eel form but are still transparent. Shortly after entering estuaries, the glass eels acquire pigmentation and transform into elvers. In the Delaware Estuary, 5- to 8-cm long elvers appear in February-March, when they concentrate in tidal creeks of the lower estuary. They reach the middle estuary in April-May and the upper estuary in May-June. Females travel farther toward freshwater than do males. Both sexes tend to occur in deeper or fresher water in the colder months, returning to coastal areas in the spring.

Except for the aforementioned seasonal movements, eels are quite sedentary and usually remain in home territories. Males mature at 28 to 30.5 cm in length, and rarely exceed 60 cm in length. Females mature at about 46 cm, often attaining lengths of 60 to 90 cm (Bigelow and Schroeder, 1953). In estuaries, juveniles and adults primarily feed on crustaceans, bivalves, and polychaetes. At 5 to 20 years, adults leave the estuary and return to the Sargasso Sea to spawn in the spring, after which they die. Stone et al. (1994) reported that elvers are common in the Barnegat Bay-Little Egg Harbor Estuary from February through April. Later juveniles are common year-round, while adults are rare.

Alewife (*Alosa pseudoharengus*) and Blueback Herring  
(*Alosa aestivalis*)

These two species are collectively called “river herring.” They are anadromous, entering brackish to freshwater to spawn and then migrating back to coastal areas. The alewife ranges from Labrador to South Carolina, and is most abundant in Mid-Atlantic and New England waters. The blueback herring occurs from Nova Scotia to Florida, but is most common from Chesapeake Bay south. The alewife usually spawns in mid-spring at water temperatures of 16-19°C. The blueback herring spawns later in spring at temperatures of ~5°C warmer. Both species enter the Delaware River Estuary as early as February and begin spawning runs. They also spawn in tributaries of Great Bay. Adult forms are reportedly abundant in the Barnegat Bay-Little Egg Harbor Estuary, and they spawn there in April and May, a time when eggs and larvae are also numerous. Adults are common in March and June, and juveniles are abundant year-round.

Adult blueback herring are observed from March through June. Spawning takes place from April through June, with eggs and larvae generally observed during these months. Juveniles are common year-round (Stone et al., 1994).

Spawning usually begins at age 3, preferably in shallow areas. The blueback herring favors areas with hard substrates and fast currents, whereas the alewife uses a variety of habitats, typically with slower currents. Many historical spawning areas are not presently available due to dams and/or pollution. Loss of these spawning and nursery grounds has undoubtedly been a major factor in the decline of herring stocks. However, where upstream habitats are suitable (e.g., good water quality), the installation of fish ladders at dams can effectively enhance the stocks of these important forage species. Alewives live as long as 10 years and reach a maximum length of 36 cm. Blueback herring, in turn, live 7 to 8 years and reach a maximum length of 33 cm (Bigelow and Schroeder, 1953).

Larvae of both species transform to juveniles at ~2 cm in length. The juveniles become similar in appearance to adults at ~3 cm. Larval river herring are planktivores, feeding selectively on small copepods and cladocerans. Juveniles consume larger plankton. The diet of adults includes fish eggs, small fish, plankton, bottom invertebrates (such as amphipods), and insects. When abundant, all life stages of river herring are important in food webs. Adults are a preferred prey of birds, whales, and many fish species, notably bluefish, striped bass, and weakfish.

### Bluefish (*Pomatomus saltatrix*)

In the western Atlantic, the bluefish ranges from Nova Scotia to Argentina. Bluefish occurring off the Mid-Atlantic and southeast U.S. coasts may belong to a single genetic stock. These fish spawn in offshore waters from March through August. Most bluefish are capable of spawning by age 2. Eggs and larvae generally remain in oceanic waters. Early juveniles (2 to 5 cm) move toward coastal and estuarine nursery areas by active swimming and/or passive movement with currents. The numbers of larvae reaching these nursery areas are quite variable and may be a key determinant of the subsequent abundance of larger juveniles and adults. Early-spawned fish enter Mid-Atlantic estuaries in late May to mid-June, at an average length of 6 cm. Fish spawned in summer either remain in coastal waters or enter estuaries in August when they are ~4.5 cm in length.

Bluefish are fast growing. Young-of-the-year fish may be 25-cm long by fall, and ultimately comprise the popular “snapper” fishery. Maximum size is ~1.1 m in length and 12.3 kg in weight. Maximum age is ~12 years. This predatory fish is usually found in schools of similar-sized individuals. There are seasonal migrations, with movement into Mid-Atlantic coastal and estuarine waters in the spring, and a return southward or offshore in the fall. The larger fish tend to move farther north in summer but perhaps not as far south in winter. Adults are common and juveniles are abundant in Great Bay and the Barnegat Bay-Little Egg Harbor Estuary from about May to November (Stone et al., 1994).

Larval bluefish mainly consume copepods. Fish appear in the bluefish diet when the larvae are slightly over 2.5-cm long, and soon become the main staple. However,

young bluefish may prey more on invertebrates, such as crustaceans and polychaetes, in some areas or seasons. The Atlantic menhaden (*Brevoortia tyrannus*) is a very important prey species for larger individuals. Mature bluefish, in turn, are consumed by sharks, tunas, and billfish. Oceanic birds are major predators of young-of-the-year bluefish. Some cannibalism has been reported.

The importance of specific estuarine habitats to bluefish stocks is not known. Since the egg and larval stages develop at sea, estuarine dependence is undoubtedly less than for species in which these sensitive stages occur inshore. The pelagic bluefish is also not closely tied to particular water depths, bottom types, or aquatic vegetation, though young-of-the-year fish tend to congregate in shallow nearshore areas. It does not appear to use marsh surfaces. Estuaries, and specific estuarine features such as marsh creeks, probably provide benefits in terms of shelter and abundant forage that leads to rapid growth, especially among young-of-the-year fish.

### Striped Bass (*Morone saxatilis*)

The striped bass, one of the largest fish species inhabiting estuaries, is a very popular gamefish. It also is highly valued commercially. Although this species has a natural range from the Gulf of St. Lawrence to the Gulf of Mexico, it has been



successfully introduced elsewhere, such as San Francisco Bay. Being anadromous, the striped bass lives in coastal and estuarine areas and enters fresh or low salinity waters for spawning, as well as egg and larval development. There are both migratory and non-

migratory stocks, with the former predominating in the Mid-Atlantic. Most of the Mid-Atlantic fish originate in Chesapeake Bay. The Hudson River also has an important spawning stock. Migrating stripers move north in the spring; many find their natal estuary to spawn, and then resume their northward coastal migration. The return migration occurs in the fall, with individuals overwintering in coastal areas from New Jersey to North Carolina, and in Chesapeake Bay.

Striped bass are not very abundant in Great Bay, Little Egg Harbor, and the back-bays to the south (i.e., Little Bay, Reeds Bay, Absecon Bay). Stone et al. (1994) reported that adults and juveniles are rare in Barnegat Bay from March through December. There are reports of stripers overwintering in the Barnegat Bay-Little Egg Harbor Estuary and in areas just outside of this system, as well as in Great Bay. Some striped bass have been counted in fish kills at the Oyster Creek Nuclear Generating Station.

There are no records of striped bass spawning in the Mullica River watershed. In the Delaware River Estuary, spawning is from early April to June at temperatures of 10-25°C, with peak activity generally from late April to early May at temperatures of 15-18°C. The semi-buoyant eggs are released over various substrates in shallow waters (< 6 m) with moderate flow rates ( $\geq 0.3$  m/s). Eggs and larvae are often concentrated in channels, whereas juveniles disperse throughout the estuary and use all depths as nursery areas, moving toward deeper, more saline areas as they grow. Most young-of-the-year fish (and some adults) overwinter in the estuary; however, individuals greater than 2 years of age often spend the winter in adjacent coastal waters. Most stripers reach sexual maturity at age 5 (Bigelow and Schroeder, 1953).

Striped bass may grow to ~10 cm in length by the end of their first summer and 30 cm or more by their second summer. They can grow to great sizes, with the maximum on record being over 1.8 m in length and 56 kg in weight. Most fish larger than 13.5 kg are females (Bigelow and Schroeder, 1953). The diet of small stripers is often dominated by amphipods and shrimp, whereas larger bass consume a wide variety of fish as well as worms, crustaceans, squid, and clams (Bigelow and Schroeder, 1953).

Commercial and recreational catches of striped bass declined drastically in the Mid-Atlantic region during the mid-1970s (Clark, 1998). The decrease in abundance was largely due to the very low production of juveniles in Chesapeake Bay from the early 1970s through the late 1980s. After declaration of a coastwide moratorium on commercial harvesting, juvenile production increased. This led to 1993 and 1996 juvenile indices that were the highest on record. When the moratorium ended, commercial landings had rebounded to 2.2 million kg in 1996. The stock was declared restored in 1995, and it is now considered fully exploited. There are no data on recreational landings of striped bass in the JCNERR.

#### Summer Flounder (*Paralichthys dentatus*)

The summer flounder (or fluke) is one of the most popular sportfish in the Mid-Atlantic region, and it is commercially important. The species ranges from Nova Scotia to at least as far south as Florida. It is found in estuaries to the outer continental shelf. The center of abundance of the summer flounder occurs from Cape Cod (MA) to Cape Hatteras (NC). It is unclear if summer flounder in the Mid-Atlantic region constitute a single stock; there may be a separate stock in the vicinity of Cape Hatteras and another in

the South Atlantic Bight. There are pronounced seasonal migrations, with most adults inhabiting inshore waters during the warmer months and wintering well offshore to depths as great as 150 m. In subsequent years, individuals tend to return to the same estuary or move north and east. Older fish may remain offshore year-round. Females reach sexual maturity at a size of ~28 cm, and males at a size of ~25 cm. The median age of sexual maturity in both sexes is 1.5 years (Packer and Greisbach, 2003). The species attains a maximum size of ~0.9 m and 6.7 kg. The largest individual on record is 11.7 kg.

Spawning takes place offshore, peaking in October and November, with females capable of producing more than 4 million eggs. The total number of eggs produced is size- and age-dependent. Eggs are pelagic and buoyant, and early larvae are planktonic. Later stage larvae and postlarvae migrate to coastal and estuarine nursery areas from October to May, where they complete metamorphosis to the typical flatfish form. Metamorphosis involves the migration of the right eye across the top of the head, and the widening and flattening of the body. It typically occurs when the larvae are between 0.64 cm and 1.91 cm long. After this transformation, they move to the bottom, bury in the sediment, and complete development to the juvenile stage. According to Stone et al. (1994), juveniles and adults are common in the Barnegat Bay-Little Egg Harbor Estuary from May through September, and juveniles are present but rare the remainder of the year. These life stages are common in the Mullica River-Great Bay Estuary. Larvae are rare, occurring in these systems from October through May.

Great Bay and Little Egg Harbor are valuable sources of shelter and food for intermediate stages of the species, especially metamorphosing larvae and early juveniles

(Rountree et al., 1992). Juveniles usually are found in sandy areas, adjacent eelgrass beds, among macroalgae, and in marsh creeks. Since these areas are vulnerable to perturbations, they have been identified by the Mid-Atlantic Fishery Management Council as habitat of particular concern in summer flounder management (Packer and Hoff, 1999).

The larval diet is dominated by immature copepods, and also includes tintinnids, bivalve larvae, and copepod eggs and adults. Toward the end of metamorphosis, the diet shifts toward benthic invertebrates. Small juvenile flounder less than ~10 cm long feed opportunistically on whatever suitable prey is available, consuming mostly crustaceans and polychaetes. Fish are more prominent in the diet of larger juveniles. For young-of-the-year summer flounder in marsh creeks of Great Bay and Little Egg Harbor, the most important prey are silversides, followed by mummichogs, grass shrimp, and sand shrimp. In other estuaries, mysid shrimp are also commonly consumed. Adults may forage on larger fish such as spot and pipefish. The likely predators of larval flounder include mummichogs and sand shrimp. Juvenile and adult flounder are probably consumed by the blue crab, spiny dogfish, goosefish, cod, sea raven, longhorn sculpin, fourspot flounder, as well as silver, red, and spotted hake.

#### Winter Flounder (*Pseudopleuronectes americanus*)

The winter flounder is a small-mouthed, right-eyed flatfish. It is valuable in both commercial and recreational fisheries of northwest Atlantic estuaries and continental shelf areas. The species prefers cool temperatures; its range is from Labrador to Georgia, with highest abundances in Canadian waters. The Federal Fishery Management Plan for

winter flounder considers the species to consist of three stocks: Gulf of Maine, Southern New England/Middle Atlantic, and Georges Bank stocks.

Except for Georges Bank fish, adults migrate inshore in fall and early winter, and spawn in late winter and early spring. In the Mid-Atlantic, the peak of spawning is February and March. Most adults return to offshore waters after spawning. Migrating adults sometimes travel long distances. In one tagging study, the average distance was ~65 km, and in another study, a fish tagged in the inner New York Bight was recovered ~315 km away near Nantucket, Massachusetts. South of Cape Cod, females become sexually mature at 3 years of age and an average length of 27.7 cm, and males at 3.3 years of age and an average length of 29.0 cm (Bigelow and Schroeder, 1953). Maximum length is ~63.5 cm, and the maximum age is more than 15 years. Stone et al. (1994) state that in the Barnegat Bay-Little Egg Harbor Estuary adults are abundant from November through April, and spawning occurs from January through March, with eggs and larvae being abundant at this time. Juveniles are abundant year-round. The winter flounder is also relatively abundant in Great Bay.

Except for the Georges Bank stock, the species is estuarine-dependent, requiring shallow, lower-salinity waters to spawn. Eggs adhere to various substrates including mud, sand, gravel, and vegetation. Eggs are ~0.3 cm in diameter when they hatch, typically in two to three weeks, with faster hatching times occurring at higher temperatures. Larvae are negatively buoyant. This probably enables them to be retained in greater numbers in suitable estuarine nursery areas rather than being swept out to sea. As they approach metamorphosis (which usually occurs 5 to 8 weeks after hatching), the larvae become increasingly bottom-oriented, feeding on copepods, copepod and barnacle

nauplii, polychaetes, and invertebrate eggs. Metamorphosing larvae settle on the bottom when they are ~1.3 cm in length.

Young-of-the-year winter flounder inhabit shallow waters of New Jersey's coastal bays, feeding on polychaetes and crustaceans, especially amphipods. Here, they may grow to 10 to 18 cm in length during the first year. Most of these fish overwinter in estuaries, but they are also commonly found in adjacent coastal waters. In some estuarine areas, there are restrictions on dredging from January 1 through May 31 to protect spawning and early life stages in these important habitats. Since winter flounder are visual feeders, they may be adversely affected by natural or anthropogenic factors that reduce water clarity. Large docks and other platforms may also impair feeding, perhaps by blocking or decreasing available light (Duffy-Anderson and Able, 1999)

#### Weakfish (*Cynoscion regalis*)

The weakfish ranges from Nova Scotia to Florida, with its center of abundance in Chesapeake Bay and Delaware Bay. It is estuarine-dependent, since all life stages are found in this environment. Spawning begins at water temperatures of ~15°C and generally peaks from mid-May through mid-June. Spawning occurs in 1-3 batches per season on sand and hard substrates throughout the lower estuary. Some spawning also occurs in coastal waters. Young-of-the-year weakfish appear by June and occupy nursery habitats in a wide range of temperatures and salinities in both the mainstem estuary and smaller tributaries and creeks.

The diet of young-of-the-year forms includes mysid shrimp, crabs, worms, and clams. Most weakfish mature by their second summer, when males are 12.7 to 15.2-cm

long and females 15.2 to 20.3-cm long. A 30.5-cm long fish is probably 2 years of age, and a 61-cm individual may be 9 years old. The largest weakfish on record is 7.9 kg, but fish heavier than 5.4 kg or longer than 1 m are rare (Bigelow and Schroeder, 1953). Adults are most abundant in lower estuarine areas at salinities  $\geq 15\%$ . Weakfish tend to occur in schools of like-sized individuals. Juveniles begin to migrate out of New Jersey estuaries in August, and by mid-November both juveniles and adults have left for offshore areas. They travel south to overwinter off Virginia and North Carolina. In the Barnegat Bay-Little Egg Harbor Estuary and Mullica River-Great Bay Estuary, adults are common from April through October, and then rare through November. Eggs and larvae are rare from May to August. Juveniles are common from May to November (Stone et al., 1994).

#### Blue Crab (*Callinectes sapidus*)

The blue crab is an abundant and ubiquitous member of estuarine nektonic communities along most of the East Coast of the United States (Millikin and Williams, 1980). It is a recreationally and commercially important species in the estuarine waters of the JCNERR. The life cycle of the blue crab is approximately 2 years from egg to adult, with an average lifespan of about 3 to 4 years. In the Mid-Atlantic region, mating occurs during the summer (June-September) throughout estuaries. Males may mate more than once within a mating season and may go through at least two seasons. In contrast, females have a single opportunity to mate, immediately after their final (terminal) molt to maturity (Van Engel, 1958), and most of them mate with only a single male (Jivoff, 1997). After mating, females migrate to higher salinity waters near the estuary mouth to

overwinter and eventually spawn (Van Engel, 1958; Schaffner and Diaz, 1988; Tankersley et al., 1998). Adult males and immature crabs remain in brackish waters of estuaries, burying in bottom sediments during the winter.

In the Mid-Atlantic region, spawning typically begins the following spring and may continue into the early fall, with females producing what appears to be two or three broods of eggs (McConaugha et al., 1983; Epifanio et al., 1984). However, if mating occurs in the late spring or early summer, females may be able to produce one brood of eggs later that same summer or fall (Millikin and Williams, 1980). Individual females can produce between 700,000 and 2,000,000 eggs per brood, with larger females typically exhibiting greater fecundity (Hines, 1982; Prager et al., 1990). Larvae are released into the water column and are transported out of the estuary by tidal currents to develop offshore over the continental shelf (McConaugha et al., 1983; Johnson and Hester, 1989; Epifanio, 1995).

On the continental shelf, blue crab larvae from different estuaries may mix (Cole and Morgan, 1978; McMillen-Jackson et al., 1994) before being transported back to the estuaries by wind and water circulation patterns (Epifanio et al., 1984, 1995; Johnson and Hester, 1989; Boylan and Wenner, 1993; Morgan et al., 1996). Once the first-stage crabs settle onto the bottom, they seek protective habitats such as seagrass beds (Heck and Thoman, 1984; Ryer et al., 1990; Morgan et al., 1996; Perkins-Visser et al., 1996). Juvenile crabs molt and grow rapidly, migrating away from high salinity waters into brackish waters, where they eventually mature (after 12-18 months) and mate.

## Sea Turtles and Marine Mammals

The JCNERR also supports several species of sea turtles such as the loggerhead turtle (*Caretta caretta*) and green turtle (*Chelonia mydas*), both federal-listed threatened species, as well as the



Kemp's Ridley turtle (*Lepidochelys kempii*) and leatherback turtle (*Dermochelys coriacea*), both federal-listed endangered species. These sea turtles occur in inshore waters from late winter through early spring. Marine mammals including the right whale (*Eubalaena glacialis*) and humpback whale (*Megaptera novaenangliae*), both federal-listed endangered species, and the finback whale (*Balaenoptera physalus*), a state-listed endangered species, have been reported off the coast throughout the year. The harbor porpoise (*Phocoena phocoena*), which has been proposed for listing as a threatened species, may also occur in JCNERR waters.

Avisar (2001) investigated the population structure of the northern diamondback terrapin (*Malaclemys terrapin terrapin*) in an unaltered subtidal creek (Schooner Creek) adjacent to Great Bay Boulevard in Tuckerton, New Jersey, during summer 2001. She also compared her results with those of Rountree and Able (1992) who surveyed the

northern diamondback terrapin population in the same creek during the 1988-1989 period. Avissar (2001) estimated that the population size of the northern diamondback terrapin was 119 individuals in Schooner Creek. In addition, she showed that the mean carapace length of the terrapins captured and measured in the 2001 survey (118.4 mm) was significantly less than that registered by Rountree et al. (1992) (154.3 mm) in their 1988-1989 survey. The largest individual recorded by Avissar (2001) was 190 mm compared to a maximum size of 250 mm registered by Rountree et al. (1992). This species is susceptible to vehicular mortality. For example, Hoden and Able (2003) documented a total of 77 adult female road-kill events along Great Bay Boulevard between 1993 and 2000. The loss of females due to such events is a cause of concern for the terrapin population structure in the area.

Szerlag and McRobert (2006) conducted extensive pit tagging of northern diamondback terrapins in marsh habitat and border areas of the JCNERR. They investigated the movements of the terrapins, and their susceptibility to mortality from vehicular traffic along Great Bay Boulevard to the edge of the estuarine habitat of Little Egg Harbor. They found that mortality of the terrapins from vehicular traffic was significantly greater in the first 4-km segment of the roadway east of the JCNERR Education Center, where the volume of vehicular traffic is greatest. Their study showed the potentially significant impact that human activities can have on terrapin populations in the reserve.

## ENDANGERED AND THREATENED SPECIES

### Overview

Appendix 21 provides a list of state- and federal-designated endangered and threatened species identified in the Mullica River-Great Bay Estuary and adjoining watershed areas. The federally-listed threatened plant, swamp pink (*helonias*



*bullata*) is found within the reserve. Several occurrences of the federally-listed threatened plant, Knieskern's beaked-rush (*Rhynchospora knieskernii*), have also been documented within the reserve boundaries, as well as those of the sensitive joint-vetch (*Aeschynome*), Seabeach Amaranth (*Amaranthus pumulis*), and American chaffseed (*Schwalbea americana*), all federally-listed as threatened plants.

The piping plover (a federally-listed threatened species) builds nests within JCNERR habitat, as do the protected bald eagle and the peregrine falcon. A state endangered reptile, the Timber rattlesnake, and several threatened and endangered sea turtles and other marine mammals also utilize land and waters protected within the reserve boundaries.

### Reserve Species

The Endangered Species Act of 1973 affords protection for endangered and threatened species, as well as their habitats. Since enactment of the Endangered Species Act, many animal and plant species have been protected; in some cases (e.g., bald eagle, *Haliaeetus leucocephalus*; peregrine falcon, *Falco peregrinus*; and alligator, *Alligator*

*mississippiensis*), impacted species have shown remarkable recovery. Candidate species, in addition to species of concern, are also a focus of state and federal programs to facilitate the conservation and protection of plant and animal species in the Mullica River watershed and elsewhere in New Jersey. Most species that become endangered do so as a result of anthropogenic factors, most notably the loss and alteration of habitat, overfishing and overhunting, introduced/invasive species, and interaction with domestic animals. Of these factors, habitat loss and alteration are most serious; hence, preservation of habitat remains the principal means of protection of these impacted species. Species

may become rare in the watershed and estuarine habitats of the JCNERR due to both natural events and anthropogenic activities (Fairbrothers, 1998). Habitat loss and alteration associated with anthropogenic impacts are



particularly troubling because the environment may be changed to such a degree that prospects for survival of some species may diminish significantly.

Because most areas within the Mullica River watershed are pristine or relatively undisturbed, suitable habitat exists for a diversity of fauna and flora. The New Jersey Natural Heritage Program recognizes several priority sites for biodiversity within the Mullica River-Great Bay system. The Batsto area and Little Egg Inlet are macrosites that

are recognized as having outstanding or very high biodiversity. Ballangers Creek, Clark's Landing Bog, Dan's Island, and Port Republic have also been recognized as sites of high biodiversity. These areas support an abundance and diversity of rare and federally-listed endangered, threatened, and candidate species in New Jersey, including plants, amphibians, reptiles, mammals, birds, fish, insects and other invertebrates. The Pinelands Comprehensive Management Plan also lists endangered and threatened species specific to the Pinelands region. Appendix 22 contains a list of federal-designated endangered and threatened species for the entire State of New Jersey.

The New Jersey Department of Environmental Protection (Endangered and Nongame Species Program), examining the status of rarity and endangerment, has compiled the following definitions of categories:

- **Endangered Species:** those species whose prospects for survival within the state are in immediate danger due to one or several factors, such as loss or degradation of habitat, over-exploitation, predation, competition, disease, disturbance, or contamination. Assistance is needed to prevent future extinction in New Jersey.
- **Threatened Species:** those species which may become endangered if conditions surrounding them begin to or continue to deteriorate. Thus, a threatened species is one already vulnerable due to small population size, restricted range, narrow habitat affinities, significant population decline, or some other factor.
- **Species of Special Concern:** those species that warrant special attention because of inherent vulnerability to environmental deterioration or habitat modification that would result in their becoming threatened. This category would also be

applied to species that meet the foregoing criteria and for which there is little understanding of their current population status in the state.

- Candidate Species: those species that appear to warrant consideration for addition to the federal list of endangered and threatened species.
- Stable Species: those species that appear to be secure in New Jersey and not in danger of falling into any of the preceding categories in the near future.
- Undetermined Species: those species for which there is not enough information available to determine the status.

The New Jersey Natural Heritage Program maintains information on state-listed species. It also chronicles the most up-to-date information on candidate species in New Jersey. The U.S. Fish and Wildlife Service reviews and evaluates the candidate species list which is regionally maintained.

Section 7(a)(2) of the Endangered Species Act 16 U.S.C. 1531 *et. seq.* requires federal agencies, in consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service (NMFS), to ensure that any action authorized, funded or carried out by the agencies is not likely to jeopardize the continued existence of any listed species or result in the destruction or adverse modification of critical habitat. NOAA consults with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service with regard to species listed under the Endangered Species Act.

## **SUMMARY AND CONCLUSIONS**

The JCNERR is one of the least disturbed coastal areas in the densely populated urban corridor of the northeastern United States, encompassing terrestrial, wetland, and

aquatic habitats almost entirely in public ownership. The upland portion of the reserve consists of extensive pine-oak forest, which serves as a protective buffer for the coastal habitats. Freshwater tidal marshes border tributary streams and headwaters of the Mullica



River. Brackish marshes occupy zones in the estuary where fresh and saltwater mix. Finally, extensive salt marshes dominated by cordgrass (*Spartina alterniflora*) occur along the margins of Little Egg Harbor, Great Bay, and lower Mullica River.

The seaward segment of the reserve consists of dunes, barrier islands, and open estuarine and nearshore ocean waters. These coastal regions serve as major migratory stopovers and wintering areas for many species of waterfowl, shorebirds, wading birds, raptors, and songbirds. Subtidal waters support thriving communities of plankton, benthos, finfish, and marine mammals. The open water boundary of the reserve extends nearly 10 km offshore, incorporating the Long-Term Ecosystem Observatory (LEO) of Rutgers University.

### **SWMP Water Quality Monitoring**

The JCNERR collects physical water quality and meteorological data using guidelines established by NERRS SWMP. The Institute of Marine and Coastal Sciences (IMCS) of Rutgers University manages the JCNERR, and Rutgers personnel have been

conducting research within this system since the 1950s. After acquisition of the RUMFS site on Great Bay in 1972, Rutgers compiled extensive data sets on physical-chemical and biological conditions of estuarine waters and surrounding watershed areas of the reserve.

The meteorological conditions of the region have been monitored continuously with measurements of air and water temperature, wind speed and direction, and rainfall at nearby Atlantic City from 1888 to the present. In addition, Rutgers has been monitoring water quality parameters (temperature, salinity, turbidity) at the RUMFS site within the JCNERR since 1976. Prior to designation of the JCNERR in October 1997, Rutgers University broadened its monitoring of water quality parameters in the Mullica River-Great Bay Estuary using 6-series YSI data loggers to record salinity, water temperature, dissolved oxygen, pH, turbidity, and depth. Since 1997, data loggers have recorded measurements on the parameters in 15-minute increments at four monitoring sites within estuarine waters of the reserve. This information has been helpful in assessing short-term and long-term episodic events in the system, including patterns of circulation and the effects of upwelling events detected on the inner continental shelf. These data have also been valuable for investigating the effects of upwelling on larval fish transport into estuarine waters of the reserve as well as the general patterns of species distribution within the system.

A suite of environmental parameters is monitored every 15 minutes at these stations (i.e., temperature, salinity, DO concentration, DO percent saturation, depth, pH, and turbidity at the water monitoring stations; temperature, humidity, atmospheric pressure, wind speed and direction, solar radiation, and precipitation at the weather monitoring station). Nutrient chemistry is also monitored at each of the four SWMP

water quality monitoring stations on a monthly basis. Two of these stations (Chestnut Neck and Buoy 126) have been equipped with telemetry equipment that broadcasts water quality data to a GOES satellite, which is then posted to the World Wide Web.



Meteorological data are collected by a Campbell Weather Station located at the Richard Stockton College Marine Science and Environmental Field Station at Nacote Creek. This meteorological station is unique in that it has two collection platforms (at 10 m and 19 m elevation) for wind speed and direction, and all data are available in real time at the Institute of Marine and Coastal Sciences website (<http://marine.rutgers.edu>). This station has been collecting SWMP meteorological data since September 2002.

Meteorological parameters are measured every 5 seconds to produce 15-minute averages of air temperature, relative humidity, barometric pressure, rainfall, wind speed and wind direction. An instantaneous sample is taken every 15 minutes. Telemetry equipment was installed at the Nacote Creek Meteorological station on November 15,

2005, and it transmits data to the NOAA GOES satellite, NESDIS ID #3B00D112. The transmissions are scheduled hourly and contain four data sets reflecting 15-minute sampling intervals. By this process, the JCNERR effectively contributes to the Integrated Ocean Observing System (IOOS).

A major goal of JCNERR SWMP is to identify and track short-term variability and long-term changes in the integrity and biodiversity of estuarine waters and coastal watersheds for the purpose of contributing to effective site specific coastal zone management. Data collected in SWMP can be used to: (1) support state-specific non-point source pollution control programs by establishing local networks of continuous water quality monitoring stations in representative protected estuarine ecosystems; and (2) to help develop a nationwide database on baseline environmental conditions in the NERR system of estuaries.

The JCNERR program currently submits data to the CDMO for 4 sites within its system (Lower Bank, Chestnut Neck, Buoy 139, and Buoy 126). The long-term water quality monitoring sites in the Mullica River-Great Bay Estuary extend from the freshwater/saltwater interface at Lower Bank, down the Mullica River to the polyhaline waters of the lower estuary, covering a distance of nearly 35 km.

Physical-chemical data are also collected at LEO located on the inner continental shelf. Continual observations of coastal ocean processes are collected via two instrumented platforms (known as Node A, 74°15.73'W, 39°27.70'N and Node B, 74°14.75'W, 39°27.41'N) anchored to the sea floor and spaced 1.5 km apart. Optical fibers transfer data to computers at the Rutgers University Marine Field Station in 1-second intervals. These data are fed to the Internet and immediately made available at the

Rutgers University Coastal Ocean Observation Laboratory. The nodes support sensors that monitor an array of parameters such as temperature, salinity, dissolved oxygen, and chlorophyll.

### **Mullica River-Great Bay Estuary**

The estuarine waters of Great Bay have been traditionally pristine and free of excessive nutrient loading and chemical contaminants from anthropogenic sources. This is due to the fact that there is very little development or industry within the watershed drainage basins and their tributaries. The lower part of Great Bay had received significant nutrient loading from a menhaden fish-processing factory, which operated along the northern perimeter of the bay from the early 1930s to the early 1960s. However, this area is no longer influenced by nutrient enrichment.

The Mullica River is relatively deep, ranging from 5 to 9 m in depth in the section that is monitored by JCNERR data loggers. Great Bay averages about 2 m in depth at mean low water. The river also has a dark coloration due to naturally occurring tannins and humic acid compounds originating in the New Jersey Pine Barrens. The depth of the river and the dark color of the water limit light penetration, and therefore nutrients entering the river upstream are not effectively utilized by phytoplankton. Light begins to penetrate where the river and bay waters converge, enabling the phytoplankton to thrive and increase in



production in the bay.

Inorganic nitrogen levels are low relative to those of organic nitrogen, which reach 40  $\mu\text{M}$  or more during the summer months. Phytoplankton production in Barnegat Bay approaches 500  $\text{gC}/\text{m}^2/\text{yr}$ , reaching maximum levels in summer. This production is high relative to other coastal bay systems. More than 240 species of phytoplankton have been identified in the Barnegat Bay-Little Egg Harbor Estuary. Phytoplankton blooms are common in JCNERR estuaries, with significant diatom and dinoflagellate blooms occurring during most years. Picoplankton, brown-tide (*Aureococcus anophagefferens*) blooms, which occurred during most summers between 1995 and 2002, may be more problematic because of their potentially adverse effects on vital seagrass and shellfish beds.

Production of benthic flora is also significant in JCNERR waters. For example, SAV beds consisting of eelgrass (*Zostera marina*) and widgeon grass (*Ruppia maritima*) are extensive in Little Egg Harbor. Great Bay and the back-bays to the south are devoid of seagrass but support prolific populations of macroalgae, such as *Ulva lactuca*, *Agardhiella subulata*, *Ceramium fastigiatum*, and *Gracilaria tikvahiae*. Both the seagrass and benthic macroalgae provide habitat for numerous benthic and nektonic organisms.

Zooplankton communities in the system consist of large populations of microzooplankton, macrozooplankton, and ichthyoplankton. Copepods (*Acartia hudsonica*, *A. tonsa*, *Eurytemora affinis*, and *Oithona similis*) dominate the microzooplankton, whereas hydromedusae, comb jellies, and true jellyfishes dominate the macrozooplankton. Meroplankton and ichthyoplankton comprise significant

components of the total zooplankton, particularly during the warmer months of the year from June through September.

More than 140 benthic invertebrate species have been recorded in the Mullica River-Great Bay Estuary. Higher species richness (>200 benthic invertebrate forms) have been identified in the Barnegat Bay-Little Egg Harbor Estuary. While nearly all phyla are represented, the most abundant taxa include the polychaetes, bivalves, gastropods, and crustaceans. Along a well-defined salinity gradient of the Mullica River-Great Bay Estuary, four distinct assemblages of benthic invertebrates are evident, notably river-dominated, bay-dominated, lower-bay dominated, and estuary-wide forms. The relative concentrations of silt-clay and sand in bottom sediments strongly influence the local distribution of benthic invertebrates in JCNERR estuaries.

More than 60 species of fish have been identified in Great Bay compared to more than 100 species of fish in the Barnegat Bay-Little Egg Harbor system. Five fish assemblages are recognized, including resident species, warm-water migrants, cool-water migrants, marine strays, and freshwater strays. Species richness and absolute abundance peak during the summer months, primarily due to the influx of warm-water migrants. Estuarine habitats in the New Jersey coastal bays are heavily utilized by fish as spawning, nursery, and feeding grounds. A number of fish species are recreationally or commercially important, such as summer and winter flounder, bluefish, striped bass, and weakfish.

JCNERR estuaries and coastal waters also support a wide variety of sea turtles (e.g., loggerhead-, leatherback-, and Kemp's Ridley turtles) and marine mammals (e.g., humpback-, finback-, and right whales; harbor porpoises, and harbor seals). Several

turtles and marine mammals occurring in JCNERR waters are listed as threatened or endangered species. The northern diamondback terrapin (*Malaclemys terrapin terrapin*) is susceptible to road kill and other anthropogenic impacts.

The JCNERR lies along the Atlantic Flyway and thousands of migrating birds utilize habitats in the reserve as staging and overwintering areas. Gulls, terns, waders, rails, and raptors are well represented in reserve habitats. Songbirds, waterfowl, and seabirds have been censused from upland watershed areas to the barrier islands along the seaward boundary. Nearly 170 species of birds were registered along Great Bay Boulevard and the adjacent open estuarine waters of the JCNERR over a 13-year study period.

### **Current Research**

The JCNERR is conducting a number of studies on nutrient processes in its estuarine waters. For example, studies have compared atmospheric nitrogen data with results of water column nitrogen levels to demonstrate that both sources may contribute to seasonal algal blooms in the Mullica River-Great Bay Estuary. An atmospheric sampling platform located at RUMFS is providing atmospheric deposition data for the immediate area of Great Bay with the long-term goal to establish a nutrient budget for the Mullica River-Great Bay Estuary.

Innovative studies of phytoplankton biomass are being conducted using experimental deployment of a HOBI Labs Hydroscatt-2 backscatter fluorometer at moored sites in Great Bay. The use of a spectral backscatter-fluorometer enables chlorophyll *a* levels to be measured in a more automated manner and to be related to

phytoplankton rate processes. The objective is to generate an optical, nearly continuous time series of measurements on phytoplankton biomass at specific estuarine sites that can be correlated with changes in water quality (e.g., nutrients) measured by the aforementioned methods.

Investigations are also being conducted on larval settlement and dynamics of the epibenthic organisms in estuarine waters of the JCNERR and neighboring systems. Artificial substrates of different composition are being deployed at various sites to determine the development and structure of the epibenthic community. The deployment of aluminum, plastic, and PVC settling plates are yielding considerable data on the settlement, recruitment, and post-recruitment success of epibenthic organisms in estuarine waters of the JCNERR.

Soft-bottom benthic community sampling is also being conducted in the JCNERR to assess the benthos in the system. Both sediment and biotic samples are being collected using a Van Veen grab. More than 50 permanent benthic sampling stations have been established in Great Bay and lower Mullica River to examine the benthic habitats and community of organisms. Results of this sampling program will be compared to those of earlier investigations on the benthos conducted during the 1960s. The purpose is to delineate changes in the sediment regime and benthic community over the past 40 years.

Side-scan sonar imaging of the seabed in Great Bay has been



completed using an autonomous underwater vehicle. This project was initiated to document the complex and multi-scaled bedforms and associated benthic habitats in the bay. Small-, medium-, and large-scale bedforms (i.e., ripples, dunes, and sand waves) have been imaged and assessed as potential habitat for benthic invertebrate and finfish populations.

Shellfish are likewise being targeted, particularly the recreationally and commercially important blue crab (*Callinectes sapidus*) and hard clam (*Mercenaria mercenaria*). Studies are focusing on the effects of habitat quality in JCNERR estuaries on the dynamics of these species. This work is designed to better understand how different habitats affect the abundance, population characteristics, and mortality of these economically important species. Anthropogenic influences on the shellfish populations are being examined.

Biomonitoring projects are being conducted in Little Egg Harbor to determine the changes that occur in demographic characteristics of SAV populations (*Zostera marina* and *Ruppia maritima*) during an annual growing period. This work is addressing the following questions to document variability of SAV beds in this important JCNERR coastal bay:

- What quantitative changes take place in aboveground and belowground biomass, shoot or stem density, and maximum canopy height of SAV beds over a growing season?
- How variable is the percent cover by seagrass and macroalgae within the field survey areas? Is seasonal dominance evident among the species? Are shifts in spatial distribution of the SAV species significant within a growing season?

- Do the SAV bed boundaries expand, contract, or remain unchanged over a seasonal sampling period?
- Where is the maximum species abundance observed in the sampling segments and can this abundance be related to specific environmental factors?
- Can the surveys differentiate natural variability of the SAV from that induced by anthropogenic activities?

The project has been designed to respond to multiple coastal management needs. SAV beds are recognized as essential biotic habitats that receive special consideration in New Jersey.

Much of RUMFS research in the JCNERR is focused on the study of the early life history and ecology of fishes, many of which are important to commercial and recreational fisheries in the region. Using plankton nets during evening flood tides, RUMFS has monitored ichthyoplankton occurrence and abundance within the reserve since 1989. Long-term monitoring of juvenile fishes in the Mullica River-Great Bay Estuary began with the use of traps in 1990, and otter-trawls in 1988. These data have proved invaluable to fisheries managers and scientists for determining habitat preferences of fish and decapod crustaceans and annual fluctuations in abundance.

Researchers at RUMFS have investigated the migration dynamics of striped bass, an anadromous species of substantial ecological, recreational and commercial importance to the Middle Atlantic Bight, by providing information on their rate, seasonality, path of movement and behavior during movement. Striped bass tagged with individually coded acoustic transmitters are being monitored with strategically located hydrophone receivers that complement existing instrument packages which measure various physical

parameters in the coastal ocean and adjacent estuaries of the JCNERR. This study has important consequences for the implementation of a unified, coast-wide census of marine life, and the management of this keystone species at a period of maximum stock size.

RUMFS scientists and staff are also involved in studies evaluating essential fish habitat and juvenile fish recruitment on the inner continental shelf and in the estuarine waters of the JCNERR. Research approaches to these topics include submersible dives, habitat mapping with multibeam and side-scan acoustic systems, and otolith extraction. The adjacent Mid-Atlantic Bight has likewise been the focus of intensive surveys for all fish life history stages by the National Marine Fisheries Service (NMFS) during the last 25 years.

Two research projects completed within the reserve in 2000 included a three-year assessment of the effects of sea scallop fishing gear on juvenile fish habitat on the continental shelf off New Jersey, and a study on bluefish habitats and movement in the coastal ocean off New Jersey. In 2000, researchers began investigating the impacts of docks and piers on submerged aquatic vegetation. A variety of benthic data has been amassed including annual surveys of surf clam population densities, length/frequency analysis, and juvenile recruitment at stations within the 4.8-km limit along the New Jersey coast.

In addition to monitoring activities in the reserve, investigators are involved in restoration activities along Delaware Bay. This research parallels initiatives of NERRS that focuses on restoration in estuarine ecosystems. Projects have included monitoring and evaluation of fish and decapod use of former salt hay farms, which have recently been exposed to tidal inundation, and *Phragmites comminus* dominated marshes, which

have been treated to restore natural vegetation. The latter was complemented with work in the brackish reaches of the JCNERR addressing the invasion of *Phragmites* on these undisturbed marshes.

The IMCS Division of Pinelands Research and the Pinelands Commission have engaged in multidisciplinary studies dealing with applied research problems in the area, including mycorrhizal community functioning, soil biodiversity, and forest fire frequency effects on habitat nutrient sustainability. The Richard Stockton College of New Jersey, one of the Mullica River landowners, has monitored harbor and gray seals that have been frequenting Great Bay in recent years.

Investigations of land use/land cover change in the Mullica River watershed are also being conducted. These investigations are providing documentation via a Geographic Information System (GIS) on how the terrestrial land within the watershed draining into the reserve is being changed/developed. Some of the parameters of study include impervious surface, population, and amount of altered land. Future investigations will deal with assessment of the amount of marsh that has been developed or diked for mosquito control. The amount of change in the physical structure of the marsh habitat will also be examined. Finally, applications of remote sensing to detect harmful algal blooms in the reserve are also under investigation.

An analysis to quantify the amount of development at build-out has been completed for the Mullica River watershed at the Center for Remote Sensing and Spatial Analysis at Rutgers University. A similar project for the Barnegat Bay watershed was previously completed. The build-out analysis uses a GIS-based approach, enabling

investigators to create a spatially explicit model to examine potential changes in specific areas of the watershed.

To create a base layer of commercial and urban areas for the build-out analysis, land use for the Mullica River watershed has been updated using spot aerial photography and compared to existing land use and land cover data from 1995. Areas of new growth have been documented, and a large percentage of data has been field-checked for accuracy.

Several new data layers have been incorporated into the JCNERR GIS database, including 1930 black and white aerial photography for Ocean County, a 10-meter digital elevation model from the New Jersey Department of Environmental Protection (NJDEP), environmentally sensitive index data, and NJDEP brown-tide data. In addition, SWMP data collection points, 2000 land cover data, spot satellite imagery (from NOAA Coastal Services Center), 2000 census data, historical topographic maps from 1890, and many more data sources have been processed.

Future development in the Mullica River watershed has been determined based on the location of existing development, land permanently protected as open space, municipal zoning rules, the Pinelands Management Plan, and wetlands and coastal zone regulations. The potential impacts of the predicted development on the water resources have been identified using the number of dwelling units and population as indicators of residential water demand and impervious surface as an indicator of non-point source pollution. By understanding potential changes in these indicators, investigators can better identify key actions needed to protect resources in the watershed. This work will enable coastal decision makers to improve the management of natural resources in the reserve.



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Zimmer, B. J. 1981. Nitrogen Dynamics in the Surface Water of the New Jersey Pine Barrens. Ph.D. Thesis, Rutgers University, New Brunswick, New Jersey. 317 p.

**Appendix 1. List of Graduate Research Fellows awarded in the Jacques Cousteau National Estuarine Research Reserve.**

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**Tenley Conway** (2001) Integrating land use change models and stakeholder models into a framework for coastal management.

**Jennifer Haag** (2004) Atmospheric deposition of nitrogen at Great Bay, New Jersey.

**Inga La Puma** (2007) Assessment of land use and disturbance scenarios in the Jacques Cousteau National Estuarine Research Reserve watersheds using spatial modeling.

**Edward Martino** (2002) Spatial variation in fish and decapod crustacean abundance and diversity within tidal creeks along an estuarine physicochemical gradient at the Jacques Cousteau NERR in Mullica River-Great Bay Estuary.

**Amanda McGuirk** (2003) Bioavailability of particulate phosphorus in estuarine systems: a comparison between pristine and polluted sites in Jacques Cousteau National Estuarine Research Reserve.

**Melissa Neuman** (1997) Effects of upwelling on larval occurrence and abundance in the Mullica River-Great Bay Estuary.

**Dana Rowles** (2003) An evaluation of summer flounder (*Paralichthys dentatus*), coastal habitat use, and dynamics comparison between migration and summer residence in the Jacques Cousteau National Estuarine Research Reserve.

**Gregg Sakowicz** (2001) Essential fish habitat for marsh fishes: behavioral ecology of larval and juvenile *Fundulus heteroclitus* and *Cyprinodon variegates*.

**Jamie Tirado** (2005) Biomass changes in seagrass epiphytes in a New Jersey shallow coastal bay system.

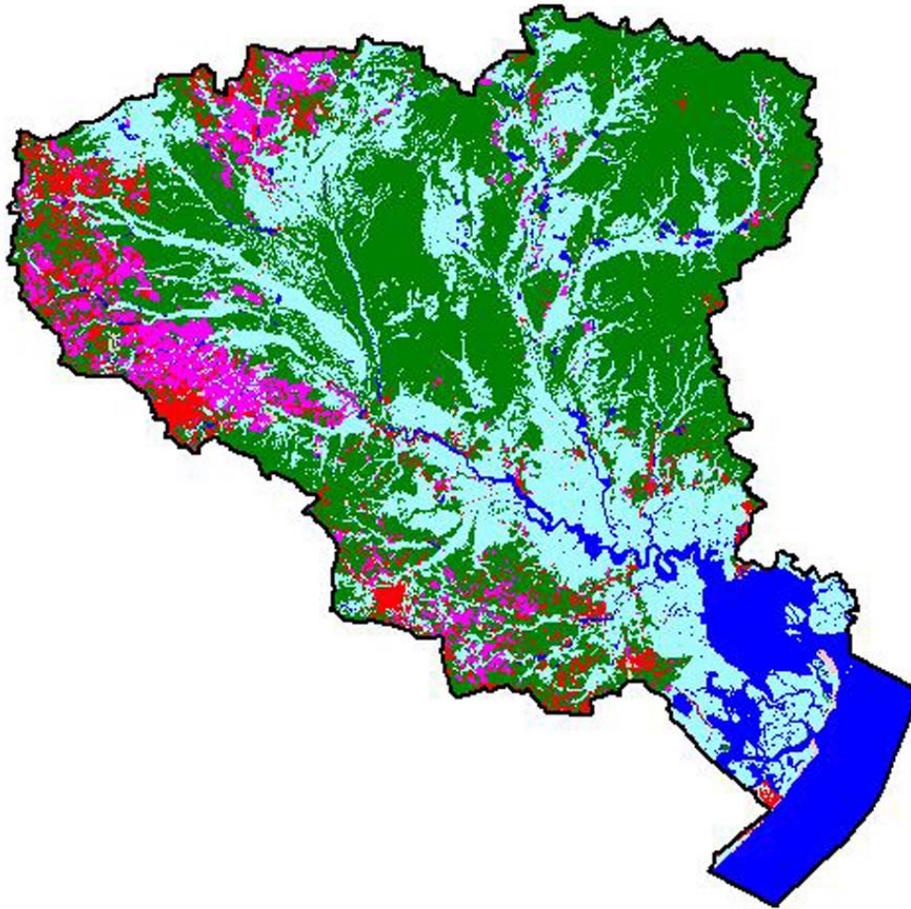
**Jason Turnure** (2007) Delineating habitat resources for weakfish, *Cynoscion regalis*: biotelemetry and passive acoustic approaches.

**Tracy Wiegner** (1999) Organic nitrogen from freshwater wetlands in the Jacques Cousteau NERR at Mullica River and Great Bay.

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## Appendix 2. A Build-out Analysis of the Mullica River Watershed

Changing Land Use in the Mullica River Watershed: Past and Future Trends.  
*1986 - 1995 - 2000 - Buildout*



Richard Lathrop  
Scott Haag  
Tenley Conway  
March 2003

CRSSA Technical Report  
Grant F. Walton Center for Remote Sensing & Spatial Analysis  
Cook College - Rutgers University  
New Brunswick, NJ 08901

## ABSTRACT

The Mullica River Watershed is located in the Pinelands ecosystem and currently contains a high percentage of unaltered land. However, due to its close proximity to the Atlantic City, Philadelphia, and New York City metropolitan areas there is great potential for further development. We were interested in determining the potential impact of past and future development on water resources. The project has three parts: (1) identifying past land use; (2) determining the potential of future development; and (3) using indicators to assess the impacts of the past and potential future development on water demand and urban non-point source pollution. While there is currently little development in the watershed, our analysis indicates that a substantial portion of the land is available for future development. However, if growth is limited to the designated Pinelands' growth areas, the impacts to water resources will be minimized.

## INTRODUCTION

The Mullica River Watershed, located in southeastern New Jersey (Figure 1), is part of the Pinelands ecosystem. The Pinelands are characterized by highly sandy acidic soils, a frequent fire regime, and a pine-oak dominated upland forest. Approximately 940,000 acres in size, the Pinelands stretch from the northern reaches of Ocean County to Cape May County. The Pinelands became the first National Reserve in 1978 and received international attention in 1983 when it was designated as an International Biosphere Reserve. Today, the Pinelands Commission regulates new development within the administrative boundaries of the New Jersey Pinelands Management Areas, approximately two-thirds of the Pinelands region. Eighty-two percent of the 420,000 acre Mullica River Watershed is within the Pinelands Management Areas. However, much of the watershed is potentially prime residential and commercial land due to the close proximity of Atlantic City, Philadelphia, and New York City. Additional development would not only alter the terrestrial ecosystem, but also has the potential to negatively impact groundwater and the downstream estuary.

The goal of this project was to identify land use trends and determine the potential impact of past and future development on water resources. There were three parts to the analysis. First, past land use was identified from existing datasets and updates completed using satellite imagery. Second, future growth potential was determined through a build-out analysis, based on the location of existing

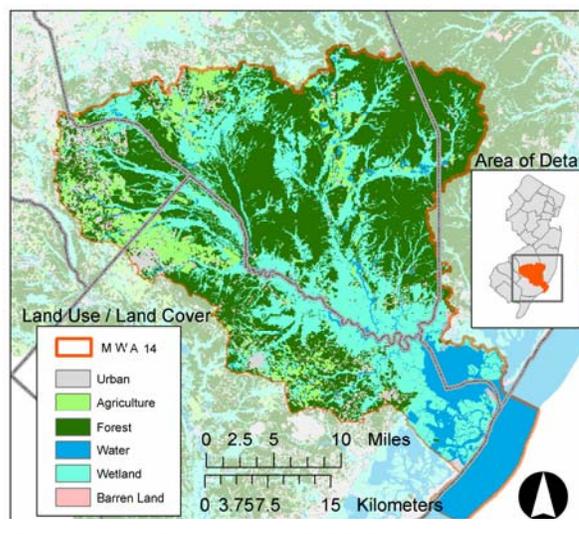


Figure 1. WMA 14 NJDEP Land Use / Land Cover 1995.

development, permanently protected open space, and applicable regulations. Several different scenarios were examined, including low constraint and high constraint analyses. The third part of the project examined the potential impacts past and future urban development might have on water resources using the number of dwelling units and population as indicators of residential water demand and impervious surface as an indicator of urban non-point source pollution. By understanding potential changes in these indicators, we can better identify actions needed to protect the water resources of the Mullica River Watershed.

## **METHODS**

To map land use and future developmental pressures in the Mullica River Watershed we used a Geographic Information System (GIS). GIS enables the creation, manipulation, and analysis of digital spatial data, allowing us to examine the location of past and future change. The Mullica River Watershed boundary used by the New Jersey Department of Environmental Protection (NJDEP) defined the spatial extent of the analysis.

### **Past Land Use**

The NJDEP dataset of land use and land cover (LULC) was used to determine land use in 1986 and 1995 (Appendix 1). The LULC dataset is based on the interpretation of one meter color infrared photography, allowing a minimum mapping unit (MMU) of one acre and fine scale differentiations between LULC classes based on Anderson levels one through four. To update this dataset, we created a GIS data layer of land use in 2000, by comparing SPOT satellite panchromatic images (10 meter ground resolution cell) obtained in 2000 with the 1995 -1997 color infrared aerial photography flown by the United States Geological Service. Areas of change were on-screen digitized using ESRI GIS software. The large pixel size for the satellite sensor dictated a MMU of 1000 sq meters, approximately one quarter of an acre. A much simpler method was used to categorize altered or changed areas as compared to the NJDEP approach. Polygons were coded as urban, agriculture, or barren/ grassland. Urban areas identified included all new commercial and residential structures. Using only the satellite data, distinctions between multiple houses and single houses could be determined based on the relative size and shape of the development (Appendix 2), but differentiating between residential and commercial areas was not possible without ancillary data. New agriculture represents all new areas that are actively being farmed, determined by shape, size, and relative proximity to existing agriculture. Barren and managed grassland were grouped together because of the difficulty in differentiating between them using the satellite imagery (Appendix 2).

### **Build-out Analysis**

Once we identified past land use, we were interested in examining the potential for future development. We used a build-out analysis to map potential future development across the landscape under specific sets of constraints. The scope and location of future urban development is identified in this type of analysis, although timing of development is not predicted. The build-out was created using a grid environment, with a five-meter grid cell length, due to ease of computation. Appendix 1 lists the data layers used.

To locate developable land we excluded land already developed, wetlands, preserved open space, parcels with severed developmental rights, and buffer zones around water bodies and wetlands. The buffer zone width was determined based on our interpretation of NJDEP regulations and the Pinelands Management Plan. The buffer ranges from no buffer to 300 feet, depending on the size of the wetland, surrounding land uses, whether threatened or endangered species are present, and if the wetland is located within a Pinelands Management Area. The remaining land was assumed to be available for development in this analysis.

Four build-out scenarios were created:

1. Low constraint scenario (LC) representing current regulations. The current regulations included in this scenario were (1) limitation on development in wetlands or buffer zones around freshwater and tidal areas as specified under the NJDEP's Freshwater Wetlands and Coastal Programs, (2) municipal zoning regulations, and (3) Pinelands Area regulations.

2. High constraints scenario one (HC1) is the same as LC except that areas without sewer service are forced to have a minimum lot size of 3.2 acres. This lot size was chosen as the Pinelands Commission determined 3.2 acres was the smallest lot that could support a septic system without negative impacts in the region (Pinelands Commission 1982). This scenario does not take into account the Pinelands' pilot septic program that is testing new technologies that would make it possible to support septic systems on smaller lots. However, HC1 is similar to current activities guided by Executive Order 109 (Springer 2002), and the recently defeated Watershed Management Rules (NJDEP 2001a) meant to replace the temporary situation of the Executive Order.

3. High constraints scenario two (HC2) is the same HC1 with an additional constraint on the maximum impervious surface allowed based on the 2000 Coastal Zone Management Rules (NJDEP 2001b). These rules use the state planning designations to define limits on the maximum impervious surface in a given area (Table 2). Current centers and zone designations were included in the HC2 scenario. Only a small percentage of the watershed area (3%) is affected by the CAFRA rules because most of the watershed is in the Pinelands Management Area, which is not covered under these rules.

4. High constraints scenario three (HC3) is the same as the HC2 scenario except maximum impervious surface limits were applied using current and proposed town centers.

**Table 2.** Maximum impervious surface cover allowed in the CAFRA planning areas.

| Planning Area              | Maximum Impervious Surface Cover | Percent of Watershed in Each Planning Area |
|----------------------------|----------------------------------|--|
| Metropolitan               | 80 %                             | 0.02 %                                     |
| Suburban, Sewer Service    | 30 %                             | 0.87 %                                     |
| Suburban, No Sewer Service | 5 %                              | 0.37 %                                     |
| Rural                      | 5 %                              | 0.60 %                                     |
| Environmentally Sensitive  | 3 %                              | 2.18 %                                     |

\*For the percent equation the total area of the Mullica River Watershed was 373,471 acres. Water areas were not included.

### Indicator Analysis

To assess the impacts of future development on water resources, two indicators were used. The number of dwelling units and population were calculated as indicators of residential water demand, while impervious surface was used as an indicator of urban non-point source pollution. Indicator values for past conditions were calculated to compare with build-out estimates.

**Dwelling Units and Population** A growing population can negatively impact the region’s water resources, as a larger population requires a larger supply of freshwater. We focused on residential water demand in this analysis because most land use conversions have been and are predicted to be from forest to residential uses. If the population continues to increase, the demand for potable freshwater could exceed the sustainable supply. Thus, it is important to understand the potential size of the population at build-out.

To determine the past population of the Mullica River Watershed census block data from 1990 and 2000 were used. The census block data were combined with the NJDEP LULC data for 1995. If the census block was completely within the Mullica River Watershed all of the population was counted. For census blocks that overlapped the watershed boundaries, a percentage of the population was added relative to the percentage of total residential area of the specific block that falls within the Watershed. For example, census block number 3879 has a 2000 population of 184 people. Eight-four percent of the residential areas of this census block in 1995 were located within the Watershed’s boundaries, so 84.2 percent (155 people) of 182 people are considered within the watershed.

Build-out population estimates were based on the number of dwelling units. To estimate the number of dwelling units, areas that could be developed were combined with digital zoning density information supplied by the Pinelands Commission and the municipalities with land outside the Pinelands Management Areas (Appendix 1). We assumed that only 80 percent of the land in each polygon could be used for building lots to account for land needed for public infrastructure. While 80 percent is the value currently used by planners in the region (McKeon, 2001), it is likely that in areas with low density zoning a smaller percentage of the land must be reserved for infrastructure. The building lot area was then divided by the maximum zoning density to determine the number of dwelling units per polygon. The number of dwelling units was then rounded down to reflect the impossibility of building a fraction of a dwelling unit. The number of predicted dwelling units was multiplied by the average number of people in a dwelling unit based on the 2000 census for the Watershed to determine the total predicted increase in population at build-out. Transfer of development rights, which could result in higher density development in certain areas, was not considered. However, the ability to transfer development rights does exist in the Pinelands Management Area, and may impact the density of future development.

In order to assess the validity of the build-out scenarios, the same methods used to calculate the number of dwelling units at build-out were applied to estimate dwelling units in 2000. The calculation was only completed for the census blocks that were completely within the Mullica River Watershed. The number of predicted dwelling units was then multiplied by average number of people per dwelling unit in 2000 (2.46 people per dwelling unit) to get an estimated population. This number was compared to the 2000 census numbers, and is discussed in the results section.

***Impervious Surface*** When land is converted to urban uses, there are physical, chemical, and biological impacts on water quality (Zandbergen 1998). Impervious surface has been proposed as an accurate measure of non-point source pollution from urban run-off and a general indicator of watershed health (Soil Conservation Service 1975; Klein 1979; Arnolds and Gibbons 1996; Wang 2001). Impervious surface refers to streets, sidewalks, driveways, roofs, patios, and other impenetrable surfaces. Areas that are more intensely developed tend to have a larger percentage of impervious surface cover, contributing more non-point source pollution to the water in the watershed. Thus, impervious surface is an important environmental indicator of the intensity of human land use and closely correlates with water quality degradation and altered runoff patterns in urban and urbanizing areas (Novotny and Chesters 1981; Brown 1988; Driver and Troutman 1989; Ferguson and Suckling 1990; Arnold and Gibbons 1996; Charbeneau and Barrett 1998).

In compiling data from a number of watersheds, Arnold and Gibbons (1996) developed a set of impact thresholds: (1) less than 10 percent impervious surface cover can be considered non-impacted; (2) between 10 and 30 percent cover can be considered impacted; and (3) greater than 30 percent cover is generally considered degraded. While these thresholds should not be considered 'hard and fast' breakpoints, they do provide a useful guide in evaluating the comparative risk of water quality degradation at a watershed scale.

The NJDEP estimated impervious surface for 1986 and 1995 based on the LULC dataset. Build-out estimates were determined by calculating the average amount of land covered by impervious surface for each zone. There is an inverse relationship between lot size and the percent of the lot covered by impervious surface. However, large lot development creates more per capita impervious cover. For the largest lot size (70 acres) the impervious surface cover was estimated at one percent, while the smallest lot size (0.08 acres) had an average impervious cover of 43 percent. The average amount of impervious surface by zoning density was applied to the build-out scenarios to determine the potential impervious surface at build-out.

## RESULTS

### Past Land Use

Table 3 shows land use in 1986, 1995, and 2000. A total of 370,571 acres, 88 percent of the watershed, was in a natural or unaltered state in 1986, making the Mullica River Watershed one of the most pristine watersheds in New Jersey. Since 1986, little change has occurred on the unaltered lands. Although 2,400 acres of forest and 300 acres of wetlands were lost between 1986 and 2000, this represents only 0.7 percent of the total watershed. Of this loss, most conversions from natural to altered land were from forest to urban land uses.

**Table 3.** Land use/ land cover in 1986, 1995, and 2000.

| <i>Land Cover</i> | Acres 1986 | Acres 1995 | <i>Acres 2000</i> | <b>Percent change 1986 to 2000</b> |
|-------------------|------------|------------|-------------------|------------------------------------|
| Agriculture       | 25,753     | 24,358     | 24,389            | -5.3 %                             |
| Barren Land       | 2,666      | 2,459      | 2,799             | +5.0 %                             |
| Forest            | 188,988    | 187,735    | 186,581           | -1.3 %                             |
| Urban             | 20,926     | 23,824     | 24,736            | +18.2 %                            |
| Water             | 46,311     | 46,444     | 46,441            | -0.2 %                             |
| Wetlands          | 135,276    | 135,096    | 134,970           | -0.3 %                             |

Traditionally the Pinelands were thought of as a wasteland due the poor nutrient content and high acidity of the soil which hindered agricultural efforts. Today specialized agriculture exists mainly through the domestication and cultivation of indigenous plant species (cranberry and blueberry) that are adapted to these adverse conditions. In 1986, 25,753 acres of land in the Mullica River Watershed were actively being farmed, approximately six percent of the total watershed. Agriculture decreased by 1,395 acres between 1986 and 1995. Most of the land was converted to forest, with approximately 54 percent left fallow. Forty-three percent of the converted agriculture can be attributed to

urban and commercial growth. It is difficult to accurately quantify the change in agricultural land between 1995 and 2000 due to the nature of satellite land use updates. Never the less, it appears that the loss of farmland may be slowing, with an increase of 30 acres of farmland between 1995 and 2000 identified.

In 1986, urban land comprised 5.84 percent of the watershed and by 1995 had increased to 6.6 percent of the watershed. Between 1995 and 2000, urban areas continued to increase to 6.9 percent. Most new development is occurring along the southwest edge of the watershed, in the areas designated for growth. This trend indicates that Pinelands regulations are effectively keeping new development away from the core areas of the region.

**Build-out Scenarios**

The percent of urban land was compared to the amount of land available for development (Table 4). In general the sub-watershed areas that have the most development in 2000 (Figure 2; Upper and Lower Mullica River) have the greatest potential to increase in development. Sub-watersheds that are least developed in 2000 (Great Bay and Bass River) have less land available for development in the future. Bass River has so little land available for development because most of the land is protected open space (Wharton State Forest), while most of the Great Bay sub-watershed is open water and wetlands.



Figure 2. Sub-watersheds (USGS HUC 11) in the Watershed.

**Table 4.** Existing urban land and land available for future development, as a percent of entire watershed.

| <i>HUC-11</i>            | Urban 1986 | Urban 1995 | Urban 2000 | <i>Available for Development</i> |
|--------------------------|------------|------------|------------|----------------------------------|
| Bass River               | 0.79       | 0.90       | 0.94       | 10.90                            |
| Basto River              | 4.40       | 5.46       | 5.68       | 11.85                            |
| Oswego River             | 0.86       | 0.97       | 1.02       | 17.77                            |
| Upper Mullica River      | 10.79      | 11.86      | 12.11      | 19.56                            |
| Mullica and Wading River | 5.68       | 7.12       | 7.83       | 17.36                            |

|                     |       |       |       |       |
|---------------------|-------|-------|-------|-------|
| Lower Mullica River | 6.84  | 7.52  | 7.76  | 18.20 |
| Great Bay           | 5.54  | 6.05  | 6.21  | 4.71  |
| Brigantine          | 38.35 | 39.84 | 39.84 | 13.68 |
| Total Watershed     | 5.84  | 6.66  | 6.92  | 16.68 |

### Indicator Results

The population was 76,383 and 83,501 in 1990 and 2000 respectively, representing a nine percent increase over the ten-year period. The build-out population was calculated as 110,363 to 124,334 (Table 5), an increase of 32 to 49 percent predicted. The LC scenario allowed the highest number of dwelling units, while the three high constraint models (H1, H2, H3) all allowed approximately the same number of dwelling units. However, all scenarios represent a substantial increase over the 2000 watershed population.

The quality check of the build-out methodology predicts a 2000 population of 55,300 for the census blocks completely within the Mullica River Watershed. The total census population for these blocks was 72,000 people, with the build-out analysis potentially underestimating predicted population by about 23 percent. The disparity is most likely due to differences in the existing zoning file and the density pre regulation development, primarily in areas of older development and the differences in the # of people per dwelling unit across the different residential development types. This may not be a problem for the model as new growth is expected to more consistently conform to the zoning information used in this analysis. But, if the model under predicts by 23 percent, however, the population and impervious surface could be significantly higher at build-out.

Table 6 shows impervious surface estimates for 1986, 1995, and the build-out scenarios. Impervious surface for the Mullica River Watershed in 1986 was 1.34 percent. Between 1986 and 1995 impervious surface increased by 741 acres to 1.53 percent. Both values are substantially less than the 10 percent threshold of Arnolds and Gibbons (1996). The build-out analysis aggregated across the entire Mullica River basin, predicted a range of impervious surface between 2.50 and 2.83 percent, with the low constraints scenario having the highest value. These values are also well below Arnold and Gibbons (1996) 10 percent threshold for impacted areas.

To highlight localized areas of potentially high impact from non-point source pollution, impervious surface was also analyzed using the USGS HUC 14 sub-watersheds. For 1986 and 1995, no sub-watersheds were over the 10 percent impervious surface threshold (Figure 3). The build-out scenarios predict anywhere from four to seven sub-watersheds over the 10 percent mark (Figure 4), with the potentially impacted sub-watersheds located in the Regional Growth Areas or outside the Pinelands Management Area. The LC scenario had the highest number of sub-watersheds over 10 percent. In addition, 19

sub-watersheds, approximately one-third of the total, are located downstream and are hydrologically connected to impacted areas in the LC scenario (Figure 5). The build-out scenarios based on the Coastal Zone Management Rules maximum impervious surface limits (HC2 and HC3) had the lowest levels of impervious surface predicted, indicating that enforcement of these rules could reduce the impact of future development on water quality.

**Table 5.** Estimated dwelling units and population.

|                  | 1990   | 2000   | LC      | HC1     | HC2     | HC3     |
|------------------|--------|--------|---------|---------|---------|---------|
| DU increase      | 30,587 | 33,916 | 50,249  | 45,306  | 44880   | 44984   |
| Total Population | 76,383 | 83,501 | 123,680 | 111,520 | 110,472 | 110,728 |

**Table 6.** Estimated impervious surface in 1986, 1995, and build-out.

|          | 1986   | 1995   | LC     | HC1    | HC2    | HC3    |
|----------|--------|--------|--------|--------|--------|--------|
| Acres    | 5,005  | 5,746  | 10,556 | 9828   | 9,372  | 9,563  |
| Percent* | 1.34 % | 1.53 % | 2.83 % | 2.63 % | 2.50 % | 2.56 % |

\*For the percent equation the total area of the Mullica River Watershed was 373,471 acres. Water areas were not included.

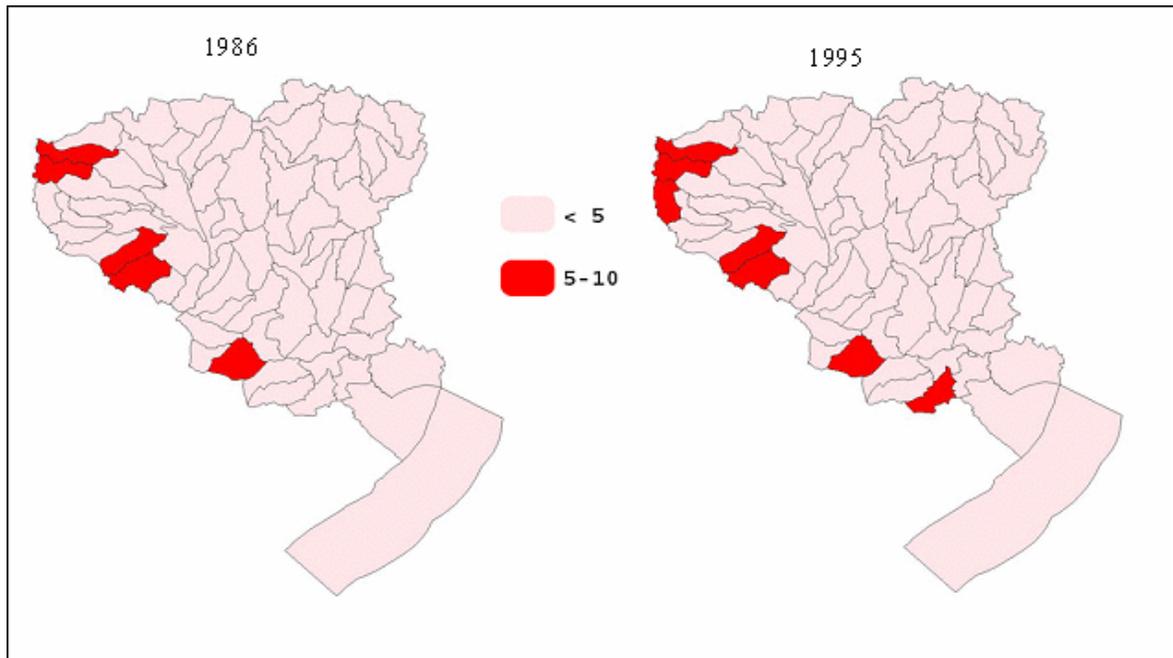


Figure 3. Impervious surface estimates by USGS HUC 14.

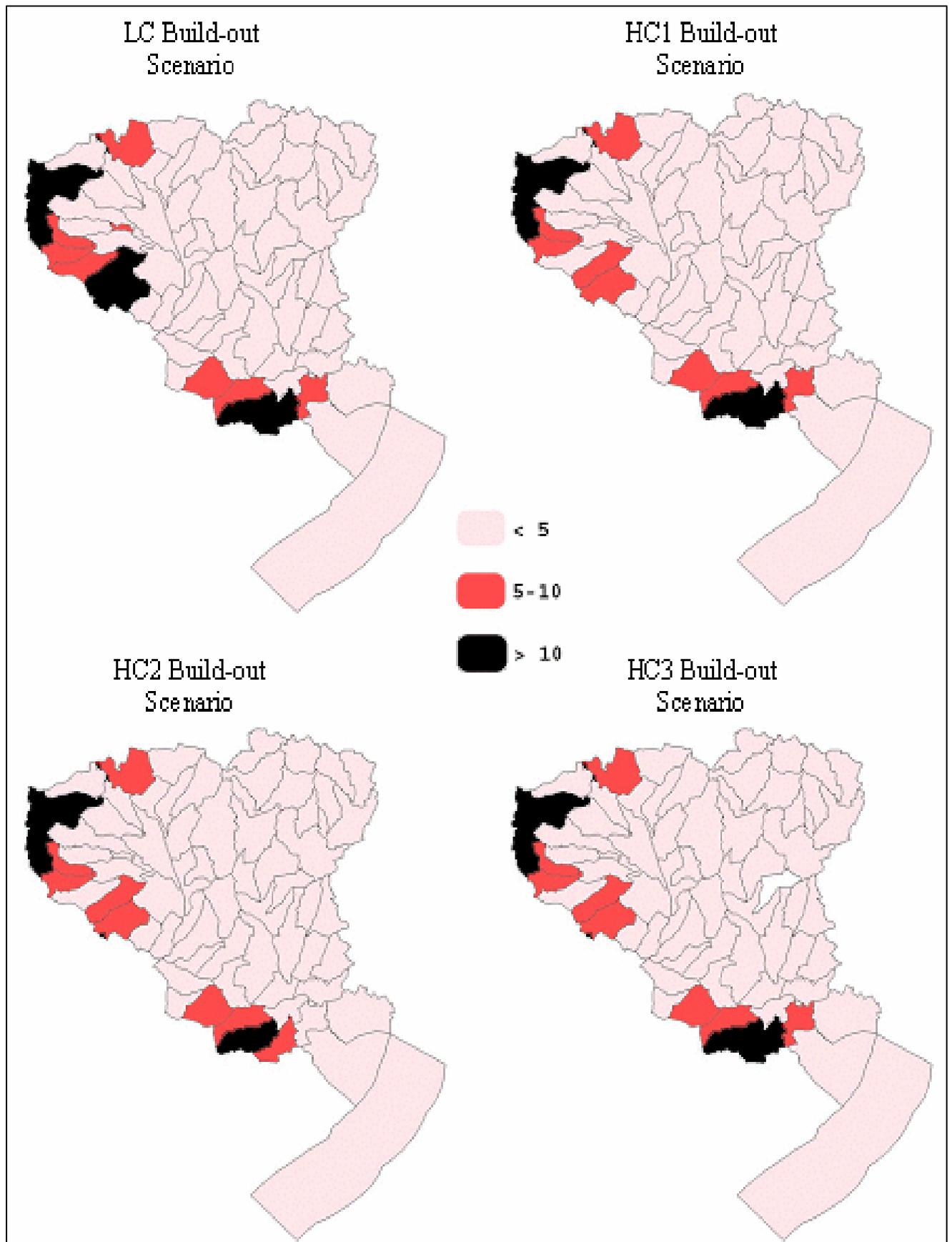


Figure 4. Build-out impervious surface estimates for USGS HUC 14.

## CONCLUSIONS

Based on our analysis, there has been an 18 percent increase in urban land in the Mullica River Watershed between 1986 and 2000. Conversely this can be seen as a real loss of around 1% of the watershed to development between 1986 and 2000. These results highlight the strength of the Pinelands regulations in limiting overall growth and steering new development towards designated growth areas. Additionally, the slowing conversion rate of agricultural land indicates that another Pinelands management goal, preserving traditional agriculture, is being met.

While regulatory, social, and economic conditions are likely to change between now and build-out, there is the potential for a substantial increase in urban development to occur that could negatively impact the water supply and quality of the downstream estuary. Again, the Pinelands regulations should help limit the impacts, with most new development concentrated in a few sub-watersheds. By concentrating the areas of high impervious surface, mitigation of urban non-point source pollution can be made more feasible by the adoption of best management storm water runoff plans. However, if the Pinelands regulations are relaxed or not enforced, then there is the potential for more widespread development, greatly impacting water quality throughout the watershed and increasing the need for mitigation activities.

Of the build-out scenarios considered, the two high constraint models based on the Coastal Zone Management Rules (HC2 and HC3) are most effective at reducing the potential impacts of impervious surface. These rules take an approach similar to the Pinelands Management Area, trying to concentrate urban development in specific areas, while minimally impacting most of the land. Again, enforcement of these rules, or ones similar, will reduce overall impacts and increase the effectiveness of mitigation actions against non-point source pollution.

While the indicator analysis highlights the need for mitigation activity limiting impacts of impervious surface in the southwest portion of the watershed, the potential increase in population suggests that sufficient water supply is also a concern, particularly as many households rely on shallow wells. Future work should consider the location of the potential new growth and the supply of water to develop a water supply management plan to help ensure there is a sufficient supply of potable water to meet future demand.

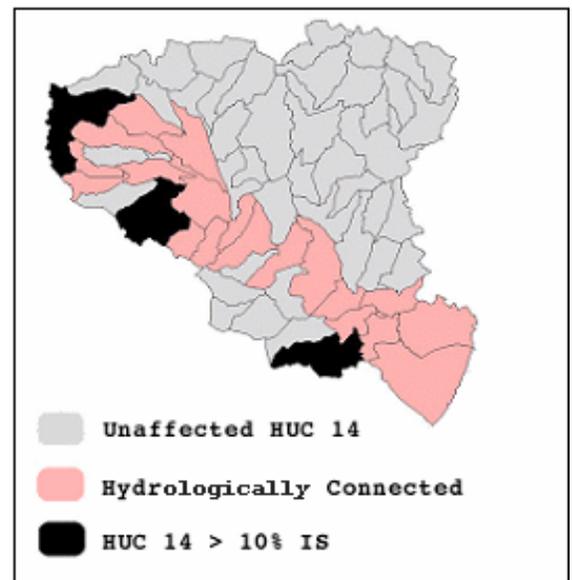


Figure 5. Hydrological connectivity for the LC build-out scenario.

## ACKNOWLEDGEMENTS

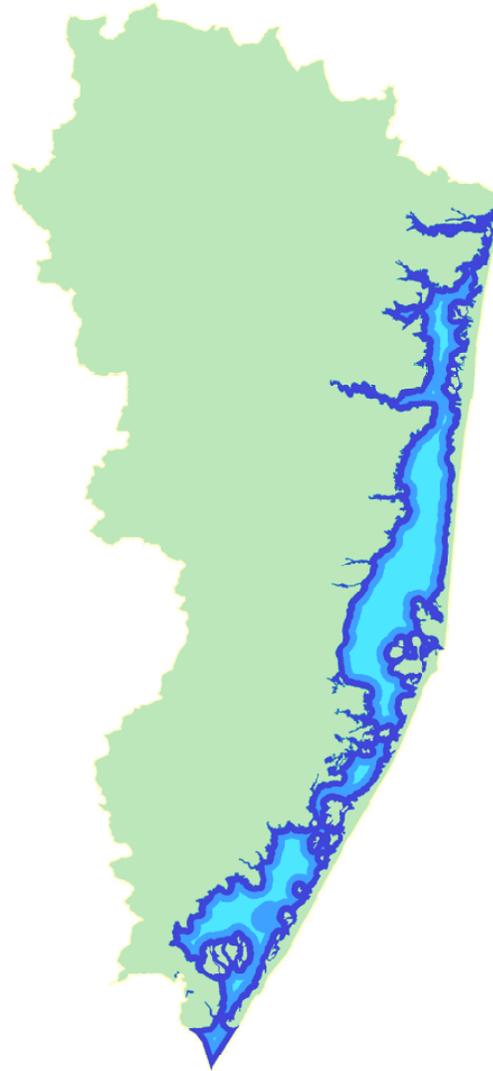
The Pinelands Commission, Brigantine City, Galloway Township, and Port Republic Township provided essential zoning data for the project. Discussions with Chris Krupka (Pinelands Commission) in the early stages of the project provided necessary direction. John Bognar and Jim Trimble provided technical support.

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## **Appendix 3. A Build-out Analysis of the Barnegat Bay Watershed**



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**May 2001**

**CRSSA Technical Report 2001-02**

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## Introduction

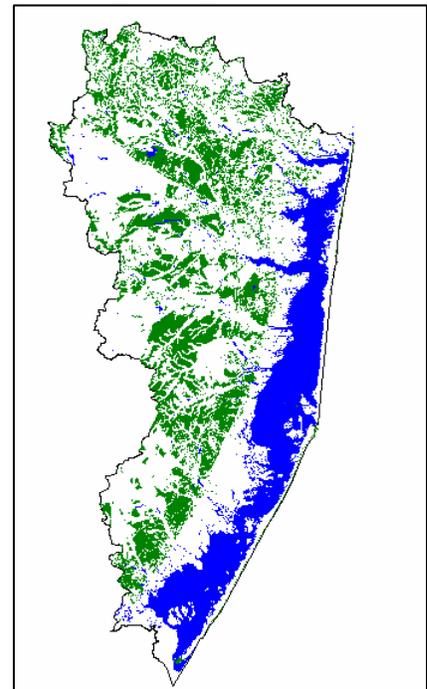
As part of the National Estuary Program, the Barnegat Bay region has been the focus of an ambitious scientific characterization and data synthesis process. This effort has recently culminated in the development a Comprehensive Conservation and Management Plan (CCMP) for the bay and its watershed (Barnegat Bay Estuary Program, 2000a). The goal of the CCMP is to balance the competing demands of human uses of the region while promoting the long term sustainability of the bay and its diverse natural resources. In implementing the CCMP and targeting conservation efforts, a prospective look at future development patterns was deemed necessary. In response, we have completed a build-out analysis of the watershed. A build-out analysis maps the expected location of future development and estimates the number of new dwelling units when all land available for development is developed at the highest intensities possible. However, a build-out analysis does not project when build-out will occur. A build-out analysis is useful in long-term planning efforts as a way to understand the potential future growth. The goal of this Barnegat Bay watershed build-out study is to provide information to local decision-makers on the scope and magnitude of future development patterns based on several different scenarios of zoning and land use management policies.

In this study, we use the number of dwelling units, population, and percent of impervious surface cover as ways to quantify the amount of development possible at build-out. The number of dwelling units and population are indicators of residential water demand, while impervious surface is an indicator of non-point source pollution. By understanding the potential changes of these indicators, we can better identify actions needed to protect the resource in the Barnegat Bay.

### Methods to Create Build-out Scenarios

We created the build-out model using a Geographic Information System. This is a computer based tool used to manage, manipulate, and analyze digital data. The approach allowed us to create a spatially explicit model so we could examine potential changes in specific areas of the watershed.

The first step in creating the build-out model was identifying land that is available for development. Already developed areas, permanently protected open space, and land that is undevelopable for environmental



**Figure 1. Land available for development.**

reasons (e.g., consists of wetlands or adjacent buffer lands) were excluded from this category. The remaining land in the watershed was deemed available for development (Figure 1). The next step was to identify the type of development that could occur on the available land. Municipal zoning regulation and the Pinelands Comprehensive Management Plan were used to determine potential future land uses. Sewer service areas were included in the analysis, as lower development densities are often required in places that do not have sewer service. Once the potential land uses of the developable areas were determined, we were able to map potential land uses at build-out.

Three build-out scenarios were considered:

1. **Baseline:** This is based on current regulations, with down zoning to 3.2 ac outside sewer service areas. We believe this is the most likely prediction of future build-out. The 3.2 acre figure was derived as an average of the existing zoning regulations for non-sewered areas in the Pinelands Reserve and other Ocean County municipalities.
2. **No down zoning:** This scenario is based on current regulations but with no down zoning outside sewer service areas.
3. **Century Plan Implemented:** This scenario is based on current regulations with down zoning outside sewer service areas to 3.2 ac. Under this scenario, the tracts of land the Trust for Public Land identified in the Century Plan (Blanchard, 1997; Blanchard and Herpetological Associates, 1995) as important to protect as open space are removed from future development.

## **Indicators Used to Determine Potential Impacts of Build-out**

### **Dwelling Unit and Population Increase**

The population living in the watershed will increase as more areas in the watershed are developed. A growing population can negatively impact the regions water resources as a larger population requires a larger supply of freshwater. At present, increase in water demand has lowered the aquifers under the watershed, leading to saltwater intrusion from the Barnegat Bay in certain locations (Barnegat Bay Estuary Program, 2000b). This salt water intrusion threatens the freshwater supply, while potentially negatively impacting the watershed's biological resources. If the population continues to increase, the demand for potable freshwater could exceed the sustainable supply. Thus, it is important to understand the potential size of the population at build-out.

To estimate the increase in population in the watershed we began by estimating the number of new dwelling units. For each patch of land available for development, the number of new dwelling units was calculated by determining the number of units that

could be built on that patch based on the minimum lot size requirements for the area as specified in the existing zoning maps. As new development requires public infrastructure (roads, new schools, etc.) we used the 80-20 rule of thumb to calculate the number of new dwelling units. This rule of thumb states that generally 80 percent of the land will be used for residential homesites, while the remaining 20 percent is reserved for infrastructure (e.g., roads).

Once the predicted number of potential new dwelling units was determined, we multiplied new dwelling unit by the average number of people per dwelling unit based on 1990 census data for Ocean County. The resulting number is the predicted population growth at build-out. Adding the predicted new growth to the existing numbers, we then estimated the potential number of total dwelling units and population of the watershed at build-out.

As a means of validating the above build-out modeling methods, we compared predicted vs. observed results for our baseline year of 1995. The predicted number of dwelling units was approximately 16% greater than the observed number in 1995. The over prediction can be explained several ways. First, development does not always occur at maximum density as zoned, which is assumed in the build-out model. In many cases residential lots are larger than the zoned minimum lot size. The second major factor may be the 1995 digital mapped land use/land cover (LULC) data (NJDEP, 2000). The LULC data set was used to map existing development and these data are not mapped on an ownership parcel basis. Areas mapped as developable do not necessarily represent a complete parcel, or may be composed of several partial parcels that have been placed into one contiguous tract that meets the development criteria. Because of the data limitations and unpredictable nature of residential development, the number of new dwelling units is given as a range. The initial model prediction of new dwelling units represents the high end and adjusted prediction (down-weighted by 16%) represents the low end of the range of possible new dwelling units in the watershed.

### **Impervious Surface**

Dominated by sandy soils, the upland and wetland systems of Barnegat Bay's watershed (known locally as the Pinelands) act as a single hydrologic unit. Human development readily impacts the region's surface waters, associated wetlands (Morgan and Good, 1988; Zampella, 1994) and groundwater aquifers (Vowinkel and Siwec, 1991). Previous work in the Mullica River basin, under similar Pinelands conditions, revealed a gradient of increasing pH, specific conductance, and nutrients that paralleled a watershed-disturbance gradient of increasing developed and agricultural land-use intensity and wastewater flow (Zampella 1994; Dow and Zampella 2000). This same general pattern of decreasing water quality with increasing watershed development is also evident in the Barnegat Bay watershed (Hunchak-Kariouk et al., 2001). This degraded water quality, in turn, has also impacted the ecological structure and function of the region's freshwater aquatic and wetland communities (Morgan and Philipp 1986; Ehrenfeld and Schneider 1991; Zampella and Laidig, 1997; Zampella and Bunnell, 1998). Continuing

downstream, Barnegat Bay is on the receiving end of this nutrient enriched runoff and has experienced negative impacts associated with eutrophication (Kennish et al., 1984; Seitzinger and Styles, 1999). Thus, there is a close connection between the forcing factors of human-mediated watershed disturbance and the resulting impacts to downstream freshwater and estuarine systems.

Impervious surface is an important environmental indicator of the intensity of human land use and closely correlates with water quality degradation and altered runoff patterns in urban and urbanizing areas (Novotny and Chesters, 1981; Brown, 1988; Driver and Troutman, 1989; Ferguson and Suckling, 1990; Arnold and Gibbons, 1996; Charbeneau and Barrett, 1998). Impervious surface refers to roads, sidewalks, roofs, patios, and other surfaces that water can not penetrate. The percent of impervious surface cover is a good indicator of the amount of non-point source pollution. As non-point source pollution is a leading cause of water quality degradation, understanding potential increases is important for understanding impacts on water quality. Areas that are more intensely developed tend to have a larger percentage of impervious surface cover, contributing more non-point source pollution to the water in the watershed. In compiling data from a number of watersheds, Arnold and Gibbons (1996) developed a set of impact thresholds: 1) < 10% impervious surface cover can be considered non-impacted; 2) between 10-30% cover can be considered impacted; and 3) > 30% cover is generally considered degraded. While these thresholds should not be considered 'hard and fast' breakpoints, they do provide a useful guide in evaluating the comparative risk of water degradation on a watershed scale.

To estimate the percent impervious surface in the watershed at build-out, we used the New Jersey's Department of Environmental Protection's impervious surface estimates from the 1995 digital mapped LULC data (NJDEP, 2000). Build-out impervious surface values were determined by assigning the average values of areas with similar zoning classes that were already developed in 1995. Impervious surface information was then summarized at the catchment level. Summarizing the data by catchments, which average 9 sq. miles, allowed us to identify localized areas where the amount of non-point source pollution is potential quite high.

### **Results from the Build-out Analysis**

In 1995, 25 percent of the watershed was urban land, while 27 percent is available for development (Table 1). The remaining land is either permanently protected open space or unavailable for development for environmental reasons (e.g., wetlands). It is important to remember that not all land available for development can be converted to urban land uses. Some of the land, particularly in the Pinelands Management Area, is limited to rural land uses. Areas designated for low density residential development or agriculture are not urban but they are built-out based on land use regulations.

## Dwelling Unit and Population Increase

In 1995, the model estimates 246,817 dwelling units in the Barnegat Bay Watershed. At build-out 73,087 to 84,985 potential new dwelling units are predicted. Based on regulations they would be built-out at a density of 1.2 to 1.4 dwelling units per acre.

**Table 1. Existing Urban and Land Available for Development.**

| Sub-watershed               | Total Acres    | % Urban   | % Developable |
|-----------------------------|----------------|-----------|---------------|
| Metedeconk River            | 22,064         | 41        | 27            |
| Toms River                  | 15,425         | 19        | 41            |
| Union Branch                | 16,111         | 16        | 22            |
| Kettle Creek                | 4,433          | 50        | 26            |
| Silver Bay                  | 8,504          | 66        | 17            |
| Wrangle Brook/ Jakes Branch | 12,552         | 30        | 32            |
| Potters Creek               | 2,359          | 36        | 16            |
| Cedar Creek                 | 14,064         | 7         | 27            |
| Stouts Creek                | 1,955          | 22        | 5             |
| Forked River                | 6,525          | 15        | 32            |
| Oyster Creek                | 10,060         | 16        | 28            |
| Mill Creek/ Westecunk Creek | 19,026         | 14        | 24            |
| Tuckerton Creek             | 8,316          | 18        | 24            |
| <b>TOTAL</b>                | <b>171,606</b> | <b>25</b> | <b>27</b>     |

The potential new development is associated with a estimated total population of between 812,556 and 842,777 people (these figures represent year-round residents and do not take into account part-time summer residents and visitors). This is an increase of 30 to 34 percent over the baseline year of 1995. If the Century Plan land is removed from possible development through preservation as public open space, then predictions are reduced to a potential 25 to 29 percent increase. However, if there is no down zoning outside sewer service areas, then as much as a 37 to 43 percent increase in dwelling units and population could occur.

**Table 2 Predicted number of dwelling units and population.**

| Scenario                           | Dwelling Units    | Population        | % Increase |
|------------------------------------|-------------------|-------------------|------------|
| 1995                               | 246,817           | 626,914           | -          |
| Baseline build-out scenario        | 319,904 - 331,802 | 812,556 - 842,777 | 30 - 34    |
| Build-out, no down zoning scenario | 338,236 - 353,118 | 859,119 - 896,920 | 37 - 43    |
| Century Plan scenario              | 308,359 - 318,377 | 783,231 - 808,678 | 25 - 29    |

## Impervious Surface

In 1986, the watershed land area consisted of approximately seven percent impervious surface cover. In 1995, the percent impervious surface cover increases to approximately eight percent. Thirty-two percent of the catchments were above the 10 percent impervious surface threshold identified by previous studies to be the point where water quality begins to be impacted (Arnold and Gibbons, 1996). In 1995, no catchments were above 30 percent impervious surface threshold that can be considered degraded (Arnold and Gibbons, 1996). At build-out, the model predicts impervious surface will rise to 12 percent, with 46 percent of the catchments over 10 percent. Figure 2 clearly illustrates how the existing and future development is concentrated in the northern third of the bay's watershed. The total percent impervious surface cover is predicted at 13 percent if there is no down zoning and 12 percent if the Century Plan land is removed from development. Fifty-seven percent of the catchments are above the 10 percent threshold in the no down zoning scenario, while only 42 percent are predicted as above the 10 percent threshold in the Century Plan scenario. Five percent of the catchments are predicted as above the 30 percent threshold in all three build-out scenarios. Examining the amount of change within each catchment, the baseline scenario has fewer catchments covering more than 10 percent of the land with impervious surface than the no down zoning scenarios (Table 3).

**Table 3. Percent of additional land covered by impervious surface, by catchment .**

| Percent Increase | 1986 to 1995 | 1995 to Build-out (Baseline) | 1995 to Build-out (no down zoning) | 1995 to Build-out (Century Plan Removed) |
|------------------|--------------|------------------------------|------------------------------------|--|
| No Change        | 35*          | 14                           | 12                                 | 16                                       |
| 1 - 5            | 40           | 40                           | 36                                 | 44                                       |
| 6 - 10           | 1            | 17                           | 20                                 | 13                                       |
| 11 - 15          | 0            | 2                            | 5                                  | 2  |
| 16 - 20          | 0            | 2                            | 2                                  | 0  |
| 21 - 25          | 0            | 1                            | 1                                  | 1  |

\* Three catchments reduced the estimated amount of impervious surface by 1 percent from 1986 to 1995.

One advantage of this GIS-based modeling technique is the ability to highlight areas of greatest potential change, allowing greater targeting of planning or mitigation efforts to the locations that need them the most. Four of the five catchments that will cover an additional 10 percent of the land with impervious surface in the baseline scenario are contiguous to each other. This hot spot of potential impervious surface increase straddles the Toms River, Union Branch, and Kettle Creek Sub-watersheds. These catchments represent the area of greatest changes in all scenarios, with the alternative scenarios differing by only one or two percent. The other catchment predicted to have an additional 10 percent of its land under impervious surface is located along the Barnegat Bay shoreline in the Oyster Creek sub-watershed. Only eight percent of land was covered by impervious surface in 1995 while 20 percent is predicted to be impervious at build-out. A substantial area of land in this catchment is targeted for protection as open

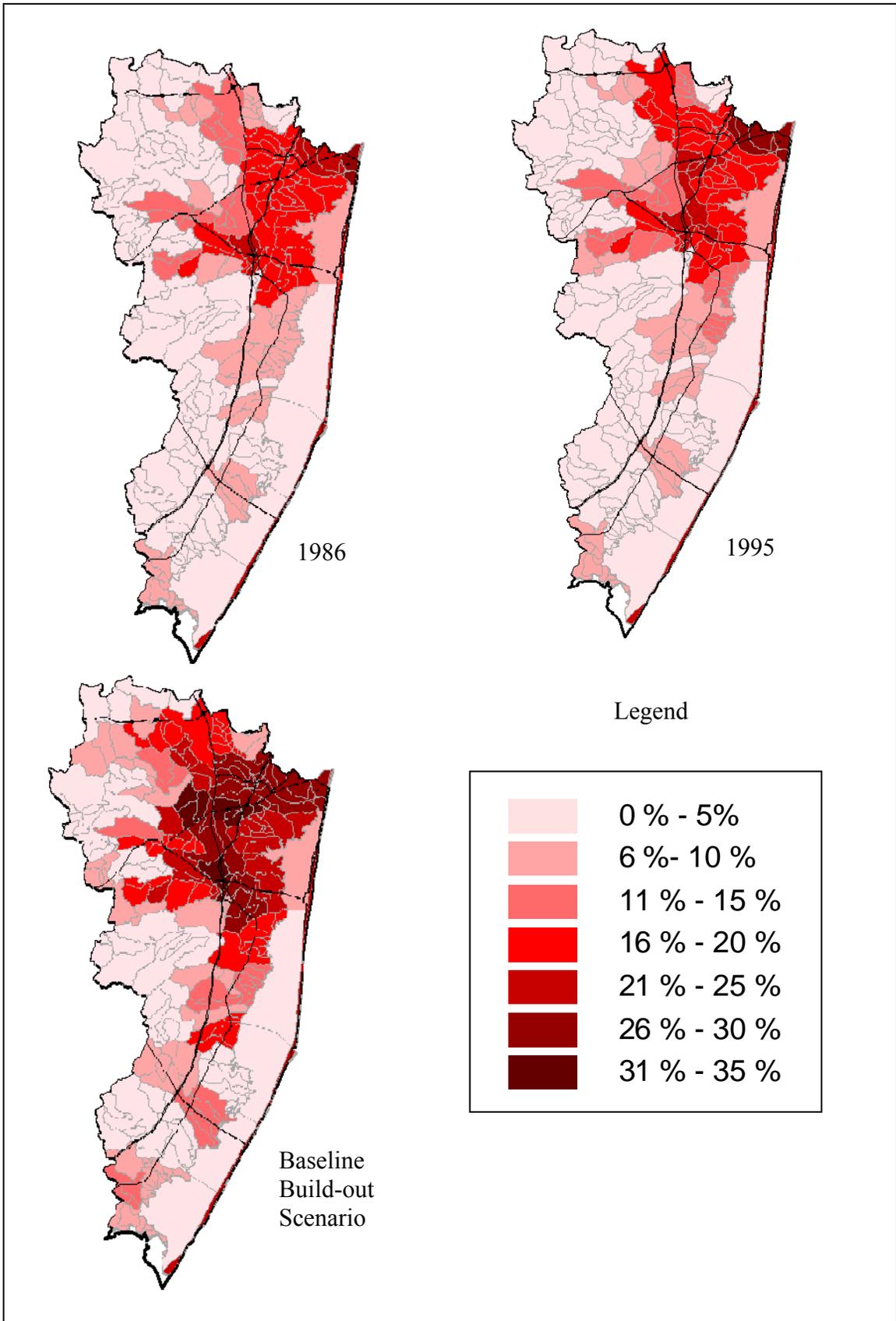


Figure 2. Percent impervious surface cover.

space by the Century Plan. If the land is purchased as open space as proposed, the impervious surface is predicted to increase to only 10 percent of the total catchment land. This type of spatial analysis underscore the advantage of this GIS-based approach to evaluate site-specific scenarios.

## **Summary and Recommendations**

We completed a build-out analysis of the Barnegat Bay Watershed to gain a better understanding of the potential future growth in the watershed. The potential number of dwelling units, residential population, and amount of impervious surface were estimated at build-out under several different scenarios. The build-out model estimates that the number of dwelling units and population could increase 30 to 34 percent in the baseline scenario. An additional four percent of the land area, up from eight percent, in the watershed is predicted to be covered by impervious surface at build-out; this represents an increase in impervious surface cover of 50 percent. Approximately 50 percent of the catchments will have more than 10 percent impervious surface cover, suggesting that water quality will be impacted. Unfortunately estuarine and watershed-related science is not sufficiently advanced to allow us to definitively predict how much the water quality will decrease and what the precise impacts will be on Barnegat Bay proper. Whereas we may know enough to predict a general trend towards increasing eutrophication, we are unsure of the exact details. Previous experience in other eutrophic water bodies suggests that we should be prepared for unexpected surprises.

While protecting open space in the Barnegat Bay watershed is important, the results of the Century Plan build-out scenario suggest that this approach alone is not sufficient to ensure protection of water resources. Under the Century Plan scenario, approximately 89,000 acres of open space would be purchased, reducing the overall amount of developable land by 32 percent. However, as these open space tracts are generally zoned as low density residential, their removal from development reduces the total number of dwelling units by only 11,500 or 16 percent and only minimally reduces the overall impervious surface cover. These results suggest several important points: 1) aggressive purchase of open space as outlined in the Century Plan will still allow considerable room for additional growth in the Barnegat Bay watershed; and 2) to protect the bay's water resources, the adverse impacts of this additional development should be mitigated.

Although the exact amount of additional development may vary based on the amount of land protected as open space, zoning and other regulations, and socioeconomic factors, the build-out analysis indicates that significant additional development will occur in the watershed. This build-out analysis reinforces the idea that comprehensive watershed scale planning is needed to address future development impacts. The Barnegat Bay Comprehensive Conservation and Management Plan identifies a number of actions that new and existing residents can adopt to help protect the water quality and supply. For example, new construction should minimize the amount of impervious surface and maximize the amount of undisturbed native vegetation cover to promote water

infiltration. Low impact lawn/garden care techniques should be promoted to reduce nutrient inputs in runoff and conserve water supply. Riparian buffers should be retained and in many places restored to help filter runoff and inhibit soil erosion. Storm water management systems need proper design and maintenance to effectively reduce storm peak flows and associated non-point source pollution. These types of activities, along with a number of other recommendations, are outlined in the CCMP.

It is our hope that this build-out analysis can be used to highlight ‘hotspots’ of future change and thereby aid in local planning and management decision making. Rather than generic best management practices, using GIS-based decision support modeling techniques we can more readily and effectively customize recommendations to address the specific circumstances of individual sites. For example, watershed managers could target high risk locations for mitigation actions such as riparian buffer restoration in a more cost effective manner. Only by incorporating both watershed, municipal, and site level actions will we meet the Estuary Program’s goals of protecting the public water supply and maintaining and restoring ecological conditions in the Barnegat Bay.

### **GIS Data Availability**

The GIS data (in an ArcView .shp file format) used to develop the build-out analysis as well as the resulting scenario outputs will be made available for free download at the following web site: <http://www.crssa.rutgers.edu/projects/runj/bbay.html>.

### **Acknowledgements**

Dave McKeon and staff at Ocean County Planning offered insight and aided in the data gathering process. Scott Haag and Steve Lennartz provided valuable assistance during the digitizing and analysis phases. Funding was provided by the US EPA through the Barnegat Bay National Estuary Program.

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**Appendix 4. Summary of nutrient, productivity, and hydrographic monitoring in the Mullica River-Great Bay estuarine system and the adjacent Atlantic Ocean between 1957 and 1979. Parameters measured include chlorophyll (C), nitrogen (N), phosphorus (P) and carbon (\*), and standard hydrographic data (H) including Secchi, water temperature, salinity, and dissolved oxygen.**

| Station | Year |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|-------|-------|------|-------|-------|-------|
|         | 1957 | 1958 | 1959 | 1960 | 1961 | 1962 | 1963 | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 | 1974  | 1975  | 1976 | 1977  | 1978  | 1979  |
| CL      |      |      |      | HCP  | HNP  | HCNP | HCNP | HCN  |      |      |      |      |      |      |      |      |      |       |       |      |       | HCNP* | HNP   |
| R17     |      |      |      |      | HNP  | HCNP |      |      |      |      |      | HCN  | H    |      |      |      |      |       |       |      |       |       | HCNP* |
| R14     |      |      |      |      | HNP  | HCNP |      |      |      |      |      | HC   | H    |      |      | HCN* |      |       |       |      |       |       | HCNP* |
| R12     |      |      |      |      |      |      |      |      |      |      |      | HCN  | H    |      |      | HCN* | HCN* | HCN*  |       |      |       |       | HCNP* |
| R11     |      |      |      |      | HNP  | HCNP |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       | H     |
| R6      | HCP  | HCP  | HCP  | HCP  | HCNP | HCNP | HCNP | HC   | HC   | HC   | HCN  | HCN  | H    | H    | HCN* | HCN* |      |       |       |      |       | HCN*  | HCN*  |
| TI      | H    | HCP  | HCP  | HCP  | HCNP | HCNP | HCNP | HCN  | HCN  | HCNP | HCN  | HCN  | HCN* | HCN* | HCN* | HCN* | HCN* | HCN*  | HCN*  | HCN* | HCN*  | HCN*  | HCN*  |
| GP      |      |      |      |      |      | HCNP |      | H    |      |      |      | H    | H    |      |      |      |      |       |       |      |       |       |       |
| PC      | H    | HP   | HCP  | HCP  | HCNP |      |      |      | H    | H    | H    | H    | H    | H    |      |      |      |       |       |      |       |       |       |
| MB      |      |      |      |      | HNP  | HCNP | HCNP | HC   | HC   | HC   | HCN  | HCN  |      |      |      | HCN* |      |       |       |      |       |       |       |
| CH      |      |      | HCP  | HCP  | HCNP | HCNP | HCNP | H    | H    | H    | H    | HCN  | H    | H    |      |      |      |       |       |      |       |       |       |
| M2O     |      |      |      |      |      |      |      |      |      |      |      | H    |      |      |      |      | HCN* | HCNP* | HCNP* | HCN* | HCNP* | HCNP* | HCNP* |
| CG      |      |      |      |      |      |      |      |      |      |      |      | HCN  | H    |      |      | HCN* | HCN* | HCN*  | HCNP* | HC   | HCN*  | HCNP* | HCNP* |
| F       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
| C       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
| Site    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
| BRG     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
| BH      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
| ½       |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |
| Off     |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |       |       |      |       |       |       |

| <u>Stations</u> |                 | GP  | Graveling Point                   | C    | Buoy C in Little Egg Inlet     |
|-----------------|-----------------|-----|-----------------------------------|------|--------------------------------|
| CL              | Crowley Landing | OC  | Oyster Creek                      | Site | Little Egg Inlet Buoy          |
| R17             | Green Bank      | MB  | Mid Bay                           | BRG  | off Brigantine                 |
| R14             | Lower Bank      | CH  | Cape Horn                         | BH   | Beach Haven                    |
| R12             | Hog Island      | M2O | Intercoastal Waterway             | 1/2  | 6.5 miles off Little Egg Inlet |
| R11             | River Mile 11   | CG  | Rutgers Marine Field Station      | Off  | 13 miles off Little Egg Inlet  |
| R6              | French Point    | F   | Marker Buoy F in Little Egg Inlet |      |                                |
| TI              | Turtle Island   |     |                                   |      |                                |

Able, K. W., R. Hoden, D. Witting, and J. B. Durand. 1992. Physical Parameters of the Great Bay-Mullica River Estuary (With a List of Research Publications). Technical Report,

Contribution No. 92-06, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey. 38 p.

**Appendix 5. Mean monthly water temperature (°C) recorded at the Rutgers University Marine Field Station on Great Bay, New Jersey.<sup>a</sup>**

| MONTH | Year    |       |       |       |       |       |       |       |       |       |       |       |       |       |       |       |
|-------|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
|       | 1976    | 1977  | 1978  | 1979  | 1980  | 1981  | 1982  | 1983  | 1984  | 1985  | 1986  | 1987  | 1988  | 1989  | 1990  | ALL   |
| JAN   | No Data | -0.40 | 0.09  | 2.20  | 3.63  | -0.75 | 0.76  | 4.92  | 1.75  | 1.50  | 1.21  | 3.03  | 0.60  | 4.00  | 3.57  | 2.11  |
| FEB   | No Data | 0.33  | -0.14 | -0.38 | 1.78  | 2.43  | 2.53  | 4.36  | 5.84  | 2.01  | 1.71  | 1.22  | 3.11  | 3.99  | 5.96  | 2.64  |
| MAR   | No Data | 7.16  | 4.03  | 6.18  | 4.87  | 4.72  | 6.13  | 7.00  | 5.42  | 6.87  | 6.37  | 5.83  | 6.69  | 5.81  | 7.62  | 6.09  |
| APR   | No Data | 12.36 | 9.73  | 9.31  | 10.73 | 11.79 | 9.87  | 10.09 | 10.81 | 11.40 | 10.16 | 9.64  | 9.80  | 11.04 | 10.88 | 10.55 |
| MAY   | No Data | 15.80 | 13.66 | 16.18 | 15.31 | 15.39 | 16.14 | 15.10 | 14.46 | 16.70 | 16.38 | 14.07 | 15.40 | 15.02 | 15.71 | 15.37 |
| JUN   | 20.89   | 19.48 | 19.05 | 18.87 | 18.89 | 20.01 | 20.17 | 20.33 | 20.16 | 20.62 | 20.89 | 20.23 | 19.76 | 21.08 | 20.28 | 19.98 |
| JUL   | No Data | 23.27 | 21.90 | 23.50 | 21.93 | 24.31 | 23.80 | 25.08 | 21.15 | 24.34 | 24.68 | 24.31 | 21.05 | 24.06 | 23.75 | 23.29 |
| AUG   | No Data | 24.36 | 24.96 | 24.58 | 23.75 | 22.65 | 22.51 | 23.46 | 24.86 | 25.25 | 23.59 | 24.72 | 21.70 | 24.16 | 24.65 | 23.89 |
| SEP   | 20.77   | 22.00 | 21.02 | 21.13 | 22.32 | 21.13 | 20.25 | 21.86 | 21.09 | 23.19 | 21.23 | 22.47 | 20.13 | 22.37 | 21.65 | 21.48 |
| OCT   | 14.34   | 14.83 | 15.95 | 15.48 | 15.59 | 14.77 | 16.53 | 16.97 | 17.33 | 18.48 | 16.24 | 15.18 | 14.03 | 16.57 | 17.97 | 16.06 |
| NOV   | 6.57    | 10.75 | 11.31 | 11.75 | 8.98  | 10.41 | 12.83 | 10.79 | 11.18 | 13.44 | 11.03 | 10.90 | 10.96 | 11.68 | 10.65 | 10.93 |
| DEC   | 3.01    | 4.75  | 6.27  | 6.25  | 3.43  | 4.40  | 7.59  | 5.32  | 7.35  | 5.17  | 6.54  | 6.47  | 4.89  | 2.62  | 7.31  | 5.60  |
| ALL   | 12.49   | 13.92 | 12.89 | 13.04 | 12.90 | 12.76 | 13.34 | 13.64 | 13.53 | 13.56 | 12.83 | 13.64 | 12.41 | 13.77 | 14.06 | 13.29 |

<sup>a</sup>1976 to 1990 Period.

Able, K. W., R. Hoden, D. Witting, and J. B. Durand. 1992. Physical Parameters of the Mullica River-Great Bay Estuary (With a List of Research Publications). Technical Report, Contribution No. 92-06, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey. 38 p.

**Appendix 6. Mean monthly salinity recorded at the Rutgers University Marine Field Station on Great Bay, New Jersey.<sup>a</sup>**

| MONTH | Year    |       |       |         |       |         |       |       |       |         |       |       |       |       |       |       |
|-------|---------|-------|-------|---------|-------|---------|-------|-------|-------|---------|-------|-------|-------|-------|-------|-------|
|       | 1976    | 1977  | 1978  | 1979    | 1980  | 1981    | 1982  | 1983  | 1984  | 1985    | 1986  | 1987  | 1988  | 1989  | 1990  | ALL   |
| JAN   | No Data | 29.60 | 25.19 | 25.76   | 29.46 | 30.73   | 27.58 | 28.59 | 27.83 | 29.98   | 28.21 | 26.25 | 26.75 | 30.05 | 29.76 | 28.48 |
| FEB   | No Data | 27.73 | 27.69 | No Data | 31.26 | 30.65   | 25.94 | 26.47 | 27.65 | 29.31   | 29.94 | 28.62 | 28.30 | 29.63 | 28.80 | 28.75 |
| MAR   | No Data | 27.69 | 26.53 | No Data | 29.86 | 29.22   | 26.55 | 25.05 | 25.75 | 30.47   | 30.28 | 28.14 | 27.83 | 28.22 | 30.64 | 28.20 |
| APR   | No Data | 27.96 | 27.07 | No Data | 27.61 | 28.70   | 27.65 | 28.63 | 24.05 | 30.30   | 30.29 | 25.25 | 29.70 | 27.65 | 29.52 | 28.13 |
| MAY   | No Data | 28.59 | 26.16 | 23.62   | 27.75 | 29.05   | 27.48 | 31.60 | 26.61 | 28.27   | 29.62 | 26.22 | 28.90 | 25.59 | 30.05 | 28.00 |
| JUN   | 28.43   | 29.91 | 27.05 | 27.08   | 28.71 | 30.30   | 27.56 | 32.48 | 26.64 | 30.78   | 30.43 | 28.43 | 30.24 | 26.91 | 28.16 | 28.89 |
| JUL   | No Data | 31.07 | 27.07 | 28.81   | 29.81 | 29.68   | 28.10 | 32.07 | 28.01 | 31.53   | 30.31 | 28.33 | 31.47 | 27.70 | 29.10 | 29.44 |
| AUG   | No Data | 29.86 | 27.41 | 28.97   | 29.82 | 30.29   | 29.26 | 34.50 | 27.83 | No Data | 30.19 | 29.65 | 31.30 | 28.45 | 28.45 | 29.80 |
| SEP   | 29.96   | 29.78 | 29.09 | 29.08   | 30.93 | 29.65   | 29.00 | 29.62 | 29.75 | No Data | 30.05 | 30.00 | 31.60 | 28.39 | 29.62 | 29.76 |
| OCT   | 28.71   | 28.47 | 30.03 | 28.42   | 31.22 | No Data | 29.57 | 28.95 | 29.69 | 30.09   | 30.12 | 30.32 | 31.33 | 27.10 | 30.43 | 29.64 |
| NOV   | 27.32   | 27.48 | 30.19 | 28.64   | 29.88 | 29.57   | 29.15 | 27.00 | 29.39 | 30.41   | 29.94 | 28.79 | 30.16 | 27.35 | 28.45 | 28.96 |
| DEC   | 27.68   | 26.59 | 28.28 | 28.94   | 28.49 | 28.00   | 27.96 | 26.54 | 29.22 | 27.24   | 27.35 | 28.56 | 30.10 | 29.44 | 28.44 | 28.23 |
| All   | 28.51   | 28.74 | 27.62 | 28.17   | 29.63 | 29.57   | 28.01 | 29.31 | 27.71 | 30.01   | 29.67 | 28.31 | 29.80 | 27.99 | 29.30 | 28.87 |

<sup>a</sup>1976 to 1990 Period.

From Able, K. W., R. Hoden, D. Witting, and J. B. Durand. 1992. Physical Parameters of the Mullica River-Great Bay Estuary (With a List of Research Publications). Technical Report, Contribution No. 92-06, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey. 38 p.

**Appendix 7. Mean low tide (height in meters above mean low water) recorded at the Rutgers University Marine Field Station on Great Bay, New Jersey.<sup>a</sup>**

| MONTH | Year    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-------|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|       | 1976    | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | ALL  |
| JAN   | No Data | 2.75 | 2.05 | 2.42 | 2.35 | 1.53 | 1.80 | 2.26 | 2.23 | 2.17 | 1.56 | 2.39 | 1.85 | 2.10 | 1.84 | 2.05 |
| FEB   | No Data | 2.29 | 2.59 | 2.25 | 2.29 | 1.66 | 2.06 | 2.57 | 2.28 | 2.06 | 2.49 | 2.20 | 2.26 | 2.02 | 2.10 | 2.21 |
| MAR   | No Data | 2.08 | 2.28 | 2.27 | 2.16 | 2.01 | 1.95 | 2.68 | 2.59 | 2.00 | 1.71 | 2.77 | 2.11 | 2.39 | 1.96 | 2.22 |
| APR   | No Data | 2.46 | 2.76 | 2.50 | 2.67 | 1.69 | 1.87 | 2.60 | 2.95 | 2.12 | 2.88 | 2.91 | 2.78 | 2.16 | 2.11 | 2.46 |
| MAY   | No Data | 2.26 | 2.75 | 2.53 | 2.54 | 2.23 | 2.43 | 2.38 | 2.32 | 2.44 | 2.63 | 2.55 | 2.52 | 2.40 | 2.52 | 2.47 |
| JUN   | 2.20    | 2.75 | 2.55 | 2.56 | 2.23 | 2.22 | 2.80 | 2.49 | 2.50 | 2.52 | 2.44 | 2.58 | 2.51 | 2.44 | 2.40 | 2.48 |
| JUL   | No Data | 2.60 | 2.70 | 2.63 | 2.05 | 2.38 | 2.33 | 2.65 | 2.35 | 2.36 | 2.69 | 2.73 | 2.30 | 2.55 | 2.56 | 2.48 |
| AUG   | No Data | 2.62 | 2.91 | 2.62 | 2.30 | 2.40 | 2.34 | 2.64 | 2.69 | 2.56 | 2.88 | 2.90 | 2.37 | 2.73 | 2.84 | 2.63 |
| SEP   | 2.82    | 2.98 | 3.12 | 2.58 | 2.23 | 2.57 | 2.64 | 2.70 | 2.68 | 2.67 | 2.57 | 2.82 | 2.46 | 2.86 | 2.69 | 2.68 |
| OCT   | 3.11    | 2.87 | 2.70 | 2.40 | 2.08 | 2.25 | 2.75 | 2.97 | 2.88 | 2.66 | 2.81 | 2.58 | 2.54 | 2.90 | 2.53 | 2.64 |
| NOV   | 2.31    | 3.01 | 2.88 | 2.33 | 1.93 | 2.42 | 2.10 | 2.54 | 2.53 | 2.92 | 2.49 | 2.57 | 2.17 | 2.17 | 2.40 | 2.43 |
| DEC   | 1.92    | 3.01 | 2.19 | 2.01 | 1.68 | 2.05 | 2.23 | 2.13 | 2.18 | 2.32 | 2.45 | 2.48 | 2.14 | 1.91 | 2.09 | 2.18 |
| All   | 2.59    | 2.65 | 2.66 | 2.43 | 2.20 | 2.12 | 2.28 | 2.55 | 2.52 | 2.40 | 2.47 | 2.62 | 2.33 | 2.35 | 2.34 | 2.41 |

<sup>a</sup>1976 to 1990 Period.

From Able, K. W., R. Hoden, D. Witting, and J. B. Durand. 1992. Physical Parameters of the Mullica River-Great Bay Estuary (With a List of Research Publications). Technical Report, Contribution No. 92-06, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey. 38 p.

**Appendix 8. Mean high tide (height in meters above mean low water) recorded at the Rutgers University Marine Field Station on Great Bay, New Jersey.<sup>a</sup>**

| MONTH | Year    |      |      |      |      |      |      |      |      |      |      |      |      |      |      |      |
|-------|---------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
|       | 1976    | 1977 | 1978 | 1979 | 1980 | 1981 | 1982 | 1983 | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 | ALL  |
| JAN   | No Data | 4.85 | 5.34 | 5.89 | 5.70 | 4.98 | 5.19 | 5.67 | 5.76 | 5.35 | 5.15 | 5.79 | 5.21 | 5.32 | 5.28 | 5.43 |
| FEB   | No Data | 5.56 | 6.08 | 5.65 | 5.73 | 5.07 | 5.38 | 5.93 | 5.53 | 5.32 | 5.70 | 5.27 | 5.41 | 5.39 | 5.32 | 5.51 |
| MAR   | No Data | 5.36 | 5.78 | 5.68 | 5.60 | 5.42 | 5.33 | 6.07 | 5.79 | 5.15 | 5.23 | 5.92 | 5.25 | 5.49 | 5.30 | 5.53 |
| APR   | No Data | 5.57 | 6.22 | 5.85 | 5.96 | 5.15 | 5.20 | 5.86 | 6.18 | 5.37 | 6.11 | 5.98 | 5.97 | 5.41 | 5.38 | 5.72 |
| MAY   | No Data | 5.37 | 6.16 | 5.86 | 5.94 | 5.70 | 5.79 | 5.62 | 5.66 | 5.74 | 5.76 | 5.69 | 5.81 | 5.73 | 5.82 | 5.78 |
| JUN   | 5.66    | 5.81 | 6.00 | 5.95 | 5.73 | 5.65 | 6.08 | 5.80 | 5.80 | 5.52 | 5.59 | 5.71 | 5.86 | 5.84 | 5.72 | 5.79 |
| JUL   | No Data | 5.74 | 6.06 | 6.04 | 5.51 | 5.91 | 5.68 | 5.82 | 5.74 | 5.70 | 5.76 | 5.89 | 5.59 | 5.87 | 5.83 | 5.80 |
| AUG   | No Data | 5.93 | 6.22 | 5.99 | 5.77 | 5.87 | 5.69 | 5.98 | 6.06 | 5.84 | 5.79 | 6.01 | 5.72 | 5.95 | 6.03 | 5.92 |
| SEP   | 6.36    | 6.33 | 6.49 | 5.99 | 5.60 | 5.93 | 5.95 | 5.96 | 5.97 | 5.89 | 5.75 | 5.91 | 5.73 | 6.10 | 5.90 | 5.96 |
| OCT   | 6.51    | 6.19 | 6.05 | 5.88 | 5.56 | 5.58 | 6.05 | 6.09 | 6.03 | 5.81 | 5.96 | 5.77 | 5.70 | 6.05 | 5.83 | 5.91 |
| NOV   | 5.80    | 6.31 | 6.15 | 5.81 | 5.43 | 5.76 | 5.46 | 5.98 | 5.69 | 6.19 | 5.78 | 5.71 | 5.39 | 5.53 | 5.71 | 5.76 |
| DEC   | 5.10    | 6.57 | 5.68 | 5.50 | 5.13 | 5.45 | 5.66 | 5.63 | 5.40 | 5.50 | 5.67 | 5.55 | 5.25 | 5.23 | 5.40 | 5.51 |
| All   | 6.04    | 5.90 | 6.05 | 5.84 | 5.63 | 5.54 | 5.62 | 5.87 | 5.80 | 5.62 | 5.69 | 5.77 | 5.57 | 5.63 | 5.63 | 5.72 |

<sup>a</sup>1976 to 1990 Period.

From Able, K. W., R. Hoden, D. Witting, and J. B. Durand. 1992. Physical Parameters of the Mullica River-Great Bay Estuary (With a List of Research Publications). Technical Report, Contribution No. 92-06, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey. 38 p.

**Appendix 9. Mean monthly water turbidity (NTU)<sup>a</sup> at the Rutgers University Marine Field Station on Great Bay, New Jersey.<sup>b</sup>**

| MONTH | Year    |         |       |       |
|-------|---------|---------|-------|-------|
|       | 1988    | 1989    | 1990  | All   |
| JAN   | No Data | 13.58   | 12.91 | 13.24 |
| FEB   | No Data | 17.00   | 12.34 | 14.48 |
| MAR   | No Data | 16.81   | 8.11  | 12.36 |
| APR   | No Data | 15.48   | 9.86  | 12.53 |
| MAY   | No Data | 16.75   | 11.68 | 14.27 |
| JUN   | 10.49   | 11.33   | 4.87  | 8.95  |
| JUL   | 14.00   | 18.00   | 7.10  | 10.56 |
| AUG   | 15.02   | 15.40   | 11.11 | 13.22 |
| SEP   | 10.56   | No Data | 7.36  | 9.05  |
| OCT   | 10.78   | No Data | 12.52 | 11.65 |
| NOV   | 17.92   | No Data | 11.53 | 14.64 |
| DEC   | 10.74   | No Date | 13.45 | 12.02 |
| All   | 12.81   | 15.16   | 10.26 | 12.18 |

<sup>a</sup>Nephelometric Turbidity Units

<sup>b</sup>1988 to 1990 Period.

From Able, K. W., R. Hoden, D. Witting, and J. B. Durand. 1992. Physical Parameters of the Mullica River-Great Bay Estuary (With a List of Research Publications). Technical Report, Contribution No. 92-06, Institute of Marine and Coastal Sciences, Rutgers University, New Brunswick, New Jersey. 38 p.

**Appendix 10. Summary statistics for environmental parameters monitored at three SWMP sites (i.e., Buoy 126, Chestnut Neck, and Lower Bank) in the JCNERR for data years 1999 and 2000 (covering the period from December 1998 to November 2000)(Kennish and O'Donnell, 2002).**

Table 1. Lower Bank 1999 (Temperature and Salinity).

| <u>Yearly Temperature (°C)</u> |          | <u>Winter Temperature (°C)</u> |         | <u>Spring Temperature (°C)</u> |         | <u>Summer Temperature (°C)</u> |         | <u>Fall Temperature (°C)</u> |         |
|--------------------------------|----------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|------------------------------|---------|
| Mean                           | 15.06    | Mean                           | 5.10    | Mean                           | 12.13   | Mean                           | 25.99   | Mean                         | 15.74   |
| Std. Error                     | 0.07     | Std. Error                     | 0.05    | Std. Error                     | 0.08    | Std. Error                     | 0.04    | Std. Error                   | 0.08    |
| Median                         | 14.03    | Median                         | 5.06    | Median                         | 12.34   | Median                         | 26.40   | Median                       | 15.13   |
| Mode                           | 27.00    | Mode                           | 4.73    | Mode                           | 15.70   | Mode                           | 27.00   | Mode                         | 9.77    |
| Std. Deviation                 | 8.59     | Std. Deviation                 | 3.14    | Std. Deviation                 | 5.13    | Std. Deviation                 | 2.38    | Std. Deviation               | 5.18    |
| Variance                       | 73.74    | Variance                       | 9.86    | Variance                       | 26.33   | Variance                       | 5.66    | Variance                     | 26.82   |
| Range                          | 32.07    | Range                          | 13.38   | Range                          | 22.85   | Range                          | 12.10   | Range                        | 21.35   |
| Minimum                        | -0.57    | Minimum                        | -0.57   | Minimum                        | 2.05    | Minimum                        | 19.40   | Minimum                      | 5.59    |
| Maximum                        | 31.50    | Maximum                        | 12.81   | Maximum                        | 24.90   | Maximum                        | 31.50   | Maximum                      | 26.94   |
| Count                          | 16540.00 | Count                          | 3857.00 | Count                          | 4007.00 | Count                          | 4311.00 | Count                        | 4365.00 |
| <u>Yearly Salinity (ppt)</u>   |          | <u>Winter Salinity (ppt)</u>   |         | <u>Spring Salinity (ppt)</u>   |         | <u>Summer Salinity (ppt)</u>   |         | <u>Fall Salinity (ppt)</u>   |         |
| Mean                           | 3.15     | Mean                           | 3.30    | Mean                           | 0.98    | Mean                           | 6.49    | Mean                         | 1.69    |
| Std. Error                     | 0.03     | Std. Error                     | 0.06    | Std. Error                     | 0.02    | Std. Error                     | 0.06    | Std. Error                   | 0.03    |
| Median                         | 1.64     | Median                         | 1.57    | Median                         | 0.45    | Median                         | 5.90    | Median                       | 1.15    |
| Mode                           | 0.04     | Mode                           | 0.05    | Mode                           | 0.04    | Mode                           | 2.60    | Mode                         | 0.05    |
| Std. Deviation                 | 3.68     | Std. Deviation                 | 3.73    | Std. Deviation                 | 1.22    | Std. Deviation                 | 4.18    | Std. Deviation               | 1.67    |
| Variance                       | 13.52    | Variance                       | 13.91   | Variance                       | 1.49    | Variance                       | 17.45   | Variance                     | 2.79    |
| Range                          | 18.50    | Range                          | 14.60   | Range                          | 7.30    | Range                          | 18.40   | Range                        | 9.39    |
| Minimum                        | 0.00     | Minimum                        | 0.04    | Minimum                        | 0.00    | Minimum                        | 0.10    | Minimum                      | 0.03    |
| Maximum                        | 18.50    | Maximum                        | 14.64   | Maximum                        | 7.30    | Maximum                        | 18.50   | Maximum                      | 9.42    |
| Count                          | 16514.00 | Count                          | 3852.00 | Count                          | 3999.00 | Count                          | 4311.00 | Count                        | 4352.00 |

Table 1. Lower Bank 1999 (Dissolved Oxygen).

| <u>Yearly DO (mg/L)</u> |          | <u>Winter DO (mg/L)</u> |         | <u>Spring DO (mg/L)</u> |         | <u>Summer DO (mg/L)</u> |         | <u>Fall DO (mg/L)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 8.98     | Mean                    | 11.49   | Mean                    | 9.67    | Mean                    | 6.32    | Mean                  | 8.28    |
| Std. Error              | 0.02     | Std. Error              | 0.01    | Std. Error              | 0.02    | Std. Error              | 0.01    | Std. Error            | 0.03    |
| Median                  | 9.10     | Median                  | 11.41   | Median                  | 9.95    | Median                  | 6.40    | Median                | 8.07    |
| Mode                    | 6.50     | Mode                    | 11.11   | Mode                    | 9.50    | Mode                    | 6.50    | Mode                  | 8.34    |
| Std. Deviation          | 2.20     | Std. Deviation          | 0.77    | Std. Deviation          | 0.93    | Std. Deviation          | 0.66    | Std. Deviation        | 1.70    |
| Variance                | 4.85     | Variance                | 0.59    | Variance                | 0.87    | Variance                | 0.44    | Variance              | 2.89    |
| Range                   | 9.93     | Range                   | 4.25    | Range                   | 4.85    | Range                   | 4.90    | Range                 | 7.55    |
| Minimum                 | 3.50     | Minimum                 | 9.18    | Minimum                 | 6.40    | Minimum                 | 3.50    | Minimum               | 4.91    |
| Maximum                 | 13.43    | Maximum                 | 13.43   | Maximum                 | 11.25   | Maximum                 | 8.40    | Maximum               | 12.46   |
| Count                   | 12309.00 | Count                   | 3316.00 | Count                   | 2516.00 | Count                   | 2793.00 | Count                 | 3684.00 |

| <u>Yearly DO (% saturation)</u> |          | <u>Winter DO (% saturation)</u> |         | <u>Spring DO (% saturation)</u> |         | <u>Summer DO (% saturation)</u> |         | <u>Fall DO (% saturation)</u> |         |
|---------------------------------|----------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|-------------------------------|---------|
| Mean                            | 87.69    | Mean                            | 92.48   | Mean                            | 94.35   | Mean                            | 80.81   | Mean                          | 84.06   |
| Std. Error                      | 0.08     | Std. Error                      | 0.08    | Std. Error                      | 0.09    | Std. Error                      | 0.14    | Std. Error                    | 0.15    |
| Median                          | 89.00    | Median                          | 91.90   | Median                          | 94.50   | Median                          | 80.90   | Median                        | 83.50   |
| Mode                            | 89.10    | Mode                            | 90.20   | Mode                            | 96.70   | Mode                            | 81.00   | Mode                          | 80.60   |
| Std. Deviation                  | 8.74     | Std. Deviation                  | 4.50    | Std. Deviation                  | 4.53    | Std. Deviation                  | 7.52    | Std. Deviation                | 8.97    |
| Variance                        | 76.41    | Variance                        | 20.22   | Variance                        | 20.49   | Variance                        | 56.49   | Variance                      | 80.38   |
| Range                           | 60.00    | Range                           | 21.10   | Range                           | 27.50   | Range                           | 60.00   | Range                         | 45.60   |
| Minimum                         | 47.60    | Minimum                         | 83.70   | Minimum                         | 77.50   | Minimum                         | 47.60   | Minimum                       | 59.10   |
| Maximum                         | 107.60   | Maximum                         | 104.80  | Maximum                         | 105.00  | Maximum                         | 107.60  | Maximum                       | 104.70  |
| Count                           | 12309.00 | Count                           | 3316.00 | Count                           | 2516.00 | Count                           | 2793.00 | Count                         | 3684.00 |

Table 1. Lower Bank 1999 (Depth and pH).

| <u>Yearly Depth (m)</u> |          | <u>Winter Depth (m)</u> |         | <u>Spring Depth (m)</u> |         | <u>Summer Depth (m)</u> |         | <u>Fall Depth (m)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 1.74     | Mean                    | 1.72    | Mean                    | 1.77    | Mean                    | 1.75    | Mean                  | 1.73    |
| Std. Error              | 0.00     | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error            | 0.01    |
| Median                  | 1.77     | Median                  | 1.73    | Median                  | 1.79    | Median                  | 1.78    | Median                | 1.75    |
| Mode                    | 2.10     | Mode                    | 2.17    | Mode                    | 2.07    | Mode                    | 2.10    | Mode                  | 1.66    |
| Std. Deviation          | 0.35     | Std. Deviation          | 0.36    | Std. Deviation          | 0.35    | Std. Deviation          | 0.34    | Std. Deviation        | 0.37    |
| Variance                | 0.13     | Variance                | 0.13    | Variance                | 0.12    | Variance                | 0.11    | Variance              | 0.13    |
| Range                   | 1.93     | Range                   | 1.82    | Range                   | 1.86    | Range                   | 1.59    | Range                 | 1.85    |
| Minimum                 | 0.68     | Minimum                 | 0.78    | Minimum                 | 0.75    | Minimum                 | 0.96    | Minimum               | 0.68    |
| Maximum                 | 2.61     | Maximum                 | 2.60    | Maximum                 | 2.61    | Maximum                 | 2.55    | Maximum               | 2.54    |
| Count                   | 16537.00 | Count                   | 3857.00 | Count                   | 4007.00 | Count                   | 4311.00 | Count                 | 4362.00 |

| <u>Yearly pH</u> |          | <u>Winter pH</u> |         | <u>Spring pH</u> |         | <u>Summer pH</u> |         | <u>Fall pH</u> |         |
|------------------|----------|------------------|---------|------------------|---------|------------------|---------|----------------|---------|
| Mean             | 6.14     | Mean             | 5.82    | Mean             | 5.74    | Mean             | 6.62    | Mean           | 6.14    |
| Std. Error       | 0.01     | Std. Error       | 0.03    | Std. Error       | 0.01    | Std. Error       | 0.01    | Std. Error     | 0.01    |
| Median           | 6.40     | Median           | 5.64    | Median           | 5.90    | Median           | 6.70    | Median         | 6.30    |
| Mode             | 6.70     | Mode             | 7.48    | Mode             | 6.50    | Mode             | 6.80    | Mode           | 6.73    |
| Std. Deviation   | 0.85     | Std. Deviation   | 1.29    | Std. Deviation   | 0.69    | Std. Deviation   | 0.37    | Std. Deviation | 0.70    |
| Variance         | 0.72     | Variance         | 1.66    | Variance         | 0.48    | Variance         | 0.13    | Variance       | 0.49    |
| Range            | 4.00     | Range            | 4.00    | Range            | 2.74    | Range            | 2.70    | Range          | 3.05    |
| Minimum          | 3.71     | Minimum          | 3.71    | Minimum          | 4.43    | Minimum          | 4.50    | Minimum        | 4.27    |
| Maximum          | 7.71     | Maximum          | 7.71    | Maximum          | 7.17    | Maximum          | 7.20    | Maximum        | 7.32    |
| Count            | 14489.00 | Count            | 2643.00 | Count            | 3199.00 | Count            | 4311.00 | Count          | 4336.00 |

Table 1. Lower Bank 1999 (Turbidity).

| <u>Yearly Turbidity (NTU)</u> |          | <u>Winter Turbidity (NTU)</u> |         | <u>Spring Turbidity (NTU)</u> |         | <u>Summer Turbidity (NTU)</u> |         | <u>Fall Turbidity (NTU)</u> |         |
|-------------------------------|----------|-------------------------------|---------|-------------------------------|---------|-------------------------------|---------|-----------------------------|---------|
| Mean                          | 25.04    | Mean                          | 18.85   | Mean                          | 31.30   | Mean                          | 20.02   | Mean                        | 26.49   |
| Std. Error                    | 0.15     | Std. Error                    | 0.25    | Std. Error                    | 0.33    | Std. Error                    | 0.29    | Std. Error                  | 0.24    |
| Median                        | 20.60    | Median                        | 15.60   | Median                        | 26.00   | Median                        | 15.00   | Median                      | 23.20   |
| Mode                          | 9.00     | Mode                          | 7.30    | Mode                          | 14.00   | Mode                          | 9.00    | Mode                        | 12.20   |
| Std. Deviation                | 17.64    | Std. Deviation                | 13.38   | Std. Deviation                | 20.89   | Std. Deviation                | 15.07   | Std. Deviation              | 16.02   |
| Variance                      | 311.28   | Variance                      | 179.12  | Variance                      | 436.55  | Variance                      | 227.14  | Variance                    | 256.55  |
| Range                         | 176.10   | Range                         | 86.10   | Range                         | 159.80  | Range                         | 171.00  | Range                       | 157.00  |
| Minimum                       | 0.00     | Minimum                       | 1.90    | Minimum                       | 0.00    | Minimum                       | 5.00    | Minimum                     | 1.90    |
| Maximum                       | 176.00   | Maximum                       | 88.00   | Maximum                       | 159.70  | Maximum                       | 176.00  | Maximum                     | 158.90  |
| Count                         | 13958.00 | Count                         | 2830.00 | Count                         | 4004.00 | Count                         | 2760.00 | Count                       | 4364.00 |

Table 2. Lower Bank 2000 (Temperature and Salinity).

| <u>Yearly Temperature (°C)</u> |          | <u>Winter Temperature (°C)</u> |         | <u>Spring Temperature (°C)</u> |         | <u>Summer Temperature (°C)</u> |         | <u>Fall Temperature (°C)</u> |         |
|--------------------------------|----------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|------------------------------|---------|
| Mean                           | 15.26    | Mean                           | 4.70    | Mean                           | 14.17   | Mean                           | 24.70   | Mean                         | 14.91   |
| Std. Error                     | 0.06     | Std. Error                     | 0.05    | Std. Error                     | 0.07    | Std. Error                     | 0.03    | Std. Error                   | 0.09    |
| Median                         | 14.80    | Median                         | 5.39    | Median                         | 12.80   | Median                         | 24.90   | Median                       | 15.20   |
| Mode                           | 26.00    | Mode                           | 0.00    | Mode                           | 12.00   | Mode                           | 26.00   | Mode                         | 10.70   |
| Std. Deviation                 | 8.07     | Std. Deviation                 | 2.88    | Std. Deviation                 | 4.52    | Std. Deviation                 | 2.11    | Std. Deviation               | 6.18    |
| Variance                       | 65.05    | Variance                       | 8.29    | Variance                       | 20.41   | Variance                       | 4.45    | Variance                     | 38.20   |
| Range                          | 30.30    | Range                          | 12.10   | Range                          | 19.60   | Range                          | 11.90   | Range                        | 25.30   |
| Minimum                        | -0.70    | Minimum                        | -0.70   | Minimum                        | 6.10    | Minimum                        | 17.70   | Minimum                      | 1.80    |
| Maximum                        | 29.60    | Maximum                        | 11.40   | Maximum                        | 25.70   | Maximum                        | 29.60   | Maximum                      | 27.10   |
| Count                          | 16531.00 | Count                          | 3343.00 | Count                          | 4415.00 | Count                          | 4406.00 | Count                        | 4367.00 |
| <u>Yearly Salinity (ppt)</u>   |          | <u>Winter Salinity (ppt)</u>   |         | <u>Spring Salinity (ppt)</u>   |         | <u>Summer Salinity (ppt)</u>   |         | <u>Fall Salinity (ppt)</u>   |         |
| Mean                           | 2.08     | Mean                           | 1.29    | Mean                           | 1.39    | Mean                           | 2.73    | Mean                         | 2.73    |
| Std. Error                     | 0.02     | Std. Error                     | 0.03    | Std. Error                     | 0.02    | Std. Error                     | 0.03    | Std. Error                   | 0.04    |
| Median                         | 1.30     | Median                         | 0.43    | Median                         | 0.70    | Median                         | 2.20    | Median                       | 2.10    |
| Mode                           | 0.10     | Mode                           | 0.00    | Mode                           | 0.10    | Mode                           | 0.40    | Mode                         | 0.10    |
| Std. Deviation                 | 2.16     | Std. Deviation                 | 1.79    | Std. Deviation                 | 1.63    | Std. Deviation                 | 2.09    | Std. Deviation               | 2.51    |
| Variance                       | 4.66     | Variance                       | 3.22    | Variance                       | 2.66    | Variance                       | 4.35    | Variance                     | 6.29    |
| Range                          | 11.20    | Range                          | 10.61   | Range                          | 9.30    | Range                          | 9.70    | Range                        | 11.20   |
| Minimum                        | 0.00     | Minimum                        | 0.00    | Minimum                        | 0.00    | Minimum                        | 0.00    | Minimum                      | 0.00    |
| Maximum                        | 11.20    | Maximum                        | 10.61   | Maximum                        | 9.30    | Maximum                        | 9.70    | Maximum                      | 11.20   |
| Count                          | 16517.00 | Count                          | 3329.00 | Count                          | 4415.00 | Count                          | 4406.00 | Count                        | 4367.00 |

Table 2. Lower Bank 2000 (Dissolved Oxygen).

| <u>Yearly DO (mg/L)</u> |          | <u>Winter DO (mg/L)</u> |         | <u>Spring DO (mg/L)</u> |         | <u>Summer DO (mg/L)</u> |         | <u>Fall DO (mg/L)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 9.18     | Mean                    | 12.19   | Mean                    | 9.44    | Mean                    | 6.27    | Mean                  | 9.14    |
| Std. Error              | 0.02     | Std. Error              | 0.02    | Std. Error              | 0.02    | Std. Error              | 0.01    | Std. Error            | 0.04    |
| Median                  | 9.40     | Median                  | 11.92   | Median                  | 9.60    | Median                  | 6.10    | Median                | 8.10    |
| Mode                    | 6.00     | Mode                    | 12.10   | Mode                    | 9.60    | Mode                    | 6.00    | Mode                  | 7.60    |
| Std. Deviation          | 2.50     | Std. Deviation          | 1.03    | Std. Deviation          | 1.21    | Std. Deviation          | 0.76    | Std. Deviation        | 2.36    |
| Variance                | 6.27     | Variance                | 1.06    | Variance                | 1.47    | Variance                | 0.58    | Variance              | 5.57    |
| Range                   | 11.80    | Range                   | 4.31    | Range                   | 6.20    | Range                   | 5.70    | Range                 | 10.00   |
| Minimum                 | 3.10     | Minimum                 | 10.59   | Minimum                 | 5.60    | Minimum                 | 3.10    | Minimum               | 4.50    |
| Maximum                 | 14.90    | Maximum                 | 14.90   | Maximum                 | 11.80   | Maximum                 | 8.80    | Maximum               | 14.50   |
| Count                   | 14926.00 | Count                   | 3343.00 | Count                   | 4413.00 | Count                   | 3788.00 | Count                 | 3382.00 |

| <u>Yearly DO (% saturation)</u> |          | <u>Winter DO (% saturation)</u> |         | <u>Spring DO (% saturation)</u> |         | <u>Summer DO (% saturation)</u> |         | <u>Fall DO (% saturation)</u> |         |
|---------------------------------|----------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|-------------------------------|---------|
| Mean                            | 88.04    | Mean                            | 95.08   | Mean                            | 91.66   | Mean                            | 76.49   | Mean                          | 89.30   |
| Std. Error                      | 0.08     | Std. Error                      | 0.06    | Std. Error                      | 0.07    | Std. Error                      | 0.14    | Std. Error                    | 0.18    |
| Median                          | 91.00    | Median                          | 94.90   | Median                          | 92.70   | Median                          | 75.25   | Median                        | 87.90   |
| Mode                            | 93.80    | Mode                            | 97.60   | Mode                            | 93.80   | Mode                            | 74.80   | Mode                          | 83.20   |
| Std. Deviation                  | 10.14    | Std. Deviation                  | 3.51    | Std. Deviation                  | 4.86    | Std. Deviation                  | 8.33    | Std. Deviation                | 10.75   |
| Variance                        | 102.77   | Variance                        | 12.35   | Variance                        | 23.57   | Variance                        | 69.42   | Variance                      | 115.64  |
| Range                           | 71.20    | Range                           | 22.50   | Range                           | 36.70   | Range                           | 65.90   | Range                         | 57.00   |
| Minimum                         | 39.30    | Minimum                         | 87.50   | Minimum                         | 67.10   | Minimum                         | 39.30   | Minimum                       | 53.50   |
| Maximum                         | 110.50   | Maximum                         | 110.00  | Maximum                         | 103.80  | Maximum                         | 105.20  | Maximum                       | 110.50  |
| Count                           | 14914.00 | Count                           | 3331.00 | Count                           | 4413.00 | Count                           | 3788.00 | Count                         | 3382.00 |

Table 2. Lower Bank 2000 (Depth and pH).

| <u>Yearly Depth (m)</u> |          | <u>Winter Depth (m)</u> |         | <u>Spring Depth (m)</u> |         | <u>Summer Depth (m)</u> |         | <u>Fall Depth (m)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 1.73     | Mean                    | 1.60    | Mean                    | 1.76    | Mean                    | 1.80    | Mean                  | 1.74    |
| Std. Error              | 0.00     | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error            | 0.01    |
| Median                  | 1.75     | Median                  | 1.60    | Median                  | 1.79    | Median                  | 1.83    | Median                | 1.76    |
| Mode                    | 2.03     | Mode                    | 1.27    | Mode                    | 2.03    | Mode                    | 2.15    | Mode                  | 2.05    |
| Std. Deviation          | 0.37     | Std. Deviation          | 0.39    | Std. Deviation          | 0.37    | Std. Deviation          | 0.34    | Std. Deviation        | 0.37    |
| Variance                | 0.14     | Variance                | 0.15    | Variance                | 0.14    | Variance                | 0.12    | Variance              | 0.14    |
| Range                   | 1.95     | Range                   | 1.83    | Range                   | 1.82    | Range                   | 1.51    | Range                 | 1.84    |
| Minimum                 | 0.63     | Minimum                 | 0.63    | Minimum                 | 0.76    | Minimum                 | 1.00    | Minimum               | 0.74    |
| Maximum                 | 2.58     | Maximum                 | 2.46    | Maximum                 | 2.58    | Maximum                 | 2.51    | Maximum               | 2.58    |
| Count                   | 16531.00 | Count                   | 3343.00 | Count                   | 4415.00 | Count                   | 4406.00 | Count                 | 4367.00 |

| <u>Yearly pH</u> |          | <u>Winter pH</u> |         | <u>Spring pH</u> |         | <u>Summer pH</u> |         | <u>Fall pH</u> |         |
|------------------|----------|------------------|---------|------------------|---------|------------------|---------|----------------|---------|
| Mean             | 6.24     | Mean             | 5.75    | Mean             | 6.08    | Mean             | 6.44    | Mean           | 6.57    |
| Std. Error       | 0.00     | Std. Error       | 0.01    | Std. Error       | 0.01    | Std. Error       | 0.00    | Std. Error     | 0.01    |
| Median           | 6.40     | Median           | 5.80    | Median           | 6.20    | Median           | 6.50    | Median         | 6.70    |
| Mode             | 6.60     | Mode             | 4.90    | Mode             | 6.60    | Mode             | 6.50    | Mode           | 6.90    |
| Std. Deviation   | 0.64     | Std. Deviation   | 0.68    | Std. Deviation   | 0.68    | Std. Deviation   | 0.29    | Std. Deviation | 0.53    |
| Variance         | 0.41     | Variance         | 0.47    | Variance         | 0.46    | Variance         | 0.08    | Variance       | 0.28    |
| Range            | 3.20     | Range            | 2.88    | Range            | 2.90    | Range            | 1.50    | Range          | 2.90    |
| Minimum          | 4.50     | Minimum          | 4.58    | Minimum          | 4.50    | Minimum          | 5.60    | Minimum        | 4.80    |
| Maximum          | 7.70     | Maximum          | 7.46    | Maximum          | 7.40    | Maximum          | 7.10    | Maximum        | 7.70    |
| Count            | 16531.00 | Count            | 3343.00 | Count            | 4415.00 | Count            | 4406.00 | Count          | 4367.00 |

Table 2. Lower Bank 2000 (Turbidity).

| <u>Yearly Turbidity (NTU)</u> |          | <u>Winter Turbidity (NTU)</u> |         | <u>Spring Turbidity (NTU)</u> |         | <u>Summer Turbidity (NTU)</u> |         | <u>Fall Turbidity (NTU)</u> |         |
|-------------------------------|----------|-------------------------------|---------|-------------------------------|---------|-------------------------------|---------|-----------------------------|---------|
| Mean                          | 24.27    | Mean                          | 27.96   | Mean                          | 32.39   | Mean                          | 22.67   | Mean                        | 16.13   |
| Std. Error                    | 0.15     | Std. Error                    | 0.38    | Std. Error                    | 0.37    | Std. Error                    | 0.20    | Std. Error                  | 0.21    |
| Median                        | 20.00    | Median                        | 23.00   | Median                        | 27.00   | Median                        | 21.00   | Median                      | 13.00   |
| Mode                          | 10.00    | Mode                          | 8.00    | Mode                          | 13.00   | Mode                          | 11.00   | Mode                        | 1.00    |
| Std. Deviation                | 18.87    | Std. Deviation                | 22.19   | Std. Deviation                | 22.26   | Std. Deviation                | 12.98   | Std. Deviation              | 13.70   |
| Variance                      | 356.00   | Variance                      | 492.60  | Variance                      | 495.57  | Variance                      | 168.42  | Variance                    | 187.82  |
| Range                         | 335.40   | Range                         | 334.20  | Range                         | 140.00  | Range                         | 119.00  | Range                       | 130.00  |
| Minimum                       | 0.00     | Minimum                       | 0.20    | Minimum                       | 3.00    | Minimum                       | 3.00    | Minimum                     | 0.00    |
| Maximum                       | 334.40   | Maximum                       | 334.40  | Maximum                       | 143.00  | Maximum                       | 122.00  | Maximum                     | 129.00  |
| Count                         | 15682.00 | Count                         | 3343.00 | Count                         | 3646.00 | Count                         | 4392.00 | Count                       | 4301.00 |

Table 3. Chestnut Neck 1999 (Temperature and Salinity).

| <u>Yearly Temperature (°C)</u> |          | <u>Winter Temperature (°C)</u> |         | <u>Spring Temperature (°C)</u> |         | <u>Summer Temperature (°C)</u> |         | <u>Fall Temperature (°C)</u> |         |
|--------------------------------|----------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|------------------------------|---------|
| Mean                           | 12.91    | Mean                           | 4.88    | Mean                           | 10.52   | Mean                           | 24.52   | Mean                         | 16.25   |
| Std. Error                     | 0.07     | Std. Error                     | 0.05    | Std. Error                     | 0.07    | Std. Error                     | 0.05    | Std. Error                   | 0.08    |
| Median                         | 11.98    | Median                         | 4.70    | Median                         | 11.60   | Median                         | 24.40   | Median                       | 16.24   |
| Mode                           | 4.10     | Mode                           | 4.10    | Mode                           | 11.66   | Mode                           | 23.90   | Mode                         | 24.30   |
| Std. Deviation                 | 7.78     | Std. Deviation                 | 3.18    | Std. Deviation                 | 4.44    | Std. Deviation                 | 2.12    | Std. Deviation               | 5.03    |
| Variance                       | 60.55    | Variance                       | 10.10   | Variance                       | 19.70   | Variance                       | 4.49    | Variance                     | 25.30   |
| Range                          | 29.96    | Range                          | 12.89   | Range                          | 18.00   | Range                          | 9.23    | Range                        | 18.82   |
| Minimum                        | -0.57    | Minimum                        | -0.57   | Minimum                        | 2.34    | Minimum                        | 20.16   | Minimum                      | 6.98    |
| Maximum                        | 29.39    | Maximum                        | 12.32   | Maximum                        | 20.34   | Maximum                        | 29.39   | Maximum                      | 25.80   |
| Count                          | 13823.00 | Count                          | 3834.00 | Count                          | 3657.00 | Count                          | 2213.00 | Count                        | 4119.00 |

| <u>Yearly Salinity (ppt)</u> |          | <u>Winter Salinity (ppt)</u> |         | <u>Spring Salinity (ppt)</u> |         | <u>Summer Salinity (ppt)</u> |         | <u>Fall Salinity (ppt)</u> |         |
|------------------------------|----------|------------------------------|---------|------------------------------|---------|------------------------------|---------|----------------------------|---------|
| Mean                         | 15.18    | Mean                         | 15.66   | Mean                         | 12.73   | Mean                         | 18.77   | Mean                       | 14.99   |
| Std. Error                   | 0.04     | Std. Error                   | 0.08    | Std. Error                   | 0.06    | Std. Error                   | 0.07    | Std. Error                 | 0.06    |
| Median                       | 15.30    | Median                       | 16.29   | Median                       | 12.75   | Median                       | 18.86   | Median                     | 15.22   |
| Mode                         | 15.50    | Mode                         | 13.50   | Mode                         | 11.78   | Mode                         | 18.40   | Mode                       | 14.40   |
| Std. Deviation               | 4.43     | Std. Deviation               | 4.93    | Std. Deviation               | 3.55    | Std. Deviation               | 3.24    | Std. Deviation             | 3.75    |
| Variance                     | 19.66    | Variance                     | 24.27   | Variance                     | 12.57   | Variance                     | 10.51   | Variance                   | 14.10   |
| Range                        | 23.91    | Range                        | 22.69   | Range                        | 18.65   | Range                        | 18.70   | Range                      | 20.30   |
| Minimum                      | 2.89     | Minimum                      | 2.89    | Minimum                      | 4.31    | Minimum                      | 8.10    | Minimum                    | 3.50    |
| Maximum                      | 26.80    | Maximum                      | 25.58   | Maximum                      | 22.96   | Maximum                      | 26.80   | Maximum                    | 23.80   |
| Count                        | 13823.00 | Count                        | 3834.00 | Count                        | 3657.00 | Count                        | 2213.00 | Count                      | 4119.00 |

Table 3. Chestnut Neck 1999 (Dissolved Oxygen).

| <u>Yearly DO (mg/L)</u> |          | <u>Winter DO (mg/L)</u> |         | <u>Spring DO (mg/L)</u> |         | <u>Summer DO (mg/L)</u> |         | <u>Fall DO (mg/L)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 9.04     | Mean                    | 10.98   | Mean                    | 9.75    | Mean                    | 5.98    | Mean                  | 8.02    |
| Std. Error              | 0.02     | Std. Error              | 0.02    | Std. Error              | 0.02    | Std. Error              | 0.02    | Std. Error            | 0.03    |
| Median                  | 9.21     | Median                  | 11.26   | Median                  | 9.37    | Median                  | 5.90    | Median                | 7.78    |
| Mode                    | 12.20    | Mode                    | 12.20   | Mode                    | 9.15    | Mode                    | 5.40    | Mode                  | 6.70    |
| Std. Deviation          | 2.12     | Std. Deviation          | 0.98    | Std. Deviation          | 1.35    | Std. Deviation          | 0.85    | Std. Deviation        | 1.40    |
| Variance                | 4.50     | Variance                | 0.97    | Variance                | 1.84    | Variance                | 0.72    | Variance              | 1.97    |
| Range                   | 8.90     | Range                   | 3.71    | Range                   | 5.51    | Range                   | 4.85    | Range                 | 5.24    |
| Minimum                 | 3.60     | Minimum                 | 8.79    | Minimum                 | 6.96    | Minimum                 | 3.60    | Minimum               | 5.10    |
| Maximum                 | 12.50    | Maximum                 | 12.50   | Maximum                 | 12.47   | Maximum                 | 8.45    | Maximum               | 10.34   |
| Count                   | 11493.00 | Count                   | 3205.00 | Count                   | 3649.00 | Count                   | 2001.00 | Count                 | 2638.00 |

| <u>Yearly DO (% saturation)</u> |          | <u>Winter DO (% saturation)</u> |         | <u>Spring DO (% saturation)</u> |         | <u>Summer DO (% saturation)</u> |         | <u>Fall DO (% saturation)</u> |         |
|---------------------------------|----------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|-------------------------------|---------|
| Mean                            | 89.84    | Mean                            | 95.45   | Mean                            | 93.61   | Mean                            | 79.37   | Mean                          | 85.74   |
| Std. Error                      | 0.09     | Std. Error                      | 0.08    | Std. Error                      | 0.07    | Std. Error                      | 0.23    | Std. Error                    | 0.17    |
| Median                          | 92.20    | Median                          | 95.40   | Median                          | 94.10   | Median                          | 78.70   | Median                        | 87.60   |
| Mode                            | 93.40    | Mode                            | 93.90   | Mode                            | 96.00   | Mode                            | 77.00   | Mode                          | 92.60   |
| Std. Deviation                  | 9.13     | Std. Deviation                  | 4.77    | Std. Deviation                  | 4.01    | Std. Deviation                  | 10.38   | Std. Deviation                | 8.59    |
| Variance                        | 83.38    | Variance                        | 22.71   | Variance                        | 16.04   | Variance                        | 107.78  | Variance                      | 73.78   |
| Range                           | 62.80    | Range                           | 23.20   | Range                           | 24.80   | Range                           | 62.80   | Range                         | 40.70   |
| Minimum                         | 48.50    | Minimum                         | 85.20   | Minimum                         | 77.10   | Minimum                         | 48.50   | Minimum                       | 61.50   |
| Maximum                         | 111.30   | Maximum                         | 108.40  | Maximum                         | 101.90  | Maximum                         | 111.30  | Maximum                       | 102.20  |
| Count                           | 11493.00 | Count                           | 3205.00 | Count                           | 3649.00 | Count                           | 2001.00 | Count                         | 2638.00 |

Table 3. Chestnut Neck 1999 (Depth and pH).

| <u>Yearly Depth (m)</u> |          | <u>Winter Depth (m)</u> |         | <u>Spring Depth (m)</u> |         | <u>Summer Depth (m)</u> |         | <u>Fall Depth (m)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 1.68     | Mean                    | 1.86    | Mean                    | 1.40    | Mean                    | 1.75    | Mean                  | 1.72    |
| Std. Error              | 0.00     | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error            | 0.01    |
| Median                  | 1.72     | Median                  | 1.86    | Median                  | 1.34    | Median                  | 1.77    | Median                | 1.74    |
| Mode                    | 1.60     | Mode                    | 1.60    | Mode                    | 1.26    | Mode                    | 1.97    | Mode                  | 2.11    |
| Std. Deviation          | 0.47     | Std. Deviation          | 0.36    | Std. Deviation          | 0.62    | Std. Deviation          | 0.33    | Std. Deviation        | 0.33    |
| Variance                | 0.22     | Variance                | 0.13    | Variance                | 0.39    | Variance                | 0.11    | Variance              | 0.11    |
| Range                   | 2.68     | Range                   | 1.86    | Range                   | 2.68    | Range                   | 1.61    | Range                 | 1.61    |
| Minimum                 | 0.11     | Minimum                 | 0.94    | Minimum                 | 0.11    | Minimum                 | 1.01    | Minimum               | 0.84    |
| Maximum                 | 2.80     | Maximum                 | 2.80    | Maximum                 | 2.79    | Maximum                 | 2.62    | Maximum               | 2.45    |
| Count                   | 13823.00 | Count                   | 3834.00 | Count                   | 3657.00 | Count                   | 2213.00 | Count                 | 4119.00 |

| <u>Yearly pH</u> |          | <u>Winter pH</u> |         | <u>Spring pH</u> |         | <u>Summer pH</u> |         | <u>Fall pH</u> |         |
|------------------|----------|------------------|---------|------------------|---------|------------------|---------|----------------|---------|
| Mean             | 7.20     | Mean             | 7.15    | Mean             | 7.18    | Mean             | 7.26    | Mean           | 7.23    |
| Std. Error       | 0.00     | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error     | 0.00    |
| Median           | 7.20     | Median           | 7.20    | Median           | 7.19    | Median           | 7.21    | Median         | 7.23    |
| Mode             | 7.20     | Mode             | 7.10    | Mode             | 7.23    | Mode             | 7.20    | Mode           | 7.20    |
| Std. Deviation   | 0.22     | Std. Deviation   | 0.26    | Std. Deviation   | 0.21    | Std. Deviation   | 0.17    | Std. Deviation | 0.19    |
| Variance         | 0.05     | Variance         | 0.07    | Variance         | 0.04    | Variance         | 0.03    | Variance       | 0.04    |
| Range            | 1.54     | Range            | 1.46    | Range            | 1.21    | Range            | 1.08    | Range          | 1.22    |
| Minimum          | 6.34     | Minimum          | 6.34    | Minimum          | 6.48    | Minimum          | 6.80    | Minimum        | 6.50    |
| Maximum          | 7.88     | Maximum          | 7.80    | Maximum          | 7.69    | Maximum          | 7.88    | Maximum        | 7.72    |
| Count            | 13206.00 | Count            | 3834.00 | Count            | 3656.00 | Count            | 1597.00 | Count          | 4119.00 |

Table 3. Chestnut Neck 1999 (Turbidity).

| <u>Yearly Turbidity (NTU)</u> |          | <u>Winter Turbidity (NTU)</u> |         | <u>Spring Turbidity (NTU)</u> |         | <u>Summer Turbidity (NTU)</u> |         | <u>Fall Turbidity (NTU)</u> |         |
|-------------------------------|----------|-------------------------------|---------|-------------------------------|---------|-------------------------------|---------|-----------------------------|---------|
| Mean                          | 9.69     | Mean                          | 12.85   | Mean                          | 13.25   | Mean                          | 7.46    | Mean                        | 5.54    |
| Std. Error                    | 0.08     | Std. Error                    | 0.23    | Std. Error                    | 0.16    | Std. Error                    | 0.09    | Std. Error                  | 0.06    |
| Median                        | 7.10     | Median                        | 11.00   | Median                        | 10.80   | Median                        | 7.00    | Median                      | 4.60    |
| Mode                          | 4.00     | Mode                          | 1.90    | Mode                          | 6.10    | Mode                          | 3.00    | Mode                        | 4.00    |
| Std. Deviation                | 8.88     | Std. Deviation                | 12.08   | Std. Deviation                | 9.46    | Std. Deviation                | 4.03    | Std. Deviation              | 4.06    |
| Variance                      | 78.88    | Variance                      | 145.95  | Variance                      | 89.48   | Variance                      | 16.27   | Variance                    | 16.49   |
| Range                         | 111.70   | Range                         | 111.70  | Range                         | 79.70   | Range                         | 26.80   | Range                       | 61.00   |
| Minimum                       | 0.00     | Minimum                       | 0.00    | Minimum                       | 1.90    | Minimum                       | 1.00    | Minimum                     | 0.00    |
| Maximum                       | 111.60   | Maximum                       | 111.60  | Maximum                       | 81.60   | Maximum                       | 27.80   | Maximum                     | 61.00   |
| Count                         | 12514.00 | Count                         | 2876.00 | Count                         | 3494.00 | Count                         | 2031.00 | Count                       | 4113.00 |

Table 4. Chestnut Neck 2000 (Temperature and Salinity).

| <u>Yearly Temperature (°C)</u> |          | <u>Winter Temperature (°C)</u> |         | <u>Spring Temperature (°C)</u> |         | <u>Summer Temperature (°C)</u> |         | <u>Fall Temperature (°C)</u> |         |
|--------------------------------|----------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|------------------------------|---------|
| Mean                           | 14.81    | Mean                           | 4.21    | Mean                           | 13.41   | Mean                           | 24.29   | Mean                         | 15.24   |
| Std. Error                     | 0.07     | Std. Error                     | 0.05    | Std. Error                     | 0.07    | Std. Error                     | 0.03    | Std. Error                   | 0.10    |
| Median                         | 15.30    | Median                         | 5.00    | Median                         | 12.10   | Median                         | 24.70   | Median                       | 15.80   |
| Mode                           | 24.60    | Mode                           | -0.90   | Mode                           | 11.80   | Mode                           | 24.60   | Mode                         | 15.80   |
| Std. Deviation                 | 7.99     | Std. Deviation                 | 2.95    | Std. Deviation                 | 4.21    | Std. Deviation                 | 2.09    | Std. Deviation               | 5.75    |
| Variance                       | 63.79    | Variance                       | 8.68    | Variance                       | 17.75   | Variance                       | 4.37    | Variance                     | 33.05   |
| Range                          | 29.00    | Range                          | 10.70   | Range                          | 15.90   | Range                          | 10.80   | Range                        | 21.50   |
| Minimum                        | -1.30    | Minimum                        | -1.30   | Minimum                        | 6.50    | Minimum                        | 16.90   | Minimum                      | 3.20    |
| Maximum                        | 27.70    | Maximum                        | 9.40    | Maximum                        | 22.40   | Maximum                        | 27.70   | Maximum                      | 24.70   |
| Count                          | 14673.00 | Count                          | 3052.00 | Count                          | 4142.00 | Count                          | 3869.00 | Count                        | 3610.00 |

| <u>Yearly Salinity (ppt)</u> |          | <u>Winter Salinity (ppt)</u> |         | <u>Spring Salinity (ppt)</u> |         | <u>Summer Salinity (ppt)</u> |         | <u>Fall Salinity (ppt)</u> |         |
|------------------------------|----------|------------------------------|---------|------------------------------|---------|------------------------------|---------|----------------------------|---------|
| Mean                         | 14.95    | Mean                         | 14.46   | Mean                         | 13.78   | Mean                         | 15.84   | Mean                       | 15.77   |
| Std. Error                   | 0.03     | Std. Error                   | 0.07    | Std. Error                   | 0.06    | Std. Error                   | 0.05    | Std. Error                 | 0.05    |
| Median                       | 15.20    | Median                       | 14.43   | Median                       | 14.00   | Median                       | 16.00   | Median                     | 16.00   |
| Mode                         | 15.90    | Mode                         | 14.60   | Mode                         | 13.50   | Mode                         | 15.10   | Mode                       | 17.10   |
| Std. Deviation               | 3.57     | Std. Deviation               | 3.83    | Std. Deviation               | 3.75    | Std. Deviation               | 2.99    | Std. Deviation             | 3.24    |
| Variance                     | 12.78    | Variance                     | 14.67   | Variance                     | 14.08   | Variance                     | 8.94    | Variance                   | 10.52   |
| Range                        | 22.80    | Range                        | 21.20   | Range                        | 18.40   | Range                        | 16.90   | Range                      | 18.70   |
| Minimum                      | 4.10     | Minimum                      | 5.70    | Minimum                      | 4.10    | Minimum                      | 5.90    | Minimum                    | 5.80    |
| Maximum                      | 26.90    | Maximum                      | 26.90   | Maximum                      | 22.50   | Maximum                      | 22.80   | Maximum                    | 24.50   |
| Count                        | 14670.00 | Count                        | 3049.00 | Count                        | 4142.00 | Count                        | 3869.00 | Count                      | 3610.00 |

Table 4. Chestnut Neck 2000 (Dissolved Oxygen).

| <u>Yearly DO (mg/L)</u> |          | <u>Winter DO (mg/L)</u> |         | <u>Spring DO (mg/L)</u> |         | <u>Summer DO (mg/L)</u> |         | <u>Fall DO (mg/L)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 8.64     | Mean                    | 11.64   | Mean                    | 8.73    | Mean                    | 5.87    | Mean                  | 8.01    |
| Std. Error              | 0.02     | Std. Error              | 0.02    | Std. Error              | 0.03    | Std. Error              | 0.01    | Std. Error            | 0.03    |
| Median                  | 9.00     | Median                  | 11.80   | Median                  | 9.20    | Median                  | 5.90    | Median                | 7.80    |
| Mode                    | 5.90     | Mode                    | 12.20   | Mode                    | 9.20    | Mode                    | 5.90    | Mode                  | 7.90    |
| Std. Deviation          | 2.25     | Std. Deviation          | 0.99    | Std. Deviation          | 1.66    | Std. Deviation          | 0.48    | Std. Deviation        | 1.72    |
| Variance                | 5.08     | Variance                | 0.98    | Variance                | 2.76    | Variance                | 0.23    | Variance              | 2.95    |
| Range                   | 9.10     | Range                   | 4.37    | Range                   | 6.30    | Range                   | 2.50    | Range                 | 6.90    |
| Minimum                 | 4.60     | Minimum                 | 9.33    | Minimum                 | 5.40    | Minimum                 | 4.60    | Minimum               | 4.90    |
| Maximum                 | 13.70    | Maximum                 | 13.70   | Maximum                 | 11.70   | Maximum                 | 7.10    | Maximum               | 11.80   |
| Count                   | 11692.00 | Count                   | 2228.00 | Count                   | 4141.00 | Count                   | 1731.00 | Count                 | 3592.00 |

| <u>Yearly DO (% saturation)</u> |          | <u>Winter DO (% saturation)</u> |         | <u>Spring DO (% saturation)</u> |         | <u>Summer DO (% saturation)</u> |         | <u>Fall DO (% saturation)</u> |         |
|---------------------------------|----------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|-------------------------------|---------|
| Mean                            | 88.07    | Mean                            | 98.27   | Mean                            | 89.53   | Mean                            | 75.64   | Mean                          | 86.06   |
| Std. Error                      | 0.10     | Std. Error                      | 0.07    | Std. Error                      | 0.16    | Std. Error                      | 0.12    | Std. Error                    | 0.14    |
| Median                          | 91.00    | Median                          | 98.70   | Median                          | 92.70   | Median                          | 75.20   | Median                        | 86.90   |
| Mode                            | 98.80    | Mode                            | 98.80   | Mode                            | 92.80   | Mode                            | 72.30   | Mode                          | 95.40   |
| Std. Deviation                  | 10.48    | Std. Deviation                  | 3.48    | Std. Deviation                  | 10.07   | Std. Deviation                  | 5.12    | Std. Deviation                | 8.67    |
| Variance                        | 109.89   | Variance                        | 12.11   | Variance                        | 101.32  | Variance                        | 26.25   | Variance                      | 75.20   |
| Range                           | 54.00    | Range                           | 22.20   | Range                           | 51.40   | Range                           | 31.50   | Range                         | 40.60   |
| Minimum                         | 61.30    | Minimum                         | 89.10   | Minimum                         | 63.90   | Minimum                         | 61.80   | Minimum                       | 61.30   |
| Maximum                         | 115.30   | Maximum                         | 111.30  | Maximum                         | 115.30  | Maximum                         | 93.30   | Maximum                       | 101.90  |
| Count                           | 11691.00 | Count                           | 2228.00 | Count                           | 4140.00 | Count                           | 1731.00 | Count                         | 3592.00 |

Table 4. Chestnut Neck 2000 (Depth and pH).

| <u>Yearly Depth (m)</u> |          | <u>Winter Depth (m)</u> |         | <u>Spring Depth (m)</u> |         | <u>Summer Depth (m)</u> |         | <u>Fall Depth (m)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 1.73     | Mean                    | 1.59    | Mean                    | 1.71    | Mean                    | 1.84    | Mean                  | 1.74    |
| Std. Error              | 0.00     | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error            | 0.01    |
| Median                  | 1.74     | Median                  | 1.59    | Median                  | 1.73    | Median                  | 1.86    | Median                | 1.75    |
| Mode                    | 1.97     | Mode                    | 1.23    | Mode                    | 1.97    | Mode                    | 2.16    | Mode                  | 1.97    |
| Std. Deviation          | 0.36     | Std. Deviation          | 0.37    | Std. Deviation          | 0.38    | Std. Deviation          | 0.33    | Std. Deviation        | 0.34    |
| Variance                | 0.13     | Variance                | 0.14    | Variance                | 0.14    | Variance                | 0.11    | Variance              | 0.12    |
| Range                   | 2.36     | Range                   | 2.17    | Range                   | 2.02    | Range                   | 1.47    | Range                 | 1.74    |
| Minimum                 | 0.27     | Minimum                 | 0.27    | Minimum                 | 0.61    | Minimum                 | 1.10    | Minimum               | 0.88    |
| Maximum                 | 2.63     | Maximum                 | 2.44    | Maximum                 | 2.63    | Maximum                 | 2.57    | Maximum               | 2.62    |
| Count                   | 14673.00 | Count                   | 3052.00 | Count                   | 4142.00 | Count                   | 3869.00 | Count                 | 3610.00 |

| <u>Yearly pH</u> |          | <u>Winter pH</u> |         | <u>Spring pH</u> |         | <u>Summer pH</u> |         | <u>Fall pH</u> |         |
|------------------|----------|------------------|---------|------------------|---------|------------------|---------|----------------|---------|
| Mean             | 7.37     | Mean             | 7.28    | Mean             | 7.47    | Mean             | 7.21    | Mean           | 7.51    |
| Std. Error       | 0.00     | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error     | 0.00    |
| Median           | 7.40     | Median           | 7.30    | Median           | 7.50    | Median           | 7.20    | Median         | 7.50    |
| Mode             | 7.30     | Mode             | 7.40    | Mode             | 7.60    | Mode             | 7.20    | Mode           | 7.70    |
| Std. Deviation   | 0.27     | Std. Deviation   | 0.20    | Std. Deviation   | 0.26    | Std. Deviation   | 0.21    | Std. Deviation | 0.27    |
| Variance         | 0.07     | Variance         | 0.04    | Variance         | 0.07    | Variance         | 0.04    | Variance       | 0.07    |
| Range            | 1.50     | Range            | 1.20    | Range            | 1.50    | Range            | 1.20    | Range          | 1.20    |
| Minimum          | 6.60     | Minimum          | 6.60    | Minimum          | 6.60    | Minimum          | 6.60    | Minimum        | 6.80    |
| Maximum          | 8.10     | Maximum          | 7.80    | Maximum          | 8.10    | Maximum          | 7.80    | Maximum        | 8.00    |
| Count            | 14673.00 | Count            | 3052.00 | Count            | 4142.00 | Count            | 3869.00 | Count          | 3610.00 |

Table 4. Chestnut Neck 2000 (Turbidity).

| <u>Yearly Turbidity (NTU)</u> |          | <u>Winter Turbidity (NTU)</u> |         | <u>Spring Turbidity (NTU)</u> |         | <u>Summer Turbidity (NTU)</u> |         | <u>Fall Turbidity (NTU)</u> |         |
|-------------------------------|----------|-------------------------------|---------|-------------------------------|---------|-------------------------------|---------|-----------------------------|---------|
| Mean                          | 7.85     | Mean                          | 9.98    | Mean                          | 11.77   | Mean                          | 4.28    | Mean                        | 5.35    |
| Std. Error                    | 0.06     | Std. Error                    | 0.16    | Std. Error                    | 0.14    | Std. Error                    | 0.06    | Std. Error                  | 0.08    |
| Median                        | 5.80     | Median                        | 7.20    | Median                        | 10.00   | Median                        | 4.00    | Median                      | 4.00    |
| Mode                          | 4.00     | Mode                          | 6.00    | Mode                          | 6.00    | Mode                          | 3.00    | Mode                        | 4.00    |
| Std. Deviation                | 7.62     | Std. Deviation                | 9.01    | Std. Deviation                | 8.79    | Std. Deviation                | 3.52    | Std. Deviation              | 4.90    |
| Variance                      | 58.11    | Variance                      | 81.15   | Variance                      | 77.30   | Variance                      | 12.42   | Variance                    | 24.02   |
| Range                         | 107.00   | Range                         | 106.00  | Range                         | 98.00   | Range                         | 62.00   | Range                       | 56.00   |
| Minimum                       | 0.00     | Minimum                       | 1.00    | Minimum                       | 0.00    | Minimum                       | 0.00    | Minimum                     | 0.00    |
| Maximum                       | 107.00   | Maximum                       | 107.00  | Maximum                       | 98.00   | Maximum                       | 62.00   | Maximum                     | 56.00   |
| Count                         | 14612.00 | Count                         | 3052.00 | Count                         | 4121.00 | Count                         | 3834.00 | Count                       | 3605.00 |

Table 5. Buoy 126 1999 (Temperature and Salinity).

| <u>Yearly Temperature (°C)</u> |          | <u>Winter Temperature (°C)</u> |         | <u>Spring Temperature (°C)</u> |         | <u>Summer Temperature (°C)</u> |         | <u>Fall Temperature (°C)</u> |         |
|--------------------------------|----------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|------------------------------|---------|
| Mean                           | 13.90    | Mean                           | 3.96    | Mean                           | 9.57    | Mean                           | 21.93   | Mean                         | 16.80   |
| Std. Error                     | 0.06     | Std. Error                     | 0.04    | Std. Error                     | 0.06    | Std. Error                     | 0.04    | Std. Error                   | 0.08    |
| Median                         | 13.33    | Median                         | 4.13    | Median                         | 9.50    | Median                         | 22.00   | Median                       | 17.40   |
| Mode                           | 11.80    | Mode                           | 4.61    | Mode                           | 10.70   | Mode                           | 22.00   | Mode                         | 12.40   |
| Std. Deviation                 | 7.56     | Std. Deviation                 | 1.91    | Std. Deviation                 | 3.80    | Std. Deviation                 | 2.61    | Std. Deviation               | 4.75    |
| Variance                       | 57.17    | Variance                       | 3.66    | Variance                       | 14.48   | Variance                       | 6.81    | Variance                     | 22.55   |
| Range                          | 29.00    | Range                          | 11.64   | Range                          | 21.60   | Range                          | 14.70   | Range                        | 20.00   |
| Minimum                        | -1.10    | Minimum                        | -1.10   | Minimum                        | 1.10    | Minimum                        | 13.20   | Minimum                      | 6.00    |
| Maximum                        | 27.90    | Maximum                        | 10.54   | Maximum                        | 22.70   | Maximum                        | 27.90   | Maximum                      | 26.00   |
| Count                          | 14338.00 | Count                          | 2874.00 | Count                          | 3505.00 | Count                          | 4025.00 | Count                        | 3934.00 |

| <u>Yearly Salinity (ppt)</u> |          | <u>Winter Salinity (ppt)</u> |         | <u>Spring Salinity (ppt)</u> |         | <u>Summer Salinity (ppt)</u> |         | <u>Fall Salinity (ppt)</u> |         |
|------------------------------|----------|------------------------------|---------|------------------------------|---------|------------------------------|---------|----------------------------|---------|
| Mean                         | 29.46    | Mean                         | 29.15   | Mean                         | 28.27   | Mean                         | 30.63   | Mean                       | 29.79   |
| Std. Error                   | 0.02     | Std. Error                   | 0.03    | Std. Error                   | 0.03    | Std. Error                   | 0.02    | Std. Error                 | 0.03    |
| Median                       | 30.03    | Median                       | 29.70   | Median                       | 28.80   | Median                       | 30.80   | Median                     | 30.42   |
| Mode                         | 31.40    | Mode                         | 30.26   | Mode                         | 29.50   | Mode                         | 31.40   | Mode                       | 31.00   |
| Std. Deviation               | 1.89     | Std. Deviation               | 1.72    | Std. Deviation               | 1.95    | Std. Deviation               | 1.01    | Std. Deviation             | 1.83    |
| Variance                     | 3.57     | Variance                     | 2.95    | Variance                     | 3.82    | Variance                     | 1.01    | Variance                   | 3.36    |
| Range                        | 10.15    | Range                        | 8.36    | Range                        | 9.50    | Range                        | 6.50    | Range                      | 9.34    |
| Minimum                      | 22.20    | Minimum                      | 23.18   | Minimum                      | 22.20   | Minimum                      | 25.50   | Minimum                    | 23.01   |
| Maximum                      | 32.35    | Maximum                      | 31.54   | Maximum                      | 31.70   | Maximum                      | 32.00   | Maximum                    | 32.35   |
| Count                        | 13016.00 | Count                        | 2874.00 | Count                        | 3243.00 | Count                        | 2965.00 | Count                      | 3934.00 |

Table 5. Buoy 126 1999 (Dissolved Oxygen).

| <u>Yearly DO (mg/L)</u>         |          | <u>Winter DO (mg/L)</u>         |         | <u>Spring DO (mg/L)</u>         |         | <u>Summer DO (mg/L)</u>         |         | <u>Fall DO (mg/L)</u>         |         |
|---------------------------------|----------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|-------------------------------|---------|
| Mean                            | 9.54     | Mean                            | 12.15   | Mean                            | 10.09   | Mean                            | 6.89    | Mean                          | 8.06    |
| Std. Error                      | 0.02     | Std. Error                      | 0.02    | Std. Error                      | 0.02    | Std. Error                      | 0.02    | Std. Error                    | 0.01    |
| Median                          | 9.20     | Median                          | 12.06   | Median                          | 10.10   | Median                          | 6.80    | Median                        | 8.00    |
| Mode                            | 9.20     | Mode                            | 12.71   | Mode                            | 9.20    | Mode                            | 6.70    | Mode                          | 8.60    |
| Std. Deviation                  | 2.19     | Std. Deviation                  | 0.91    | Std. Deviation                  | 1.27    | Std. Deviation                  | 1.00    | Std. Deviation                | 0.67    |
| Variance                        | 4.80     | Variance                        | 0.82    | Variance                        | 1.63    | Variance                        | 0.99    | Variance                      | 0.45    |
| Range                           | 12.56    | Range                           | 5.89    | Range                           | 9.20    | Range                           | 8.10    | Range                         | 4.08    |
| Minimum                         | 2.80     | Minimum                         | 9.47    | Minimum                         | 4.40    | Minimum                         | 2.80    | Minimum                       | 5.52    |
| Maximum                         | 15.36    | Maximum                         | 15.36   | Maximum                         | 13.60   | Maximum                         | 10.90   | Maximum                       | 9.60    |
| Count                           | 10151.00 | Count                           | 2707.00 | Count                           | 3066.00 | Count                           | 1981.00 | Count                         | 2397.00 |
| <u>Yearly DO (% saturation)</u> |          | <u>Winter DO (% saturation)</u> |         | <u>Spring DO (% saturation)</u> |         | <u>Summer DO (% saturation)</u> |         | <u>Fall DO (% saturation)</u> |         |
| Mean                            | 102.82   | Mean                            | 112.50  | Mean                            | 103.76  | Mean                            | 94.36   | Mean                          | 97.65   |
| Std. Error                      | 0.11     | Std. Error                      | 0.16    | Std. Error                      | 0.18    | Std. Error                      | 0.28    | Std. Error                    | 0.11    |
| Median                          | 101.70   | Median                          | 111.10  | Median                          | 102.20  | Median                          | 93.30   | Median                        | 97.30   |
| Mode                            | 95.10    | Mode                            | 105.90  | Mode                            | 100.90  | Mode                            | 95.00   | Mode                          | 97.10   |
| Std. Deviation                  | 11.47    | Std. Deviation                  | 8.09    | Std. Deviation                  | 10.14   | Std. Deviation                  | 12.42   | Std. Deviation                | 5.61    |
| Variance                        | 131.59   | Variance                        | 65.51   | Variance                        | 102.90  | Variance                        | 154.21  | Variance                      | 31.44   |
| Range                           | 94.40    | Range                           | 37.00   | Range                           | 79.80   | Range                           | 92.00   | Range                         | 48.90   |
| Minimum                         | 40.10    | Minimum                         | 94.70   | Minimum                         | 54.70   | Minimum                         | 40.10   | Minimum                       | 70.90   |
| Maximum                         | 134.50   | Maximum                         | 131.70  | Maximum                         | 134.50  | Maximum                         | 132.10  | Maximum                       | 119.80  |
| Count                           | 10151.00 | Count                           | 2707.00 | Count                           | 3066.00 | Count                           | 1981.00 | Count                         | 2397.00 |

Table 5. Buoy 126 1999 (Depth and pH).

| <u>Yearly Depth (m)</u> |          | <u>Winter Depth (m)</u> |         | <u>Spring Depth (m)</u> |         | <u>Summer Depth (m)</u> |         | <u>Fall Depth (m)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 2.83     | Mean                    | 2.82    | Mean                    | 2.79    | Mean                    | 2.85    | Mean                  | 2.87    |
| Std. Error              | 0.00     | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error            | 0.01    |
| Median                  | 2.82     | Median                  | 2.80    | Median                  | 2.78    | Median                  | 2.84    | Median                | 2.86    |
| Mode                    | 2.94     | Mode                    | 2.77    | Mode                    | 2.56    | Mode                    | 2.96    | Mode                  | 2.94    |
| Std. Deviation          | 0.36     | Std. Deviation          | 0.37    | Std. Deviation          | 0.36    | Std. Deviation          | 0.35    | Std. Deviation        | 0.35    |
| Variance                | 0.13     | Variance                | 0.14    | Variance                | 0.13    | Variance                | 0.12    | Variance              | 0.12    |
| Range                   | 1.98     | Range                   | 1.85    | Range                   | 1.88    | Range                   | 1.67    | Range                 | 1.69    |
| Minimum                 | 1.83     | Minimum                 | 1.96    | Minimum                 | 1.83    | Minimum                 | 2.13    | Minimum               | 2.07    |
| Maximum                 | 3.81     | Maximum                 | 3.81    | Maximum                 | 3.71    | Maximum                 | 3.80    | Maximum               | 3.76    |
| Count                   | 13679.00 | Count                   | 2874.00 | Count                   | 3505.00 | Count                   | 3366.00 | Count                 | 3934.00 |

| <u>Yearly pH</u> |          | <u>Winter pH</u> |         | <u>Spring pH</u> |         | <u>Summer pH</u> |         | <u>Fall pH</u> |         |
|------------------|----------|------------------|---------|------------------|---------|------------------|---------|----------------|---------|
| Mean             | 8.10     | Mean             | 8.14    | Mean             | 8.16    | Mean             | 7.95    | Mean           | 8.15    |
| Std. Error       | 0.00     | Std. Error       | 0.01    | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error     | 0.00    |
| Median           | 8.10     | Median           | 8.11    | Median           | 8.10    | Median           | 8.00    | Median         | 8.16    |
| Mode             | 8.10     | Mode             | 7.92    | Mode             | 8.10    | Mode             | 8.00    | Mode           | 8.40    |
| Std. Deviation   | 0.22     | Std. Deviation   | 0.24    | Std. Deviation   | 0.17    | Std. Deviation   | 0.19    | Std. Deviation | 0.20    |
| Variance         | 0.05     | Variance         | 0.06    | Variance         | 0.03    | Variance         | 0.04    | Variance       | 0.04    |
| Range            | 1.15     | Range            | 1.08    | Range            | 0.90    | Range            | 1.00    | Range          | 0.90    |
| Minimum          | 7.40     | Minimum          | 7.47    | Minimum          | 7.60    | Minimum          | 7.40    | Minimum        | 7.60    |
| Maximum          | 8.55     | Maximum          | 8.55    | Maximum          | 8.50    | Maximum          | 8.40    | Maximum        | 8.50    |
| Count            | 10181.00 | Count            | 1908.00 | Count            | 2233.00 | Count            | 2476.00 | Count          | 3564.00 |

Table 5. Buoy 126 1999 (Turbidity).

| <u>Yearly Turbidity (NTU)</u> |          | <u>Winter Turbidity (NTU)</u> |         | <u>Spring Turbidity (NTU)</u> |         | <u>Summer Turbidity (NTU)</u> |         | <u>Fall Turbidity (NTU)</u> |         |
|-------------------------------|----------|-------------------------------|---------|-------------------------------|---------|-------------------------------|---------|-----------------------------|---------|
| Mean                          | 15.38    | Mean                          | 20.09   | Mean                          | 10.18   | Mean                          | 14.57   | Mean                        | 16.54   |
| Std. Error                    | 0.19     | Std. Error                    | 0.46    | Std. Error                    | 0.30    | Std. Error                    | 0.41    | Std. Error                  | 0.34    |
| Median                        | 9.10     | Median                        | 10.90   | Median                        | 5.00    | Median                        | 10.00   | Median                      | 10.90   |
| Mode                          | 2.00     | Mode                          | 5.90    | Mode                          | 2.00    | Mode                          | 8.00    | Mode                        | 7.00    |
| Std. Deviation                | 20.44    | Std. Deviation                | 24.74   | Std. Deviation                | 16.70   | Std. Deviation                | 16.50   | Std. Deviation              | 20.19   |
| Variance                      | 417.77   | Variance                      | 611.87  | Variance                      | 278.97  | Variance                      | 272.12  | Variance                    | 407.58  |
| Range                         | 261.40   | Range                         | 259.80  | Range                         | 209.00  | Range                         | 249.00  | Range                       | 187.20  |
| Minimum                       | 0.00     | Minimum                       | 0.60    | Minimum                       | 0.00    | Minimum                       | 0.00    | Minimum                     | 1.00    |
| Maximum                       | 260.40   | Maximum                       | 260.40  | Maximum                       | 208.00  | Maximum                       | 249.00  | Maximum                     | 188.20  |
| Count                         | 11201.00 | Count                         | 2872.00 | Count                         | 3143.00 | Count                         | 1640.00 | Count                       | 3547.00 |

Table 6. Buoy 126 2000 (Temperature and Salinity).

| <u>Yearly Temperature (°C)</u> |          | <u>Winter Temperature (°C)</u> |         | <u>Spring Temperature (°C)</u> |         | <u>Summer Temperature (°C)</u> |         | <u>Fall Temperature (°C)</u> |         |
|--------------------------------|----------|--------------------------------|---------|--------------------------------|---------|--------------------------------|---------|------------------------------|---------|
| Mean                           | 13.54    | Mean                           | 4.58    | Mean                           | 10.49   | Mean                           | 21.41   | Mean                         | 15.56   |
| Std. Error                     | 0.06     | Std. Error                     | 0.06    | Std. Error                     | 0.05    | Std. Error                     | 0.04    | Std. Error                   | 0.08    |
| Median                         | 13.20    | Median                         | 5.70    | Median                         | 9.80    | Median                         | 22.00   | Median                       | 16.05   |
| Mode                           | 22.60    | Mode                           | -1.50   | Mode                           | 9.40    | Mode                           | 22.60   | Mode                         | 16.40   |
| Std. Deviation                 | 7.15     | Std. Deviation                 | 3.36    | Std. Deviation                 | 3.47    | Std. Deviation                 | 2.60    | Std. Deviation               | 5.31    |
| Variance                       | 51.07    | Variance                       | 11.26   | Variance                       | 12.07   | Variance                       | 6.77    | Variance                     | 28.24   |
| Range                          | 28.80    | Range                          | 12.01   | Range                          | 15.10   | Range                          | 12.80   | Range                        | 24.30   |
| Minimum                        | -1.70    | Minimum                        | -1.70   | Minimum                        | 4.70    | Minimum                        | 14.30   | Minimum                      | 2.50    |
| Maximum                        | 27.10    | Maximum                        | 10.31   | Maximum                        | 19.80   | Maximum                        | 27.10   | Maximum                      | 26.80   |
| Count                          | 16556.00 | Count                          | 3357.00 | Count                          | 4415.00 | Count                          | 4414.00 | Count                        | 4366.00 |

| <u>Yearly Salinity (ppt)</u> |          | <u>Winter Salinity (ppt)</u> |         | <u>Spring Salinity (ppt)</u> |         | <u>Summer Salinity (ppt)</u> |         | <u>Fall Salinity (ppt)</u> |         |
|------------------------------|----------|------------------------------|---------|------------------------------|---------|------------------------------|---------|----------------------------|---------|
| Mean                         | 29.62    | Mean                         | 30.22   | Mean                         | 29.91   | Mean                         | 28.87   | Mean                       | 29.61   |
| Std. Error                   | 0.01     | Std. Error                   | 0.03    | Std. Error                   | 0.03    | Std. Error                   | 0.03    | Std. Error                 | 0.02    |
| Median                       | 30.00    | Median                       | 30.71   | Median                       | 30.20   | Median                       | 29.30   | Median                     | 30.10   |
| Mode                         | 31.30    | Mode                         | 32.20   | Mode                         | 30.40   | Mode                         | 30.50   | Mode                       | 31.30   |
| Std. Deviation               | 1.88     | Std. Deviation               | 1.88    | Std. Deviation               | 1.94    | Std. Deviation               | 1.81    | Std. Deviation             | 1.65    |
| Variance                     | 3.55     | Variance                     | 3.54    | Variance                     | 3.75    | Variance                     | 3.27    | Variance                   | 2.71    |
| Range                        | 10.80    | Range                        | 9.12    | Range                        | 10.10   | Range                        | 9.20    | Range                      | 8.40    |
| Minimum                      | 22.50    | Minimum                      | 24.18   | Minimum                      | 23.20   | Minimum                      | 22.50   | Minimum                    | 23.70   |
| Maximum                      | 33.30    | Maximum                      | 33.30   | Maximum                      | 33.30   | Maximum                      | 31.70   | Maximum                    | 32.10   |
| Count                        | 16555.00 | Count                        | 3357.00 | Count                        | 4416.00 | Count                        | 4415.00 | Count                      | 4367.00 |

Table 6. Buoy 126 2000 (Dissolved Oxygen).

| <u>Yearly DO (mg/L)</u> |          | <u>Winter DO (mg/L)</u> |         | <u>Spring DO (mg/L)</u> |         | <u>Summer DO (mg/L)</u> |         | <u>Fall DO (mg/L)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 9.51     | Mean                    | 12.48   | Mean                    | 9.83    | Mean                    | 6.90    | Mean                  | 9.19    |
| Std. Error              | 0.02     | Std. Error              | 0.03    | Std. Error              | 0.01    | Std. Error              | 0.01    | Std. Error            | 0.02    |
| Median                  | 9.50     | Median                  | 12.20   | Median                  | 9.90    | Median                  | 6.80    | Median                | 9.00    |
| Mode                    | 10.40    | Mode                    | 11.90   | Mode                    | 10.60   | Mode                    | 6.20    | Mode                  | 8.80    |
| Std. Deviation          | 2.19     | Std. Deviation          | 1.42    | Std. Deviation          | 0.95    | Std. Deviation          | 0.89    | Std. Deviation        | 1.21    |
| Variance                | 4.82     | Variance                | 2.02    | Variance                | 0.90    | Variance                | 0.78    | Variance              | 1.46    |
| Range                   | 12.80    | Range                   | 6.23    | Range                   | 5.50    | Range                   | 6.40    | Range                 | 7.80    |
| Minimum                 | 3.20     | Minimum                 | 9.77    | Minimum                 | 6.40    | Minimum                 | 3.20    | Minimum               | 4.90    |
| Maximum                 | 16.00    | Maximum                 | 16.00   | Maximum                 | 11.90   | Maximum                 | 9.60    | Maximum               | 12.70   |
| Count                   | 14884.00 | Count                   | 3124.00 | Count                   | 4408.00 | Count                   | 3631.00 | Count                 | 3721.00 |

| <u>Yearly DO (% saturation)</u> |          | <u>Winter DO (% saturation)</u> |         | <u>Spring DO (% saturation)</u> |         | <u>Summer DO (% saturation)</u> |         | <u>Fall DO (% saturation)</u> |         |
|---------------------------------|----------|---------------------------------|---------|---------------------------------|---------|---------------------------------|---------|-------------------------------|---------|
| Mean                            | 103.96   | Mean                            | 118.39  | Mean                            | 106.06  | Mean                            | 91.86   | Mean                          | 101.16  |
| Std. Error                      | 0.12     | Std. Error                      | 0.31    | Std. Error                      | 0.10    | Std. Error                      | 0.20    | Std. Error                    | 0.14    |
| Median                          | 102.50   | Median                          | 109.20  | Median                          | 105.30  | Median                          | 90.90   | Median                        | 100.10  |
| Mode                            | 103.20   | Mode                            | 103.20  | Mode                            | 103.90  | Mode                            | 91.10   | Mode                          | 99.90   |
| Std. Deviation                  | 14.54    | Std. Deviation                  | 17.11   | Std. Deviation                  | 6.86    | Std. Deviation                  | 12.18   | Std. Deviation                | 8.29    |
| Variance                        | 211.40   | Variance                        | 292.64  | Variance                        | 47.07   | Variance                        | 148.34  | Variance                      | 68.79   |
| Range                           | 117.00   | Range                           | 70.80   | Range                           | 44.70   | Range                           | 94.60   | Range                         | 97.00   |
| Minimum                         | 42.80    | Minimum                         | 89.00   | Minimum                         | 82.40   | Minimum                         | 42.80   | Minimum                       | 58.80   |
| Maximum                         | 159.80   | Maximum                         | 159.80  | Maximum                         | 127.10  | Maximum                         | 137.40  | Maximum                       | 155.80  |
| Count                           | 14884.00 | Count                           | 3124.00 | Count                           | 4408.00 | Count                           | 3631.00 | Count                         | 3721.00 |

Table 6. Buoy 126 2000 (Depth and pH).

| <u>Yearly Depth (m)</u> |          | <u>Winter Depth (m)</u> |         | <u>Spring Depth (m)</u> |         | <u>Summer Depth (m)</u> |         | <u>Fall Depth (m)</u> |         |
|-------------------------|----------|-------------------------|---------|-------------------------|---------|-------------------------|---------|-----------------------|---------|
| Mean                    | 3.05     | Mean                    | 2.75    | Mean                    | 2.95    | Mean                    | 3.17    | Mean                  | 3.10    |
| Std. Error              | 0.00     | Std. Error              | 0.01    | Std. Error              | 0.00    | Std. Error              | 0.01    | Std. Error            | 0.01    |
| Median                  | 3.04     | Median                  | 2.76    | Median                  | 2.95    | Median                  | 3.16    | Median                | 3.09    |
| Mode                    | 2.85     | Mode                    | 2.94    | Mode                    | 2.98    | Mode                    | 2.90    | Mode                  | 2.76    |
| Std. Deviation          | 0.41     | Std. Deviation          | 0.41    | Std. Deviation          | 0.44    | Std. Deviation          | 0.37    | Std. Deviation        | 0.36    |
| Variance                | 0.17     | Variance                | 0.17    | Variance                | 0.19    | Variance                | 0.14    | Variance              | 0.13    |
| Range                   | 3.70     | Range                   | 3.38    | Range                   | 3.59    | Range                   | 1.92    | Range                 | 2.06    |
| Minimum                 | 0.59     | Minimum                 | 0.59    | Minimum                 | 0.59    | Minimum                 | 2.37    | Minimum               | 2.11    |
| Maximum                 | 4.29     | Maximum                 | 3.97    | Maximum                 | 4.18    | Maximum                 | 4.29    | Maximum               | 4.17    |
| Count                   | 16556.00 | Count                   | 3358.00 | Count                   | 7774.00 | Count                   | 4415.00 | Count                 | 4368.00 |

| <u>Yearly pH</u> |          | <u>Winter pH</u> |         | <u>Spring pH</u> |         | <u>Summer pH</u> |         | <u>Fall pH</u> |         |
|------------------|----------|------------------|---------|------------------|---------|------------------|---------|----------------|---------|
| Mean             | 7.95     | Mean             | 8.09    | Mean             | 7.90    | Mean             | 7.81    | Mean           | 8.04    |
| Std. Error       | 0.00     | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error       | 0.00    | Std. Error     | 0.00    |
| Median           | 8.00     | Median           | 8.10    | Median           | 7.90    | Median           | 7.80    | Median         | 8.00    |
| Mode             | 8.10     | Mode             | 8.10    | Mode             | 8.10    | Mode             | 7.90    | Mode           | 8.10    |
| Std. Deviation   | 0.20     | Std. Deviation   | 0.10    | Std. Deviation   | 0.22    | Std. Deviation   | 0.19    | Std. Deviation | 0.13    |
| Variance         | 0.04     | Variance         | 0.01    | Variance         | 0.05    | Variance         | 0.04    | Variance       | 0.02    |
| Range            | 1.40     | Range            | 0.90    | Range            | 1.10    | Range            | 1.40    | Range          | 0.70    |
| Minimum          | 7.00     | Minimum          | 7.40    | Minimum          | 7.30    | Minimum          | 7.00    | Minimum        | 7.60    |
| Maximum          | 8.40     | Maximum          | 8.30    | Maximum          | 8.40    | Maximum          | 8.40    | Maximum        | 8.30    |
| Count            | 15841.00 | Count            | 3358.00 | Count            | 3702.00 | Count            | 4415.00 | Count          | 4368.00 |

Table 6. Buoy 126 2000 (Turbidity).

| <u>Yearly Turbidity (NTU)</u> |          | <u>Winter Turbidity (NTU)</u> |         | <u>Spring Turbidity (NTU)</u> |         | <u>Summer Turbidity (NTU)</u> |         | <u>Fall Turbidity (NTU)</u> |         |
|-------------------------------|----------|-------------------------------|---------|-------------------------------|---------|-------------------------------|---------|-----------------------------|---------|
| Mean                          | 11.18    | Mean                          | 20.64   | Mean                          | 8.43    | Mean                          | 6.69    | Mean                        | 10.33   |
| Std. Error                    | 0.11     | Std. Error                    | 0.34    | Std. Error                    | 0.17    | Std. Error                    | 0.12    | Std. Error                  | 0.16    |
| Median                        | 7.00     | Median                        | 15.00   | Median                        | 5.00    | Median                        | 5.00    | Median                      | 7.00    |
| Mode                          | 3.00     | Mode                          | 12.00   | Mode                          | 3.00    | Mode                          | 3.00    | Mode                        | 4.00    |
| Std. Deviation                | 13.61    | Std. Deviation                | 19.84   | Std. Deviation                | 10.06   | Std. Deviation                | 7.89    | Std. Deviation              | 10.59   |
| Variance                      | 185.11   | Variance                      | 393.78  | Variance                      | 101.23  | Variance                      | 62.28   | Variance                    | 112.07  |
| Range                         | 196.00   | Range                         | 196.00  | Range                         | 88.00   | Range                         | 156.00  | Range                       | 115.00  |
| Minimum                       | 0.00     | Minimum                       | 0.00    | Minimum                       | 0.00    | Minimum                       | 0.00    | Minimum                     | 0.00    |
| Maximum                       | 196.00   | Maximum                       | 196.00  | Maximum                       | 88.00   | Maximum                       | 156.00  | Maximum                     | 115.00  |
| Count                         | 15285.00 | Count                         | 3355.00 | Count                         | 3684.00 | Count                         | 4034.00 | Count                       | 4212.00 |

**Appendix 11. Results of ANOVAs comparing physical-chemical data across three JCNERR SWMP sites (Buoy 126, Chestnut Neck, and Lower Bank) in 1999.**

| Factor                  | Source | df  | MS       | F       | P > F  |
|-------------------------|--------|-----|----------|---------|--------|
| Temperature             | Site   | 2   | 66.65    | 1.08    | 0.3404 |
|                         | Error  | 762 | 61.77    |         |        |
| Salinity                | Site   | 2   | 44200.37 | 6620.21 | <.0001 |
|                         | Error  | 720 | 6.68     |         |        |
| Dissolved Oxygen (mg/l) | Site   | 2   | 13.33    | 3.45    | 0.0327 |
|                         | Error  | 333 | 3.86     |         |        |
| pH                      | Site   | 2   | 177.46   | 957.16  | <.0001 |
|                         | Error  | 441 | 0.19     |         |        |
| Turbidity               | Site   | 2   | 16271.96 | 114.22  | <.0001 |
|                         | Error  | 531 | 142.46   |         |        |
| Depth                   | Site   | 2   | 104.74   | 1726.05 | <.0001 |
|                         | Error  | 720 | 0.06     |         |        |

From Kennish, M. J. and S. O'Donnell. 2002. Water quality monitoring in the Jacques Cousteau National Estuarine Research Reserve System. *Bulletin of the New Jersey Academy of Science* 47(2): 1-14.

**Appendix 12. Results of ANOVAs comparing physical-chemical data across three JCNERR SWMP sites (Buoy 126, Chestnut Neck, and Lower Bank) in 2000.**

| Factor                     | Source | df  | MS       | F        | P > F  |
|----------------------------|--------|-----|----------|----------|--------|
| Temperature                | Site   | 2   | 269.39   | 4.77     | 0.0087 |
|                            | Error  | 915 | 56.53    |          |        |
| Salinity                   | Site   | 2   | 57893.02 | 16571.69 | <.0001 |
|                            | Error  | 915 | 3.49     |          |        |
| Dissolved<br>Oxygen (mg/l) | Site   | 2   | 59.23    | 13.47    | <.0001 |
|                            | Error  | 624 | 4.40     |          |        |
| pH                         | Site   | 2   | 215.18   | 1776.35  | <.0001 |
|                            | Error  | 873 | 0.12     |          |        |
| Turbidity                  | Site   | 2   | 21042.27 | 211.54   | <.0001 |
|                            | Error  | 825 | 99.47    |          |        |
| Depth                      | Site   | 2   | 177.90   | 4141.36  | <.0001 |
|                            | Error  | 915 | 0.04     |          |        |

From Kennish, M. J. and S. O'Donnell. 2002. Water quality monitoring in the Jacques Cousteau National Estuarine Research Reserve System. *Bulletin of the New Jersey Academy of Science* 47(2): 1-14.

**Appendix 13. Statistical tests comparing physical-chemical measurements between years (1999 and 2000) at each JCNERR SWMP site.**

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T-tests for Buoy 126

| Variable                   | df  | t Value | P > t   |
|----------------------------|-----|---------|---------|
| Temperature                | 290 | -2.03   | 0.0432  |
| Salinity                   | 262 | 0.29    | 0.7755  |
| Dissolved Oxygen<br>(mg/l) | 199 | 1.89    | 0.0608  |
| pH                         | 191 | -5.73   | <0.0001 |
| Turbidity                  | 213 | 3.07    | 0.0024  |
| Depth                      | 276 | -15.77  | <0.0001 |

T-tests for Chestnut Neck

| Variable                   | df  | t Value | P > t   |
|----------------------------|-----|---------|---------|
| Temperature                | 255 | -0.12   | 0.9043  |
| Salinity                   | 255 | -2.52   | 0.0122  |
| Dissolved Oxygen<br>(mg/l) | 189 | 1.09    | 0.2773  |
| pH                         | 242 | 12.26   | <0.0001 |
| Turbidity                  | 235 | 3.12    | 0.0020  |
| Depth                      | 255 | -1.54   | <0.1246 |

T-tests for Lower Bank

| Variable                   | df  | t Value | P > t   |
|----------------------------|-----|---------|---------|
| Temperature                | 334 | -0.85   | 0.3947  |
| Salinity                   | 334 | -6.60   | <0.0001 |
| Dissolved Oxygen<br>(mg/l) | 222 | 2.56    | 0.0111  |
| pH                         | 295 | -1.83   | 0.0686  |
| Turbidity                  | 270 | 1.99    | 0.0471  |
| Depth                      | 334 | 0.42    | 0.6745  |

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From Kennish, M. J. and S. O'Donnell. 2002. Water quality monitoring in the Jacques Cousteau National Estuarine Research Reserve System. *Bulletin of the New Jersey Academy of Science* 47(2): 1-14.

**Appendix 14. Taxonomic list of plants identified along stream vegetation sites in the Mullica River Basin.**

| Group                    | Common Name          | Scientific Name                               |
|--------------------------|----------------------|---|
| <b>Herbaceous Plants</b> |                      |   |
|                          | Ticklegrass          | <i>Agrostis hyemalis</i>                      |
|                          | Ticklegrass          | <i>Agrostis hyemalis var. scabra</i>          |
|                          | Upland bent-grass    | <i>Agrostis perennans</i>                     |
|                          | Upland bent-grass    | <i>Agrostis perennans var. elata</i>          |
|                          | Small water plantain | <i>Alisma subcordatum</i>                     |
|                          | Garlic               | <i>Allium</i> sp.                             |
|                          | Pursh's millet-grass | <i>Amphicarpum purshii</i>                    |
|                          | Bushy beard-grass    | <i>Andropogon virginicus var. abbreviatus</i> |
|                          | Broomsedge           | <i>Andropogon virginicus var. virginicus</i>  |
|                          | Groundnut            | <i>Apios americana</i>                        |
|                          | Wild sarsaparilla    | <i>Aralia nudicaulis</i>                      |
|                          | Arethusa             | <i>Arethusa bulbosa</i>                       |
|                          | Swamp milkweed       | <i>Asclepias incarnata</i>                    |
|                          | Bushy aster          | <i>Aster dumosus</i>                          |
|                          | Bog aster            | <i>Aster nemoralis</i>                        |
|                          | New York aster       | <i>Aster novi-belgii</i>                      |
|                          | Heath aster          | <i>Aster pilosus var pringlei</i>             |
|                          | Small white aster    | <i>Aster racemosus</i>                        |
|                          | Twining bartonia     | <i>Bartonia paniculata</i>                    |
|                          | Yellow bartonia      | <i>Bartonia virginica</i>                     |

|                             |  |
|-----------------------------|--|
| Purple-stemmed beggar ticks | <i>Bidens connata</i>                  |
| Northern tickseed-sunflower | <i>Bidens coronata</i>                 |
| Small beggar ticks          | <i>Bidens discoidea</i>                |
| Beggar ticks                | <i>Bidens frondosa</i>                 |
| False nettle                | <i>Boehmeria cylindrica</i>            |
| Blue-joint grass            | <i>Calamagrostis canadensis</i>        |
| Nuttall's reed-grass        | <i>Calamagrostis cinnoides</i>         |
| Larger water starwort       | <i>Callitriche heterophylla</i>        |
| Pennsylvania bitter-cress   | <i>Cardamine pensylvanica</i>          |
| Greenish-white sedge        | <i>Carex albolutescens</i>             |
| Atlantic sedge              | <i>Carex atlantica</i>                 |
| Howe's sedge                | <i>Carex atlantica var. capillacea</i> |
| Button sedge                | <i>Carex bullata</i>                   |
| Silvery sedge               | <i>Carex canescens</i>                 |
| Collins' sedge              | <i>Carex collinsii</i>                 |
| Fringed sedge               | <i>Carex crinita</i>                   |
| Coast sedge                 | <i>Carex exilis</i>                    |
| Long sedge                  | <i>Carex folliculata</i>               |
| Bladder sedge               | <i>Carex intumescens</i>               |
| Livid sedge                 | <i>Carex livida</i>                    |
| Long's sedge                | <i>Carex longii</i>                    |
| Sallow sedge                | <i>Carex lurida</i>                    |
| Pennsylvania sedge          | <i>Carex pensylvanica</i>              |
| Pointed broom sedge         | <i>Carex scoparia</i>                  |
| Awl-fruited sedge           | <i>Carex stipata</i>                   |
| Walter's sedge              | <i>Carex striata</i>                   |

|                         |   |
|-------------------------|---|
| Tussock sedge           | <i>Carex stricta</i>                              |
| Blunt broom sedge       | <i>Carex tribuloides</i>                          |
| Three-fruited sedge     | <i>Carex trisperma</i>                            |
| Dark green sedge        | <i>Carex venusta</i>                              |
| Prickly hornwort        | <i>Ceratophyllum echinatum</i>                    |
| Slender spike-grass     | <i>Chasmanthium laxum</i>                         |
| Wood-reed               | <i>Cinna arundinacea</i>                          |
| Twig-rush               | <i>Cladium mariscoides</i>                        |
| Dodder                  | <i>Cuscuta</i> sp.                                |
| Toothed cyperus         | <i>Cyperus dentatus</i>                           |
| Red-rooted cyperus      | <i>Cyperus erythrorhizos</i>                      |
| Coarse cyperus          | <i>Cyperus odoratus</i>                           |
| Pine Barrens cyperus    | <i>Cyperus retrorsus</i>                          |
| Straw-colored cyperus   | <i>Cyperus strigosus</i>                          |
| Silky wild oat-grass    | <i>Danthonia sericea</i> var. <i>epilis</i>       |
| Swamp loosestrife       | <i>Decodon verticillatus</i>                      |
| Common wild yam         | <i>Dioscorea villosa</i>                          |
| Thread-leaved sundew    | <i>Drosera filiformis</i>                         |
| Spatulate-leaved sundew | <i>Drosera intermedia</i>                         |
| Round-leaved sundew     | <i>Drosera rotundifolia</i>                       |
| Spinulose wood fern     | <i>Dryopteris carthusiana</i>                     |
| Dulichium               | <i>Dulichium arundinaceum</i>                     |
| American barnyard grass | <i>Echinochloa muricata</i>                       |
| Needle spike-rush       | <i>Eleocharis acicularis</i>                      |
| Green spike-rush        | <i>Eleocharis flavescens</i> var. <i>olivacea</i> |

|                           |                                |
|---------------------------|--------------------------------|
| Small-fruited spike-rush  | <i>Eleocharis microcarpa</i>   |
| Blunt spike-rush          | <i>Eleocharis ovata</i>        |
| Robbin's spike rush       | <i>Eleocharis robbinsii</i>    |
| Slender spike-rush        | <i>Eleocharis tenuis</i>       |
| Tubercled spike-grass     | <i>Eleocharis tuberculosa</i>  |
| Nuttall's water-weed      | <i>Elodea nuttallii</i>        |
| Purple-leaved willow-herb | <i>Epilobium coloratum</i>     |
| Pilewort                  | <i>Erechtites hieracifolia</i> |
| Plume-grass               | <i>Erianthus giganteus</i>     |
| Seven-angled pipewort     | <i>Eriocaulon aquaticum</i>    |
| Flattened pipewort        | <i>Eriocaulon compressum</i>   |
| Ten-angled pipewort       | <i>Eriocaulon decangulare</i>  |
| Tawny cotton-grass        | <i>Eriophorum virginicum</i>   |
| Eastern joe-pye weed      | <i>Eupatorium dubium</i>       |
| Boneset                   | <i>Eupatorium perfoliatum</i>  |
| Rough boneset             | <i>Eupatorium pilosum</i>      |
| Pine Barrens boneset      | <i>Eupatorium resinsum</i>     |
| Late-flowering boneset    | <i>Eupatorium serotinum</i>    |
| Ipecac spurge             | <i>Euphorbia ipecacuanhae</i>  |
| Slender-leaved goldenrod  | <i>Euthamia tenuifolia</i>     |
| Stiff marsh bedstraw      | <i>Galium tinctorium</i>       |
| Gill-over-the-ground      | <i>Glechoma hederacea</i>      |
| Rattlesnake grass         | <i>Glyceria canadensis</i>     |
| Blunt manna-grass         | <i>Glyceria obtusa</i>         |
| Fowl manna-grass          | <i>Glycera striata</i>         |
| Northern manna-grass      | <i>Glyceria x laxa</i>         |

|                               |                                |
|-------------------------------|--------------------------------|
| Green wood orchid             | <i>Habenaria clavellata</i>    |
| Ragged fringed orchid         | <i>Habenaria lacera</i>        |
| Swamp rose mallow             | <i>Hibiscus moscheutos</i>     |
| Canada Saint John's wort      | <i>Hypericum canadense</i>     |
| Coppery Saint John's wort     | <i>Hypericum denticulatum</i>  |
| Dwarf Saint John's-wort       | <i>Hypericum mutilum</i>       |
| Saint Andrew's cross          | <i>Hypericum stragulum</i>     |
| Spotted touch-me-not          | <i>Impatiens capensis</i>      |
| Slender blue flag             | <i>Iris prismatica</i>         |
| Larger blue flag              | <i>Iris versicolor</i>         |
| Spiny-spored quillwort        | <i>Isoetes echinospora</i>     |
| Sharp-fruited rush            | <i>Juncus acuminatus</i>       |
| Two-flowered rush             | <i>Juncus biflorus</i>         |
| New Jersey rush               | <i>Juncus caesariensis</i>     |
| Canada rush                   | <i>Juncus canadensis</i>       |
| Common rush                   | <i>Juncus effusus</i>          |
| Bayonet rush                  | <i>Juncus militaris</i>        |
| Brown-fruited rush            | <i>Juncus pelocarpus</i>       |
| Redroot                       | <i>Lachnanthes caroliniana</i> |
| Rice cut-grass                | <i>Leersia oryzoides</i>       |
| Duckweed                      | <i>Lemna</i> sp.               |
| Turk's-cap lily               | <i>Lilium superbum</i>         |
| Short-stalked false pimpernel | <i>Lindernia dubia</i>         |
| Canby's lobelia               | <i>Lobelia canbyi</i>          |
| Cardinal flower               | <i>Lobelia cardinalis</i>      |
| Nuttall's lobelia             | <i>Lobelia nuttalli</i>        |

|                              |                                 |
|------------------------------|---------------------------------|
| Golden-crest                 | <i>Lophiola aurea</i>           |
| Seedbox                      | <i>Ludwigia alternifolia</i>    |
| Water purslane               | <i>Ludwigia palustris</i>       |
| Foxtail-clubmoss             | <i>Lycopodium alopecuroides</i> |
| Southern bog clubmoss        | <i>Lycopodium appressum</i>     |
| Tree clubmoss                | <i>Lycopodium obscurum</i>      |
| Northern bugleweed           | <i>Lycopus uniflorus</i>        |
| Virginia bugleweed           | <i>Lycopus virginicus</i>       |
| Swamp loosestrife            | <i>Lysimachia terrestris</i>    |
| Purple loosestrife           | <i>Lythrum salicaria</i>        |
| Eulalia                      | <i>Microstegium vimineum</i>    |
| Climbing hempweed            | <i>Mikania scandens</i>         |
| Square-stemmed monkey-flower | <i>Mimulus ringens</i>          |
| Partridge berry              | <i>Mitchella repens</i>         |
| Indian pipe                  | <i>Monotropa uniflora</i>       |
| Torrey's dropseed            | <i>Muhlenbergia torreyana</i>   |
| Late-flowering dropseed      | <i>Muhlenbergia uniflora</i>    |
| Bullhead lily                | <i>Nuphar variegata</i>         |
| White water lily             | <i>Nymphaea odorata</i>         |
| Sensitive fern               | <i>Onoclea sensibilis</i>       |
| Golden club                  | <i>Orontium aquaticum</i>       |
| Cinnamon fern                | <i>Osmunda cinnamomea</i>       |
| Royal fern                   | <i>Osmunda regalis</i>          |
| Upright yellow wood-sorrel   | <i>Oxalis stricta</i>           |
| Cowbane                      | <i>Oxypolis rigidior</i>        |
| Deertongue grass             | <i>Panicum clandestinum</i>     |

|                          |                                  |
|--------------------------|----------------------------------|
| Forked panic-grass       | <i>Panicum dichotomum</i>        |
| Small-leaved panic-grass | <i>Panicum ensifolium</i>        |
| Panic-grass              | <i>Panicum lanuginosum</i>       |
| Long-leaved panic-grass  | <i>Panicum longifolium</i>       |
| Long-leaved panic-grass  | <i>Panicum rigidulum</i>         |
| Sheathed panic-grass     | <i>Panicum scabriusculum</i>     |
| Eaton's panic-grass      | <i>Panicum spretum</i>           |
| Warty panic-grass        | <i>Panicum verrucosum</i>        |
| Switchgrass              | <i>Panicum virgatum</i>          |
| Arrow arum               | <i>Peltandra virginica</i>       |
| Reed canary grass        | <i>Phalaris arundinacea</i>      |
| Reed                     | <i>Phragmites australis</i>      |
| Pokeweed                 | <i>Phytolacca americana</i>      |
| Clearweed                | <i>Pilea pumila</i>              |
| Fowl bluegrass           | <i>Poa palustris</i>             |
| Kentucky bluegrass       | <i>Poa pratensis</i>             |
| Rose pogonia             | <i>Pogonia ophioglossoides</i>   |
| Short-leaved milkwort    | <i>Polygala brevifolia</i>       |
| Cross-leaved milkwort    | <i>Polygala cruciata</i>         |
| Halberd-leaved tearthumb | <i>Polygonum arifolium</i>       |
| Cespitose knotweed       | <i>Polygonum cespitosum</i>      |
| Mild water pepper        | <i>Polygonum hydropiperoides</i> |
| Dotted smartweed         | <i>Polygonum punctatum</i>       |
| Arrow-leaved tearthumb   | <i>Polygonum sagittatum</i>      |
| Pickereel-weed           | <i>Ponderia cordata</i>          |
| Algal-like pondweed      | <i>Potamogeton confervoides</i>  |

|                           |                                    |
|---------------------------|------------------------------------|
| Half-like pondweed        | <i>Potamogeton diversifolius</i>   |
| Nuttall's pondweed        | <i>Potamogeton epihydrus</i>       |
| Oakes' pondweed           | <i>Potamogeton oakesianus</i>      |
| Small pondweed            | <i>Potamogeton pusillus</i>        |
| Cut-leaved mermaid-weed   | <i>Proserpinaca pectinata</i>      |
| Bracken                   | <i>Pteridium aquilinum</i>         |
| Maryland meadow beauty    | <i>Rhexia mariana</i>              |
| Virginia meadow beauty    | <i>Rhexia virginica</i>            |
| White-beaked-rush         | <i>Rhynchospora alba</i>           |
| Small-headed beaked-rush  | <i>Rhynchospora capitellata</i>    |
| Loose-headed beaked-rush  | <i>Rhynchospora chalarocephala</i> |
| Marsh yellow cress        | <i>Rorippa palustris</i>           |
| Lance-leaved sabatia      | <i>Sabatia difformis</i>           |
| Engelmann's arrowhead     | <i>Sagittaria engelmanniana</i>    |
| Pitcher plant             | <i>Sarracenia purpurea</i>         |
| Little bluestem           | <i>Schizachyrium scoparium</i>     |
| Curly-grass fern          | <i>Schizaea pusilla</i>            |
| Wool-grass                | <i>Scirpus cyperinus</i>           |
| Three-square bulrush      | <i>Scirpus pungens</i>             |
| Water club-rush           | <i>Scirpus subterminalis</i>       |
| Reticulated nut-rush      | <i>Scleria reticularis</i>         |
| Sclerolepis               | <i>Sclerolepis uniflora</i>        |
| Mad-dog skullcap          | <i>Scutellaria lateriflora</i>     |
| Carrion flower            | <i>Smilax herbacea</i>             |
| Halberd-leaved greenbrier | <i>Smilax pseudochina</i>          |
| Black nightshade          | <i>Solanum nigrum</i>              |

|                            |                                |
|----------------------------|--------------------------------|
| Canada goldenrod           | <i>Solidago canadensis</i>     |
| Rough-stemmed goldenrod    | <i>Solidago rugosa</i>         |
| Slender-bur-reed           | <i>Sparganium americanum</i>   |
| Nodding ladies'-tresses    | <i>Spiranthes cernua</i>       |
| Common stitchwort          | <i>Stellaria graminea</i>      |
| Common chickweed           | <i>Stellaria media</i>         |
| Dandelion                  | <i>Taraxacum officinale</i>    |
| Marsh fern                 | <i>Thelypteris palustris</i>   |
| Bog fern                   | <i>Thelypteris simulata</i>    |
| Marsh Saint John's-wort    | <i>Triadenum virginicum</i>    |
| Starflower                 | <i>Trientalis borealis</i>     |
| Broad-leaved cattail       | <i>Typha latifolia</i>         |
| Stinging nettle            | <i>Urtica dioica</i>           |
| Horned bladderwort         | <i>Utricularia cornuta</i>     |
| Fibrous bladderwort        | <i>Utricularia fibrosa</i>     |
| Hidden-fruited bladderwort | <i>Utricularia geminiscapa</i> |
| Floating bladderwort       | <i>Utricularia inflata</i>     |
| Purple bladderwort         | <i>Utricularia purpurea</i>    |
| Zig-zag bladderwort        | <i>Utricularia subulata</i>    |
| Greater bladderwort        | <i>Utricularia vulgaris</i>    |
| Blue vervain               | <i>Verbena hastata</i>         |
| New York ironweed          | <i>Vernonia noveboracensis</i> |
| Lance-leaved violet        | <i>Viola lanceolata</i>        |
| Primrose-leaved violet     | <i>Viola primulifolia</i>      |
| Woolly blue violet         | <i>Viola sororia</i>           |
| Netted chain fern          | <i>Woodwardia areolata</i>     |

|                           |                                  |
|---------------------------|----------------------------------|
| Virginia chain fern       | <i>Woodwardia virginica</i>      |
| Turkey-beard              | <i>Xerophyllum asphodeloides</i> |
| Yellow-eyed grass         | <i>Xyris difformis</i>           |
| Small's yellow-eyed grass | <i>Xyris smalliana</i>           |
| Wild rice                 | <i>Zizania aquatica</i>          |

### Woody Plants

|                      |                                  |
|----------------------|----------------------------------|
| Red maple            | <i>Acer rubrum</i>               |
| Ailanthus            | <i>Ailanthus altissima</i>       |
| Smooth alder         | <i>Alnus serrulata</i>           |
| Oblongleaf juneberry | <i>Amelanchier canadensis</i>    |
| Coastal juneberry    | <i>Amelanchier obovalis</i>      |
| Red chokeberry       | <i>Aronia arbutifolia</i>        |
| Japanese barberry    | <i>Berberis thunbergii</i>       |
| Black birch          | <i>Betula lenta</i>              |
| Gray birch           | <i>Betula populifolia</i>        |
| Common catalpa       | <i>Catalpa bignonioides</i>      |
| Buttonbush           | <i>Cephalanthus occidentalis</i> |
| Atlantic white cedar | <i>Chamaecyparis thyoides</i>    |
| Leatherleaf          | <i>Chamaedaphne calyculata</i>   |
| Yam-leaved clematis  | <i>Clematis terniflora</i>       |
| Sweet pepperbush     | <i>Clethra alnifolia</i>         |
| Persimmon            | <i>Diospyros virginiana</i>      |
| Fetterbush           | <i>Eubotrys racemosa</i>         |
| Wintergreen          | <i>Gaultheria procumbens</i>     |
| Black huckleberry    | <i>Gaylussacia baccata</i>       |
| Dwarf huckleberry    | <i>Gaylussacia dumosa</i>        |

|                         |                                    |
|-------------------------|------------------------------------|
| Dangleberry             | <i>Gaylussacia frondosa</i>        |
| Golden heather          | <i>Hudsonia ericoides</i>          |
| Bushy Saint-John's-wort | <i>Hypericum densiflorum</i>       |
| Inkberry                | <i>Ilex glabra</i>                 |
| Smooth winterberry      | <i>Ilex laevigata</i>              |
| American holly          | <i>Ilex opaca</i>                  |
| Winterberry             | <i>Ilex verticillata</i>           |
| Virginia willow         | <i>Itea virginica</i>              |
| Red cedar               | <i>Juniperus virginiana</i>        |
| Sheep laurel            | <i>Kalmia angustifolia</i>         |
| Mountain laurel         | <i>Kalmia latifolia</i>            |
| Sand myrtle             | <i>Leiophyllum buxifolium</i>      |
| Sweet gum               | <i>Liquidambar styraciflua</i>     |
| Japanese honeysuckle    | <i>Lonicera japonica</i>           |
| Maleberry               | <i>Lyonia ligustrina</i>           |
| Staggerbush             | <i>Lyonia mariana</i>              |
| Sweet bay               | <i>Magnolia virginiana</i>         |
| Bayberry                | <i>Myrica pensylvanica</i>         |
| Black gum               | <i>Nyssa sylvatica</i>             |
| Virginia creeper        | <i>Parthenocissus quinquefolia</i> |
| Shortleaf pine          | <i>Pinus echinata</i>              |
| Pitch pine              | <i>Pinus rigida</i>                |
| White pine              | <i>Pinus strobus</i>               |
| Sycamore                | <i>Platanus occidentalis</i>       |
| Black cherry            | <i>Prunus serotina</i>             |
| White oak               | <i>Quercus alba</i>                |

|                           |   |
|---------------------------|---|
| Scrub oak                 | <i>Quercus ilicifolia</i>                 |
| Black-jack oak            | <i>Quercus marilandica</i>                |
| Black oak                 | <i>Quercus velutina</i>                   |
| Post oak                  | <i>Quercus stellata</i>                   |
| Swamp azalea              | <i>Rhododendron viscosum</i>              |
| Swamp rose                | <i>Rosa palustris</i>                     |
| Swamp dewberry            | <i>Rubus hispidus</i>                     |
| Blackberry                | <i>Rubus</i> sp.                          |
| Black willow              | <i>Salix nigra</i>                        |
| Common elder              | <i>Sambucus canadensis</i>                |
| Sassafras                 | <i>Sassafras albidum</i>                  |
| Glaucous greenbrier       | <i>Smilax glauca</i>                      |
| Laurel-leaved greenbrier  | <i>Smilax laurifolia</i>                  |
| Common greenbrier         | <i>Smilax rotundifolia</i>                |
| Red-berried greenbrier    | <i>Smilax walteri</i>                     |
| Narrow-leaved meadowsweet | <i>Spiraea alba</i> var. <i>latifolia</i> |
| Steeplebush               | <i>Spiraea tomentosa</i>                  |
| Basswood                  | <i>Tilia americana</i>                    |
| Poison ivy                | <i>Toxicodendron radicans</i>             |
| Poison sumac              | <i>Toxicodendron vernix</i>               |
| American elm              | <i>Ulmus americana</i>                    |
| Highbush blueberry        | <i>Vaccinium corymbosum</i>               |
| Large cranberry           | <i>Vaccinium macrocarpon</i>              |
| Early low blueberry       | <i>Vaccinium pallidum</i>                 |
| Southern arrowwood        | <i>Viburnum dentatum</i>                  |
| Naked withe-rod           | <i>Viburnum nudum</i> var. <i>nudum</i>   |

From Zampella, R. A., J. F. Bunnell, K. J. Laidig, and C. L. Dow. 2001. The Mullica River Basin. Technical Report, New Jersey Pinelands Commission, New Lisbon, New Jersey.

**Appendix 15. Taxonomic list of algae found in the New Jersey Pine Barrens.**

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**Division Chlorophyta (Green Algae)**

**Order VOLVOCALES**

*Chlamydomonas* spp.

*Gonium sociale* (Duj.)

**Order TETRASPORALES**

*Gloeocystis* sp.

*Asterococcus limneticus*

*Tetraspora* spp.

**Order ULOTRICHACEAE**

*Ulothrix zonata* (Weber and Mohr) Kutz.

*Ulothrix* spp.

*Microspora loefgrenii* (Nordst.) Lag.

*M. quadrata* Hazen

*M. tumidula* Hazen

*M. willeana* Lag.

*Microspora* spp.

*Cylindrocapsa* sp.

*Stigeoclonium* spp.

*Microthamnion strictissimus* Rab.

*Microthamnion* sp.

*Aphanochaete repens* A. Br.

*Coleochaete irregularis* Pringsh.

*C. pulvinata* A. Br.

#### **Order OEDOGONIALES**

*Oedogonium polymorphus* Wittr. and Lund.

*O. ciliatum* (Hass.) Pringsh.

*O. undulatum* A. Br.

*Oedogonium* spp.

*Bulbochaete brebissonii* Kütz.

*Bulbochaete* spp.

#### **Order CLADOPHORALES**

*Cladophora* spp.

#### **Order CHLOROCOCCALES**

*Dictyosphaerium ehrenbergianum* Näg.

*Pediastrum integrum* Näg.

*Coelastrum cambricum* Arch.

*Coelastrum* sp.

*Ankistrodesmus* sp.

*Eremosphaera viridis* De Bary

## **Order ZYGNEMATALES**

### **Family ZYGNEMATACEAE**

*Mougeotia* spp.

*Debarya* sp.

*Zygnema* spp.

*Zygogonium ericetorum* Kütz.

*Pleurodiscus purpureus* (Wolle) Lag.

*Spirogyra buchetii* Kütz.

*S. parvispora* Wood

*S. punctata* Cleve

*Spirogyra* spp.

*Sirogonium* sp.

### **Family MESOTAENIACEAE (Saccoderm desmids)**

*Mesotaenium endlicherianum* Näg.

*M. mirificum* Arch.

*Gonatozygon brebissonii* De Bary

*G. monotaenium* De Bary

*Cylindrocystis brebissonii* Men.

*Cylindrocystis* spp.

*Netrium digitus* (Ehr.) Itz. and Rothe

*N. interruptum* (Bréb.) Lütk.

*N. oblongum* (De Bary) Lütk. var. *cylindricum* West and West

*Netrium* spp.

*Spirotaenia condensata* Bréb.

*S. obscura* Ralfs

#### **Family DESMIDIACEAE (Placoderm desmids)**

*Closterium acutum* (Lyngb.) Bréb

*C. angustatum* Kütz.

*C. angustatum* var. *clavatum* Hast.

*C. baillyanum* Bréb.

*C. braunii* Reinsch

*C. costatum* Corda

*C. costatum* var. *angustum* Graff.

*C. cynthia* De Not.

*C. decorum* Bréb.

*C. diana* Ehr.

*C. diana* var. *arcuatum* (Bréb.) Rab.

*C. didymotocum* (Corda) Ralfs  
*C. ehrenbergii* Men.  
*C. gracile* Bréb.  
*C. gracile* var. *elongatum* West and West  
*C. idiosporum* West and West  
*C. intermedium* Ralfs  
*C. juncidum* Ralfs  
*C. libellula* Focke  
*C. libellula* var. *intermedium* (Roy and Biss.) G. S. West  
*C. libellula* var. *interruptum* (West and West) Donat  
*C. lineatum* Ehr.  
*C. lunula* Ehr.  
*C. macilentum* Bréb.  
*C. moniliferum* (Bory) Ehr.  
*C. moniliferum* var. *concauum* Klebs  
*C. navicula* (Bréb.) Lütke.  
*C. pritchardianum* Arch.  
*C. pseudodiana* Roy  
*C. ralfsii* Bréb.  
*C. ralfsii* var. *hybridum* Rab.  
*C. regulare* Bréb.  
*C. rostratum* Ehr.

*C. setaceum* Ehr.

*C. striolatum* Ehr

*C. turgidum* Ehr.

*C. ulna* Focke

*C. venus* Kütz.

*Closterium* spp.

*Penium clevei* Lund.

*P. cylindrus* (Ehr.) Bréb.

*P. spirostriolatum* Bark.

*Penium* spp.

*Pleurotaenium constrictum* (Bail.) Wood

*P. ehrenbergii* (Bréb.) De Bary

*P. minutum* (Ralfs) Delp.

*P. minutum* var. *latum* Kais.

*P. nodosum* (Bail.) Lund. Var. *latum* Irénée-Marie

*P. trabecula* (Ehr.) Näg.

*P. truncatum* (Bréb.) Näg.

*Pleurotaenium* sp.

*Docidium dilatatum* Cleve

*D. spinulosum* Wolle

*D. tridentulum* Wolle

*D. undulatum* Bail.

*Triploceras gracile* Bail.  
*T. verticillatum* Bail.  
*Tetmemorus brebissonii* (Men.) Ralfs  
*T. brebissonii* var. *minor* De Bary  
*T. laevis* (Kütz.) Ralfs –  
*T. laevis* var. *borgei* Först.  
*T. granulatus* (Bréb.) Ralfs  
*Tetmemorus* spp.  
*Euastrum affine* Ralfs  
*E. allenii* Cushm.  
*E. bidentatum* Näg.  
*E. binale* (Turp.) Ehr. and vars.  
*E. crassum* (Bréb.) Kütz.  
*E. crassum* var. *scrobiculatum* Lund.  
*E. cuspidatum* Wolle  
*E. denticulatum* (Kirchn.) Gay  
*E. didelta* (Turp.) Ralfs  
*E. formosum* Wolle  
*E. giganteum* (Wood) Nordst.  
*E. humerosum* Ralfs  
*E. inerme* Lund. var. *depressum* Wolle  
*E. insigne* Hass.

*E. insulare* (Wittr.) Roy  
*E. intermedium* Cleve  
*E. lapponicum* Schmid.  
*E. magnificum* Wolle  
*E. montanum* West and West  
*E. purum* Wolle  
*E. validum* West and West  
*E. ventricosum* Lund.  
*E. wollei* Lag. var. *pearlingtonense* Presc. and Scott  
*Euastrum* spp.  
*Actinotaenium cucurbita* (Bréb.) Teil.  
*A. cucurbitinum* (Biss.) Teil. var. *majellanicum* (Borge) Teil.  
*A. diplosporum* (Lund.) Teil. var. *americanum* (West and West) Teil  
*Cosmarium abruptum* Lund.  
*C. amoenum* Bréb. var. *mediolaeve* Nordst.  
*C. angulosum* Bréb  
*C. impressulum* Efv.  
*C. incertum* Schmid. forma *consociatum* Croasd. (?)  
*C. isthmium* West  
*C. kitchellii* Wolle  
*C. margaritatum* (Lund.) Roy and Biss.  
*C. moniliforme* (Turp.) Ralfs

*C. norimbergense* Reinsch forma *depressa* West and West

*C. novae-terrae* Taylor

*C. ornatum* Ralfs

*C. orthostichum* Lund.

*C. ovale* Ralfs

*C. portianum* Arch.

*C. pseudoconnatum* Nordst.

*C. pseudoprotuberans* Kirchn.

*C. pseudopyramidatum* Lund.

*C. pseudotoxichondron* Nordst.

*C. punctulatum* Bréb.

*C. pyramidatum* Bréb. and var. *convexum* Krieg. and Gerl.,

*C. rectangulare* Grun.

*C. reniforme* (Ralfs) Arch.

*C. sejunctum* Wolle

*C. subcucumis* Schmid.

*C. subdepressum* West and West

*C. subtumidum* Nordst.

*C. tinctum* Ralfs

*C. trilobulatum* Reinsch

*Cosmarium* spp.

*Micrasterias americana* (Ehr.) Ralfs

*M. denticulata* Bréb.  
*M. depauperata* Nordst. var. *kitchelii* (Wolle) West and West  
*M. dichotoma* Wolle  
*M. expansa* Bail.  
*M. fimbriata* Ralfs var. *apiculata* Men.  
*M. fimbriata* var. *spinosa* Biss.  
*M. foliacea* Bail.  
*M. jeneri* Ralfs  
*M. laticeps* Nordst.  
*M. mahabuleshwariensis* Hobs. var. *ringens* (Bail.) Krieg.  
*M. muricata* (Bail.) Ralfs  
*M. oscitans* Ralfs  
*M. papillifera* Bréb.  
*M. papillifera* var. *glabra* Nordst.  
*M. papillifera* var. *speciosa* Krieg.  
*M. pinnatifida* (Kütz.) Ralfs var. *pseudoscitans* Grönbl.  
*M. piquata* Salisb. var. *lata* Presc. and Scott  
*M. radiosa* Ralfs  
*M. rotata* (Grev.) Ralfs  
*M. triangularis* Wolle  
*M. truncata* (Corda) Bréb.  
*Micrasterias* spp.

*Xanthidium antilopaeum* Kütz.  
*X. antilopaeum* var. *minneapolisense* Wolle  
*X. armatum* (Bréb.) Rab.  
*X. columbianum* Wolle  
*Xanthidium* spp.  
*Staurostrum alternans* Bréb.  
*S. ankyroides* Wolle  
*S. aspinosum* Wolle  
*S. bienneanum* Rab. var. *ellipticum* Wolle  
*S. brebissonii* Arch.  
*S. botrophilum* Wolle  
*S. calyxoides* Wolle  
*S. cerastes* Lund.  
*S. coronatum* Wolle  
*S. cyrtocerum* Bréb.  
*S. dilatatum* Ehr.  
*S. divaricatum* Wolle  
*S. elongatum* Bark. var. *tetragonum* Wolle  
*S. forficatulatum* Lund.  
*S. gracile* Ralfs  
*S. hystrix* Ralfs  
*S. inconspicuum* Nordst.

*S. leptacanthum* Nordst. var. *tetrocteron* Wolle  
*S. muricatum* Bréb.  
*S. ophiura* Lund. forma  
*S. orbiculare* Ralfs  
*S. pilosum* (Näg.) Arch.  
*S. polytrichm* (Perty) Rab.  
*S. pulchrum* Wolle  
*S. punctulatum* Bréb.  
*S. quaternum* Wolle  
*S. rugulosum* Bréb.  
*S. rugulosum* var. *angulare* Grönbl.  
*S. simonyi* Heim.  
*S. teliferum* Ralfs  
*S. turgescens* De Not.  
*S. vestitum* Ralfs  
*Staurastrum* spp.  
*Arthrodesmus crassus* West and West  
*A. fragilis* Wolle  
*A. incus* (Bréb.) Hass.  
*A. rauii* Wolle  
*A. subulatus* Kütz. var. *subaequalis* West and West  
*A. triangularis* Lag. var. *subtriangularis* (Borge) West and West

*Hyalotheca dissiliens* (Smith) Bréb.

*H. mucosa* (Mert.) Ehr.

*Phymatodocis nordstedtiana* Wolle

*Desmidium aptogonum* Bréb.

*D. baileyi* (Ralfs) Nordst.

*D. elongatum* Wolle

*D. grevillii* (Kütz.) De Bary

*D. quadratum* Nordst.

*D. swartzii* Ag.

*Bambusina brebissonii* Kütz (*Gymnozygon*)

*B. delicatissima* Wolle

## **Division Euglenophyta (Euglenoids)**

### **Order EUGLENALES**

*Euglena acus* Ehr.

*E. elongata* Schewiakoff

*E. gracilis* Klebs

*E. mutabilis* Schmitz

*E. spirogyra* Ehr.

*Euglena* spp.

*Phacus crenulata* Presc.

*P. longicauda* (Ehr.) Duj.

*P. pleuronectes* (O.F. Müll.) Duj.

*P. pyrum* (Ehr.) Stein

*Phacus* spp.

*Trachelomonas armata* (Ehr.) Stein

*T. horrida* Palm

*T. lacustris* Drezepolski

*T. superba* (Swir.) Defl

*T. volvocina* Ehr.

*Trachelomonas* spp.

*Entosiphon sulcatum* (Duj.) Stein

*Peranema trichophorum* (Ehr.) Stein

## **Division Chrysophyta (Yellow-green Algae)**

### **Class XANTHOPHYCEAE**

#### **Order HETEROCOCCALES**

*Characiopsis* sp.

*Harpochytrium* sp.

*Ophiocytium capitatum* Wolle

*O. parvulum* (Perty) A. Br.

*Ophiocytium* sp.

*Botryococcus braunii* Kütz.

## **Class CHRYSOPHYCEAE**

### **Order CHRYSOMONADALES**

*Chrysococcus* sp.

*Derepyxis amphora* Stokes

*Derepyxis* sp.

*Synura ulvella* Ehr.)

*Uroglena volvox* Ehr.

*Cyclonexis annularis* Stokes

*Dinobryon sertularia* Ehr.

*D. stipitatum* Stein

*Epipyxis* sp.

### **Order RHIZOCHRYSIDALES**

*Chrysopyxis bipes* Stein

*Lagynion scherffelii* Pasch.

*L. triangulare* (Stokes) Pasch.

## **Class BACILLARIOPHYCEAE (Diatoms)**

## Order CENTRALES

*Melosira* sp.

## Order PENNALES

*Tabellaria fenestrata* (Lyngb.) Kütz.

*T. flocculosa* (Roth) Kütz.

*Fragilaria crotonensis* Kitt.

*F. virescens* Ralf

*F. virescens* var. *capitata* Østr.

*Fragilaria* spp.

*Synedra* spp.

*Asterionella formosa* Hass.

*Semiorbis hemicyclus* (Ehr.) Patr.

*Eunotia bactriana* Ehr.

*E. bidentula* Wm. Sm.

*E. curvata* (Kütz) Lagerst.

*E. flexuosa* Bréb. ex Kütz.

*E. incisa* W. Sm. ex Greg. var. *incisa* Patr.

*E. pectinalis* (O.F. Müll) Rab. var. *minor* (Kütz.) Rab.

*E. pectinalis* var. *undulata* (Ralfs) Rab.

*E. pectinalis* var. *ventralis* (Ehr.) Hust.

*E. serra* Ehr. var. *serra* Patr.  
*E. soleirolii* (Kütz.) Rab.  
*E. sudetica* O. Müll. EggR;  
*E. tenella* (Grun.) Hust. in Pascher  
*Eunotia* spp.  
*Actinella punctata* Lewis  
*Navicula oblongata* Kütz.  
*Navicula* spp.  
*Pinnularia gibba* Ehr.  
*P. legumen* Ehr.  
*P. maior* (Kütz.) Rab. var. *pulchella* Boyer  
*P. nobilis* (Ehr.) Ehr.  
*P. parvula* (Ralfs) Cl. Eul. var. *parvula* Patr.  
*Pinnularia* spp.  
*Anomoeoneis serians* (Bréb.) Cl.  
*Stauroneis anceps* Ehr.  
*S. phoenicenteron* (Nitzsch) Ehr.  
*Stauroneis* spp.  
*Frustulia rhomboides* (Ehr.) DeT.  
*Frustulia* spp.  
*Cymbella gracilis* (Rab.) Cl.  
*Cymbella* spp.

*Nitzschia sigmatella* Greg.

*Nitzschia* spp.

*Surirella anceps* Lewis

*S. arctissima* A. S.

*S. linearis* W. Sm.

*Surirella* spp. Helm

*Stenopterobia intermedia* Lewis

## **Division PYRROPHYTA (Dinoflagellates)**

### **Order GYMNODINIALES**

*Gymnodinium* spp.

### **Order PERIDINIALES**

*Peridinium* sp.

### **Order DINOCOCCALES**

*Cystodinium bataviense* Klebs

## **Division CYANOPHYTA (Blue-green Algae)**

## **Order CHROOCOCCALES**

*Chroococcus turgida* (Kütz.) Näg. [Anacystis dimidiata (Kütz.) Dr. and Dailey]

*Aphanocapsa* sp.

*Eucapsis alpina* Clem. And Shantz

*Merismopedia punctata* Meyen

## **Order OSCILLATORIALES**

*Oscillatoria princeps* Vauch.

*O. tenuis* Ag.

*Oscillatoria* spp.

*Symploca muralis* Kütz.

*Anabaena* spp.

*Cylindrospermum* sp. – Helm; pond, squeez

*Scytonema tolypothrichoides* Borr. and Flah.

*Stigonema turfaceum* (Bréb.) Cooke

*Hapalosiphon* sp.

*Rivularia* sp.

*Calathrix* sp.

## **Division RHODOPHYTA (Red Algae)**

### **Order NEMALIONALE**

*Batrachospermum brugiense* Sirod.

*B. coerulescens* Sirod.

*Batrachospermum* spp.

*Audouinella violacea* (Kütz.) Hamel

## **Groups of UNCERTAIN POSITION**

### **Order CHLOROMONADALES**

*Gonyostomum semen* (Ehr.) Diesing

### **Order CRYPTOMONADALES**

*Cryptomonas* spp.)

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From Moul, E. T. and H. T. Buell. 1998. Algae of the Pine Barrens. In:  
R. T. T. Forman (ed.), *Pine Barrens: Ecosystems and Landscape*.  
Rutgers University Press, New Brunswick, New Jersey, pp. 425-440.

**Appendix 16. Taxonomic list of avifauna identified along Great Bay Boulevard and adjacent open waters of the Jacques Cousteau National Estuarine Research Reserve.**

| Group                   | Common Name             | Scientific Name            |
|-------------------------|-------------------------|----------------------------|
| <b>Gulls and Terns</b>  |                         |                            |
|                         | Common tern             | <i>Sterna hirundo</i>      |
|                         | Least tern              | <i>Sterna antillarum</i>   |
|                         | Caspian tern            | <i>Sterna caspia</i>       |
|                         | Forester's tern         | <i>Sterna forsteri</i>     |
|                         | Royal tern              | <i>Sterna maxima</i>       |
|                         | Gull-billed tern        | <i>Sterna nilotica</i>     |
|                         | Herring gull            | <i>Larus argentatus</i>    |
|                         | Laughing gull           | <i>Larus atricilla</i>     |
|                         | Ring-billed gull        | <i>Larus delawarensis</i>  |
|                         | Great black-backed gull | <i>Larus marinus</i>       |
|                         | Black skimmer           | <i>Rynchops niger</i>      |
| <b>Loons and Grebes</b> |                         |                            |
|                         | Common loon             | <i>Gavia immer</i>         |
|                         | Red-throated loon       | <i>Gavia stellata</i>      |
|                         | Horned grebe            | <i>Podiceps auritus</i>    |
|                         | Pied-billed grebe       | <i>Podilymbus podiceps</i> |

|                          |                               |
|--------------------------|-------------------------------|
| Red-throated grebe       | <i>Podiceps grisegena</i>     |
| Northern gannet          | <i>Sula bassanus</i>          |
| Double-crested cormorant | <i>Phalacrocorax auritus</i>  |
| Brown pelican            | <i>Pelecanus occidentalis</i> |

**Bitterns, Herons, and  
Ibises**

|                            |                              |
|----------------------------|------------------------------|
| American bittern           | <i>Botaurus lentiginosus</i> |
| Great blue heron           | <i>Ardea herodias</i>        |
| Little blue heron          | <i>Egretta caerulea</i>      |
| Tricolored heron           | <i>Egretta tricolor</i>      |
| Green-backed heron         | <i>Butorides striatus</i>    |
| Black-crowned night heron  | <i>Nycticorax nycticorax</i> |
| Yellow-crowned night heron | <i>Nycticorax violaceus</i>  |
| Great egret                | <i>Casmerodius albus</i>     |
| Snowy egret                | <i>Egretta thula</i>         |
| Cattle egret               | <i>Bubulcus ibis</i>         |
| Glossy ibis                | <i>Plegadis falcinellus</i>  |
| White-faced ibis           | <i>Plegadis chihi</i>        |

**Rails**

|               |                            |
|---------------|----------------------------|
| Clapper rail  | <i>Rallus longirostris</i> |
| American coot | <i>Fulica americana</i>    |

**Ducks, Geese, and  
Swans**

|                     |                      |
|---------------------|----------------------|
| American black duck | <i>Anas rubripes</i> |
|---------------------|----------------------|

|                        |                                |
|------------------------|--------------------------------|
| Mallard                | <i>Anas platyrhynchos</i>      |
| Ruddy duck             | <i>Oxyura jamaicensis</i>      |
| Atlantic brant         | <i>Branta bernicla</i>         |
| Blue-winged teal       | <i>Anas discors</i>            |
| Green-winged teal      | <i>Anas crecca</i>             |
| Gadwall                | <i>Anas strepera</i>           |
| American wigeon        | <i>Anas americana</i>          |
| Canvasback             | <i>Aythya valisineria</i>      |
| Greater scaup          | <i>Aythya marila</i>           |
| Lesser scaup           | <i>Aythya affinis</i>          |
| Oldsquaw               | <i>Clangula hyemalis</i>       |
| Black scoter           | <i>Melanitta nigra</i>         |
| Surf scoter            | <i>Melanitta perspicillata</i> |
| White-winged scoter    | <i>Melanitta fusca</i>         |
| Common goldeneye       | <i>Bucephala clangula</i>      |
| Bufflehead             | <i>Bucephala albeola</i>       |
| Common merganser       | <i>Mergus merganser</i>        |
| Hooded merganser       | <i>Lophodytes cucullatus</i>   |
| Red-breasted merganser | <i>Mergus serrator</i>         |
| Canada goose           | <i>Branta canadensis</i>       |
| Snow goose             | <i>Chen caerulescens</i>       |
| Mute swan              | <i>Cygnus olor</i>             |

**Eagles, Falcons, Hawks,  
and Owls**

|            |                                 |
|------------|---------------------------------|
| Bald eagle | <i>Haliaeetus leucocephalus</i> |
|------------|---------------------------------|

|                    |                           |
|--------------------|---------------------------|
| Cooper's hawk      | <i>Accipiter striatus</i> |
| Sharp-shinned hawk | <i>Accipiter striatus</i> |
| Osprey             | <i>Pandion haliaetus</i>  |
| Northern harrier   | <i>Circus cyaneus</i>     |
| American kestrel   | <i>Falco peregrinus</i>   |
| Merlin             | <i>Falco columbarius</i>  |
| Peregrine falcon   | <i>Falco peregrinus</i>   |
| Common barn owl    | <i>Tyto alba</i>          |
| Great horned owl   | <i>Bubo virginianus</i>   |
| Short-eared owl    | <i>Asio flameus</i>       |
| Turkey vulture     | <i>Cathartes aura</i>     |

### **Plovers and Sandpipers**

|                        |                                |
|------------------------|--------------------------------|
| Piping plover          | <i>Charadrius melodus</i>      |
| Semipalmated plover    | <i>Charadrius semipalmatus</i> |
| Black-bellied plover   | <i>Pluvialis squatarola</i>    |
| Semipalmated sandpiper | <i>Calidris pusilla</i>        |
| Western sandpiper      | <i>Calidris mauri</i>          |
| Least sandpiper        | <i>Calidris minutilla</i>      |
| White-rumped sandpiper | <i>Calidris fuscicollis</i>    |
| Pectoral sandpiper     | <i>Calidris melanotos</i>      |
| Purple sandpiper       | <i>Calidris maritima</i>       |
| Curlew sandpiper       | <i>Calidris ferruginea</i>     |
| Dunlin                 | <i>Calidris alpina</i>         |
| Whimbrel               | <i>Numenius phaeopus</i>       |

|                        |                                   |
|------------------------|-----------------------------------|
| Marbled godwit         | <i>Limosa fedoa</i>               |
| Ruddy turnstone        | <i>Arenaria interpres</i>         |
| Red knot               | <i>Calidris canutus</i>           |
| Sanderling             | <i>Calidris alba</i>              |
| Killdeer               | <i>Charadrius vociferus</i>       |
| American oystercatcher | <i>Itaematopus palliatus</i>      |
| American avocet        | <i>Recurvirostra americana</i>    |
| Greater yellowlegs     | <i>Tringa melanoleuca</i>         |
| Lesser yellowlegs      | <i>Tringa flavipes</i>            |
| Willet                 | <i>Catoptrophorus semipalmatu</i> |

#### **Doves and Swifts**

|                   |                         |
|-------------------|-------------------------|
| Mourning dove     | <i>Zenaida macroura</i> |
| Rock dove         | <i>Columba livia</i>    |
| Belted kingfisher | <i>Ceryle alcyon</i>    |
| Common nighthawk  | <i>Chordeiles minor</i> |

#### **Flycatchers and Woodpeckers**

|                       |                                   |
|-----------------------|-----------------------------------|
| Northern flicker      | <i>Colaptes auratus</i>           |
| Eastern kingbird      | <i>Tyrannus tyrannus</i>          |
| Eastern phoebe        | <i>Sayornis phoebe</i>            |
| Red-headed woodpecker | <i>Melanerpes erythrocephalus</i> |

#### **Larks, Swallows, Jays, and Crows**

|               |                             |
|---------------|-----------------------------|
| Horned lark   | <i>Eremophila alpestris</i> |
| Purple martin | <i>Progne subris</i>        |

|                               |                                   |
|-------------------------------|-----------------------------------|
| Tree swallow                  | <i>Iridoprocne bicolor</i>        |
| Northern rough-winged swallow | <i>Stelgedopteryx serripennis</i> |
| Bank swallow                  | <i>Riparia riparia</i>            |
| Barn swallow                  | <i>Hirundo rustica</i>            |
| Blue jay                      | <i>Cyanocitta cristata</i>        |
| Fish crow                     | <i>Corvus ossifragus</i>          |

### **Kinglets and Thrashers**

|                        |                               |
|------------------------|-------------------------------|
| Golden-crowned kinglet | <i>Regulus satrapa</i>        |
| Ruby-crowned kinglet   | <i>Regulus calendula</i>      |
| American robin         | <i>Turdus migratorius</i>     |
| Hermit thrush          | <i>Catherus guttatus</i>      |
| Grey catbird           | <i>Dumetella carolinensis</i> |
| Northern mockingbird   | <i>Mimus polyglottos</i>      |
| Brown thrasher         | <i>Toxostoma rufum</i>        |
| Cedar waxwing          | <i>Bombycilla cedrorum</i>    |
| European starling      | <i>Sturnus vulgaris</i>       |

### **Blackbirds and Finches**

|                      |                            |
|----------------------|----------------------------|
| Red-winged blackbird | <i>Agelaius phoeniceus</i> |
| Eastern meadowlark   | <i>Sturnella magna</i>     |
| Common grackle       | <i>Quiscalus quiscalus</i> |
| Boat-tailed grackle  | <i>Quiscalus major</i>     |
| Brown-headed cowbird | <i>Molothrus ater</i>      |
| American goldfinch   | <i>Carduelis tristis</i>   |

|                  |                                   |
|------------------|-----------------------------------|
| House finch      | <i>Carpodacus mexicanus</i>       |
| Evening grosbeak | <i>Coccothraustes vespertinas</i> |

**Titmice, Nuthatch,  
and Wrens**

|                         |                                 |
|-------------------------|---------------------------------|
| Tufted titmouse         | <i>Parus bicolor</i>            |
| Carolina chickadee      | <i>Parus carolinensis</i>       |
| White-breasted nuthatch | <i>Sitta carolinensis</i>       |
| Red-breasted nuthatch   | <i>Sitta canadensis</i>         |
| Brown creeper           | <i>Certhia familiaris</i>       |
| Carolina wren           | <i>Thryothorus ludovicianus</i> |
| Marsh wren              | <i>Cistothorus palustris</i>    |

**Vireos and Warblers**

|                              |                               |
|------------------------------|-------------------------------|
| Red-eyed vireo               | <i>Vireo olivaceus</i>        |
| Northern parula              | <i>Parula americana</i>       |
| Blue-winged warbler          | <i>Vermivora pinus</i>        |
| Yellow warbler               | <i>Dendroica petechia</i>     |
| Chestnut-sided warbler       | <i>Dendroica pensylvanica</i> |
| Magnolia warbler             | <i>Dendroica magnolia</i>     |
| Cape May warbler             | <i>Dendroica tigrina</i>      |
| Black-throated blue warbler  | <i>Dendroica caerulescens</i> |
| Yellow-rumped warbler        | <i>Dendroica coronata</i>     |
| Black-throated green warbler | <i>Dendroica virens</i>       |

|                          |                              |
|--------------------------|------------------------------|
| Blackburnian warbler     | <i>Dendroica fusca</i>       |
| Blackpoll warbler        | <i>Dendroica striata</i>     |
| Black-and-white warbler  | <i>Mniotilta varia</i>       |
| Worm-eating yellowthroat | <i>Helminthos vermivorus</i> |
| Common Yellowthroat      | <i>Geothlypis trichas</i>    |
| Yellow-breasted chat     | <i>Icteria virens</i>        |

### **Sparrows and Tanagers**

|                        |                                |
|------------------------|--------------------------------|
| American tree sparrow  | <i>Spizella arborea</i>        |
| Sharp-tailed sparrow   | <i>Ammodramus caudacuta</i>    |
| Seaside sparrow        | <i>Ammodramus maritima</i>     |
| Fox sparrow            | <i>Passerella iliaca</i>       |
| Song sparrow           | <i>Melospiza melodia</i>       |
| Swamp sparrow          | <i>Melospiza georgiana</i>     |
| White-throated sparrow | <i>Zonotrichia albicollis</i>  |
| White-crowned sparrow  | <i>Zonotrichia leucophrys</i>  |
| Scarlet tanager        | <i>Piranga olivacea</i>        |
| Northern cardinal      | <i>Cardinalis cardinalis</i>   |
| Rose-breasted grosbeak | <i>Pheucticus ludovicianus</i> |
| Indigo bunting         | <i>Passerina cyanea</i>        |
| Snow bunting           | <i>Plectrophenax nivalis</i>   |
| Rufous-sided towhee    | <i>Pipilo erythrophthalmus</i> |
| Dark-eyed junco        | <i>Junco hyemalis</i>          |

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**Appendix 17. List of research and monitoring publications on the Jacques Cousteau National Estuarine Research Reserve.**

**PUBLICATIONS**

Able, K. W. 1990. Life history patterns of salt marsh killifishes in New Jersey. Bull. N.J. Acad. Sci. 35(2):23-30.

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**Appendix 18. Phytoplankton nitrogen requirement relative to standing stocks of nitrogen in the Mullica River-Great Bay Estuary. At the river station, nitrogen available (A) is in excess of nitrogen required (C). At the mid-station, nitrogen available is sometimes in excess of and sometimes less than that required. At the bay station, nitrogen available is less than that required.**

| Date    | <u>River Station 7</u>  |                 |                 |                 |                           | <u>Mid-Station 8</u>    |                 |                 |                 |                           | <u>Bay Station 9</u>    |                 |                 |                 |                           |
|---------|-------------------------|-----------------|-----------------|-----------------|---------------------------|-------------------------|-----------------|-----------------|-----------------|---------------------------|-------------------------|-----------------|-----------------|-----------------|---------------------------|
|         | GP <sup>a</sup><br>mg C | A<br>μg-at<br>N | B<br>μg-at<br>N | C<br>μg-at<br>N | tide<br>± hr <sup>b</sup> | GP <sup>a</sup><br>mg C | A<br>μg-at<br>N | B<br>μg-at<br>N | C<br>μg-at<br>N | tide<br>± hr <sup>b</sup> | GP <sup>a</sup><br>mg C | A<br>μg-at<br>N | B<br>μg-at<br>N | C<br>μg-at<br>N | tide<br>± hr <sup>b</sup> |
| 6/24/63 | 735                     | 8.8             |                 |                 | H-2-1/4                   | 645                     | 7.7             |                 |                 | H-2-1/2                   | 659                     | 7.9             |                 |                 | H-3                       |
| 6/24    |                         |                 | 18.6            | 9.8             | H-3/4                     |                         |                 | 3.8             | -3.9            | H-1                       |                         |                 | 2.5             | -5.4            | H-1-3/4                   |
| 7/4     | 422                     | 5.0             |                 |                 | H+2-3/4                   | 667                     | 7.9             |                 |                 | H+2-1/2                   | 825                     | 9.9             |                 |                 | H+1-3/4                   |
| 7/5     |                         |                 | 36.6            | 31.6            | H+2-1/4                   |                         |                 | 7.2             | -0.7            | H+2                       |                         |                 | 1.1             | -8.8            | H+-1                      |
| 7/12    |                         |                 |                 |                 |                           | 577                     | 6.9             |                 |                 | L-2-3/4                   | 482                     | 5.7             |                 |                 | L+1-1/4                   |
| 7/11    |                         |                 |                 |                 |                           |                         |                 | 4.1             | -2.8            | H+2-1/2                   |                         |                 | 1.8             | -3.9            | H+1-3/4                   |
| 7/18    | 686                     | 8.2             |                 |                 | L-2-1/2                   | 419                     | 5.0             |                 |                 | H+3                       | 784                     | 9.4             |                 |                 | H+2-1/2                   |
| 7/18    |                         |                 | 10.6            | 2.4             | L-2-1/2                   |                         |                 | 12.4            | 7.4             | H+3                       |                         |                 | 3.4             | -6.0            | H+2-1/2                   |
| 7/24    | 634                     | 7.6             |                 |                 | H-2                       | 958                     | 11.4            |                 |                 | H-2                       |                         |                 |                 |                 |                           |
| 7/25    |                         |                 | 31.2            | 23.6            | H+1                       |                         |                 | 12.4            | 1.0             | H-1/2                     |                         |                 |                 |                 |                           |
| 8/7     | 553                     | 6.6             |                 |                 | H-1                       | 487                     | 5.8             |                 |                 | H-1                       | 814                     | 9.7             |                 |                 | H-1-1/4                   |
| 8/8     |                         |                 | 24.6            | 18.0            | H-1                       |                         |                 | 5.2             | -0.6            | H-1                       |                         |                 | 4.5             | -5.2            | H-1-1/2                   |
| 8/11    | 446                     | 5.3             |                 |                 | L-1-1/2                   | 485                     | 5.8             |                 |                 | L-2                       |                         |                 |                 |                 |                           |
| 8/15    |                         |                 | 18.0            | 12.7            | L-2                       |                         |                 | 27.2            | 21.4            | L-2-1/4                   |                         |                 |                 |                 |                           |
| 8/23    | 613                     | 7.3             |                 |                 | H-1-3/4                   | 798                     | 9.5             |                 |                 | H-2-1/4                   | 1362                    | 16.2            |                 |                 | H-2-3/4                   |
| 8/22    |                         |                 | 49.3            | 42.0            | H-1                       |                         |                 | 11.0            | 1.5             | H-1-1/4                   |                         |                 | 5.1             | -11.1           | H-2                       |
| 8/28    | 1081                    | 12.9            |                 |                 | L-3/4                     | 525                     | 6.3             |                 |                 | L-1                       | 577                     | 6.9             |                 |                 | L-1                       |
| 8/29    |                         |                 | 24.6            | 11.7            | L-1/2                     |                         |                 | 21.0            | 14.7            | L-1                       |                         |                 | 4.9             | -2.0            | L-1                       |

<sup>a</sup>Gross primary productivity as mg C m<sup>-2</sup> d<sup>-1</sup>. Nitrogen required (A) calculated as μg-at N m<sup>-2</sup> d<sup>-1</sup>. Nitrogen available (B) equals sum of ammonium-N and nitrate-N m<sup>-2</sup> on day of sampling indicated. Excess <sup>b</sup>H, high tide; L, low tide.

From Durand, J. B. 1984. Nitrogen distribution in New Jersey coastal bays. In: M. J. Kennish and R. A. Lutz (eds.), *Ecology of Barnegat Bay, New Jersey*. Springer-Verlag, New York, pp. 29-51.

**Appendix 19. Taxonomic list of benthic invertebrates collected by Petersen Dredge  
in the Mullica River-Great Bay estuarine system.**

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**PHYLUM PORIFERA**

**Class Demospongiae**

*Cliona* sp.

*Microciona prolifera* (Ellis & Solander)

**PHYLUM COELENTERATA**

**Class Hydrozoa**

*Stylactis hooperi* (Sigerfoos)

**Class Anthozoa**

*Sagartia modesta* (Verrill)

**PHYLUM PLATYHELMINTHES**

**Class Turbellaria**

*Euplana gracilis* (Girard)

**PHYLUM NEMERTINEA**

**Class Anopla**

*Carinoma tremepheros* (Thompson)

*Cerebratulus lacteus* (Leidy)

*Zygeupolia rubens* (Coe)

**PHYLUM ANNELIDA**

## **Class Polychaeta**

- Amphitrite affinis* (Malmgren)
- Amphitrite cirrata* (O. F. Müller)
- Amphitrite johnstoni* (Malmgren)
- Aricidea jeffreysii* (McIntosh)
- Brania clavata* (Claparede)
- Chone infundibuliformis* (Kroyer)
- Cirratulus grandis* (Verrill)
- Clymenella torquata* (Leidy)
- Diopatra cuprea* (Bosc)
- Dispio uncinata* (Hartman)
- Drilonereis longa* (Webster)
- Drilonereis magna* (Webster and Benedict)
- Eteone heteropoda* (Hartman)
- Eteone longa* (Fabricius)
- Eumida sanguinea* (Cersted)
- Exogone dispar* (Webster)
- Glycera americana* (Leidy)
- Glycera dibranchiata* (Ehlers)
- Glycinde solitaria* (Webster)
- Harmothoe imbricata* (L.)
- Hydroides dianthus* (Verrill)
- Hypaniola grayi* (Pettibone)

*Lumbrineris tenuis* (Verrill)  
*Maldinopsis elongata* (Verrill)  
*Nephtys bucera* (Ehlers)  
*Nephtys incisa* (Malmgren)  
*Nephtys picta* (Ehlers)  
*Nereis arenaceodonta* (Moore)  
*Nereis grayi* (Pettibone)  
*Nereis succinea* (Frey and Leuckart)  
*Nerinides agilis* (Verrill)  
*Notomastus latereus* (Sara)  
*Paranaitis speciosa* (Webster)  
*Pectinaria gouldii* (Verrill)  
*Phyllodoce arenae* (Webster)  
*Pista palmata* (Verrill)  
*Polycirrus eximius* (Leidy)  
*Polydora ligni* (Webster)  
*Pygospio elegans* (Verrill)  
*Sabella microphthalma* (Verrill)  
*Scolecoides viridis* (Verrill)  
*Scoloplos fragilis* (Verrill)  
*Scoloplos robustus* (Verrill)  
*Sphaerosyllis hystrix* (Claparède)  
*Spio filicornis* (O. F. Müller)

*Streblospio benedicti* (Webster)

*Tharyx acutus* (Webster and Benedict)

## **PHYLUM MOLLUSCA**

### **Class Gastropoda**

*Acteocina canaliculata* (Say)

*Acteon punctostriatus* (C. B. Adams)

*Anachis avara* (Say)

*Bittium alternatum* (Say)

*Busycon canaliculatum* (L.)

*Crepidula convexa* (Say)

*Crepidula fornicata* (L.)

*Crepidula plana* (Say)

*Cylichna alba* (Brown)

*Epitonium lineatum* (Say)

*Eupleura caudata* (Say)

*Littorina littorea* (L.)

*Nitrella lunata* (Say)

*Nassarius obsoletus* (Say)

*Nassarius vibex* (Say)

*Odostomia impressa* (Say)

*Triphora nigrocincta* (C. B. Adams)

*Trophon truncatus* (Say)

*Turbonilla* sp.

*Urosalpinx cinera* (Say)

### **Class Bivalvia**

*Arca pexata* (Say)

*Crassostrea virginica* (Gmelin)

*Ensis directus* (Conrad)

*Gemma gemma* (Totten)

*Lyonsia hyalina* (Conrad)

*Macoma tenta* (Say)

*Mercenaria mercenaria* (L.)

*Mulinia lateralis* (Say)

*Mya arenaria* (L.)

*Mytilus edulis* (L.)

*Nucula* sp.

*Spisula solidissima* (Dillwyn)

*Tagelus divisus* (Spengler)

*Tellina agilis* (Stimpson)

## **PHYLUM ARTHROPODA**

### **Class Crustacea**

*Aeginella longicornis* (Kröyer)

*Ampelisca abdita* (Mills)

*Ampelisca verrilli* (Mills)

*Amphithoe longimana* (Smith)  
*Amphithoe rubricata* (Montagu)  
*Anoplodactylus lentus* (Wilson)  
*Batea secunda* (Holmes)  
*Caprella geometrica* (Say)  
*Carinogammarus mucronatus* (Say)  
*Chiridotea almyra* (Bowman)  
*Corophium cylindricum* (Say)  
*Crangon septemspinosa* (Say)  
*Cyathura polita* (Stimpson)  
*Edotea triloba* (Say)  
*Elasmopus laevis* (Smith)  
*Erichsonella attenuata* (Harger)  
*Erichthonius minax* (Smith)  
*Eurypanopeus depressus* (Smith)  
*Gammarus locusta* (L.)  
*Grubia compta* (Smith)  
*Haustorius arenarius* (Slabber)  
*Heteromysis formosa* (S. I. Smith)  
*Hippolyte zostericolor* (Smith)  
*Idotea balthica* (Pallas)  
*Labidocera aestiva* (Wheeler)  
*Leucon americanus* (Zimmer)

*Lysianopsis alba* (Holmes)  
*Melita nitida* (Smith)  
*Microdeutopus gryllotalpa* (Costa)  
*Monoculodes edwardsi* (S. I. Smith)  
*Neomysis americana* (S. I. Smith)  
*Neopanope texana* (Smith)  
*Oxyurostylis smithi* (Calman)  
*Pagurus longicarpus* (Say)  
*Palaemonetes vulgaris* (Say)  
*Paraphosux spinosus* (Holmes)  
*Ptilocheirus pinquis* (Stimpson)  
*Rithropanopeus harrisi* (Gould)  
*Stenothoe cypris* (Say)  
*Sympleustes glaber* (Boeck)  
*Unciola irrorata* (Say)

## **PHYLUM ECOTOPROCTA**

### **Class Gymnolaemata**

*Electra crustulenta* (Pallas)  
*Electra hastingsae* (Marcus)  
*Membranipora* sp.  
*Schizoporella unicornis* (Johnston)

## **PHYLUM CHORDATA**

## **Class Ascidiacea**

### *Molgula manhattensis* (De Kay)

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From Kennish, M. J., S. M. Haag, G. P. Sakowicz, and J. B. Durand. 2004. Benthic macrofaunal community structure along a well-defined salinity gradient in the Mullica River-Great Bay Estuary. *Journal of Coastal Research*, SI 45: 209-226.

**Appendix 20. Taxonomic list of fishes and selected decapods caught in Little Egg Harbor.**

| Species                       | Common Name            | Gear Used       |
|-------------------------------|------------------------|-----------------|
| <b>Fish</b>                   |                        |                 |
| <i>Alosa aestivalis</i>       | Blueback herring       | S, T, W         |
| <i>Alosa pseudoharengus</i>   | Alewife                | S, T, W         |
| <i>Alosa sapidissima</i>      | American shad          | S, T            |
| <i>Aluterus scriptus</i>      | Scrawled filefish      | T               |
| <i>Ammodytes americanus</i>   | American sand lance    | S               |
| <i>Anchoa mitchilli</i>       | Bay anchovy            | S, T, W, SS, TT |
| <i>Anchoa hepsetus</i>        | Striped anchovy        | S, T, W         |
| <i>Anguilla rostrata</i>      | American eel           | S, T, W, SS, TT |
| <i>Apeltes quadracus</i>      | Four-spine stickleback | S, T, SS, TT    |
| <i>Astroscopus guttatus</i>   | Northern stargazer     | S               |
| <i>Bairdiella chrysoura</i>   | Silver perch           | S, T            |
| <i>Brevoortia tyrannus</i>    | Atlantic menhaden      | S, T, W         |
| <i>Caranx hippos</i>          | Crevalle jack          | S, T, W         |
| <i>Centropristis striata</i>  | Black sea bass         | T, SS, TT       |
| <i>Chasmodes bosquianus</i>   | Striped blenny         | S, T            |
| <i>Chilomycterus schoepfi</i> | Striped burrfish       | S, T            |
| <i>Clupea harengus</i>        | Atlantic herring       | S, T, W         |
| <i>Conger oceanicus</i>       | Conger eel             | S, T            |
| <i>Cynoscion regalis</i>      | Weakfish               | S, T            |
| <i>Cynoscion nebulosus</i>    | Spotted seatrout       |                 |
| <i>Cyprinodon variegatus</i>  | Sheepshead minnow      | S, T, W, TT     |
| <i>Dasyatis</i> sp.           | Stingray               | S               |
| <i>Dorosoma cepedianum</i>    | Gizzard shad           | S, T            |

|                                  |                          |                 |
|----------------------------------|--------------------------|-----------------|
| <i>Engraulis eurystole</i>       | Silver anchovy           | S, T            |
| <i>Epinephelus gorio</i>         | Red grouper              | S               |
| <i>Esox niger</i>                | Chain pickerel           | S               |
| <i>Etropus microstomus</i>       | Smallmouth flounder      | S, T, SS, TT    |
| <i>Fundulus diaphanus</i>        | Banded killifish         | S, T            |
| <i>Fundulus heteroclitus</i>     | Mummichog                | S, T, W, SS, TT |
| <i>Fundulus luciae</i>           | Spotfin killifish        | W               |
| <i>Fundulus majalis</i>          | Striped killifish        | S, T, W, SS, TT |
| <i>Gasterosteus aculeatus</i>    | Three-spined stickleback | S, T, W         |
| <i>Gobiosoma bosc</i>            | Naked goby               | S, T, W, SS, TT |
| <i>Gobiosoma ginsburgi</i>       | Starboard goby           | SS, TT          |
| <i>Hippocampus erectus</i>       | Lined seahorse           | S, T, SS, TT    |
| <i>Hyporhamphus unifasciatus</i> | Halfbeak                 | S               |
| <i>Hypsoblennius hentzi</i>      | Feather blenny           | S, T            |
| <i>Ictalurus punctatus</i>       | Channel catfish          |                 |
| <i>Lagodon rhomboides</i>        | Pinfish                  | S               |
| <i>Leiostomus xanthurus</i>      | Spot                     | S, T, W, TT     |
| <i>Lucania parva</i>             | Rainwater killifish      | S, T, W, SS, TT |
| <i>Lutjanus griseus</i>          | Grey snapper             | S, SS, TT       |
| <i>Menidia beryllina</i>         | Inland silverside        | S, W            |
| <i>Menidia menidia</i>           | Atlantic silveride       | S, T, W, SS, TT |
| <i>Menticirrhus saxatilis</i>    | Northern kingfish        | S, T            |
| <i>Merluccius bilinearis</i>     | Silver hake              |                 |
| <i>Micropogonias undulatus</i>   | Atlantic croaker         | T               |
| <i>Monacanthus hispidus</i>      | Planehead filefish       | S               |
| <i>Morone americana</i>          | White perch              | S, T            |
| <i>Morone saxatilis</i>          | Striped bass             | S               |
| <i>Mugil cephalus</i>            | Striped mullet           | S, T            |

|                                      |                     |                 |
|--------------------------------------|---------------------|-----------------|
| <i>Mugil curema</i>                  | White mullet        | S, T, W         |
| <i>Mustelus canis</i>                | Smooth dogfish      | S, T, W         |
| <i>Myoxocephalus aeneus</i>          | Grubby              | S, T            |
| <i>Notemigonus crysoleucas</i>       | Golden shiner       | S               |
| <i>Ophidion marginatum</i>           | Cusk-eel            | T               |
| <i>Opsanus tau</i>                   | Oyster toadfish     | S, T, W, SS, TT |
| <i>Paralichthys dentatus</i>         | Summer flounder     | S, T, W, SS, TT |
| <i>Peprilus triacanthus</i>          | Butterfish          | S, T            |
| <i>Perca flavescens</i>              | Yellow perch        |                 |
| <i>Pogonias cromis</i>               | Black drum          | S               |
| <i>Pollachius virens</i>             | Pollack             | S, W, TT        |
| <i>Pomatomus saltatrix</i>           | Bluefish            | S, T, W         |
| <i>Priacanthus arenatus</i>          | Bigeye              | S               |
| <i>Prionotus carolinus</i>           | Northern searobin   | S, T, TT        |
| <i>Prionotus evolans</i>             | Striped searobin    | S, T            |
| <i>Pseudopleuronectes americanus</i> | Winter flounder     | S, T, W, SS, TT |
| <i>Raja elantheria</i>               | Skate               |                 |
| <i>Rhinoptera bonasus</i>            | Cownose ray         |                 |
| <i>Sardinella aurita</i>             | Spanish sardine     | S, W            |
| <i>Sciaenops ocellatus</i>           | Red drum            |                 |
| <i>Scomber scombrus</i>              | Atlantic mackerel   |                 |
| <i>Scophthalmus aquosus</i>          | Windowpane          | S, T            |
| <i>Selene vomer</i>                  | Lookdown            | S, T            |
| <i>Sphoeroides maculatus</i>         | Northern puffer     | S, T, TT        |
| <i>Sphyraena borealis</i>            | Northern sennet     | S, T, W         |
| <i>Stenopus chrysops</i>             | Scup                | T               |
| <i>Strongylura marina</i>            | Atlantic needlefish | S, T, W         |
| <i>Syngnathus fuscus</i>             | Pipefish            | S, T, W, SS, TT |

|                                |                   |                 |
|--------------------------------|-------------------|-----------------|
| <i>Synodus foetens</i>         | Lizardfish        | T               |
| <i>Tautoga onitis</i>          | Tautog            | S, T, W, SS, TT |
| <i>Tautogolabrus adspersus</i> | Cunner            | S               |
| <i>Trachinotus falcatus</i>    | Permit            | S, T            |
| <i>Trinectes maculatus</i>     | Hogchoker         | S, T            |
| <i>Urophycis chuss</i>         | Red hake          | T               |
| <i>Urophycis regia</i>         | Spotted hake      | S, T, W         |
| <i>Urophycis tenuis</i>        | White hake        | S               |
| <i>Vomer setapinnis</i>        | Atlantic moonfish | S               |

#### **Selected Decapods**

|                            |                      |       |
|----------------------------|----------------------|-------|
| <i>Callinectes sapidus</i> | Blue crab            | W, TT |
| <i>Callinectes similis</i> | Lesser blue crab     | TT    |
| <i>Cancer irroratus</i>    | Rock crab            | TT    |
| <i>Libinia dubia</i>       | 6-spined spider crab | TT    |
| <i>Libinia emarginata</i>  | Common spider crab   | TT    |
| <i>Limulus polyphemus</i>  | Horseshoe crab       |       |
| <i>Ovalipes ocellatus</i>  | Lady crab            | TT    |
| <i>Portunus gibbesii</i>   | Swimming crab        |       |

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S = seine; T = trawl; W = weir; SS = suction sampling; TT = throw trap.  
 From Jivoff, P. and K. W. Able. 2001. Characterization of the fish and selected decapods in Little Egg Harbor. *Journal of Coastal Research*, SI 32: 178-196.

**Appendix 21. A list of state- and federal-designated endangered and threatened species identified in the Mullica River-Great Bay Estuary and Watershed.**

| Common Name                 | Federal Status | Scientific Name                | State Status |
|-----------------------------|----------------|--------------------------------|--------------|
| <b>Plants</b>               |                |                                |              |
| American Chaffseed          | Endangered     | <i>Schwalbea americana</i>     | Endangered   |
| Awned meadow-beauty         | Endangered     | <i>Rhexia aristosa</i>         |              |
| Barton's Saint John's wort  | Endangered     | <i>Hypericum adpressum</i>     |              |
| Bog asphodel                | Endangered     | <i>Narthecium americanum</i>   |              |
| Boykin's lobelia            | Endangered     | <i>Lobelia boykinii</i>        |              |
| Bristling panic grass       | Endangered     | <i>Panicum aciculare</i>       |              |
| Broom crowberry             | Endangered     | <i>Corema conradii</i>         |              |
| Buttonbush dodder           | Endangered     | <i>Cuscuta cephalanthi</i>     |              |
| Clustered sedge             | Endangered     | <i>Carex cumulata</i>          |              |
| Coarse grass-like beak-rush | Endangered     | <i>Rhynchospora globularis</i> |              |
| Coast flat sedge            | Endangered     | <i>Cyperus polystachyos</i>    |              |

|                             |            |                                 |            |
|-----------------------------|------------|---------------------------------|------------|
| Dwarf azalea                | Endangered | <i>Rhododendron atlanticum</i>  |            |
| Dwarf white bladderwort     | Endangered | <i>Utricularia olivacea</i>     |            |
| False asphodel              | Endangered | <i>Tofieldia racemosa</i>       |            |
| False boneset               | Endangered | <i>Kuhnia eupatorioides</i>     |            |
| Fringed yellow-eyed grass   | Endangered | <i>Xyris fimbriata</i>          |            |
| Hirst brothers' panic grass | Endangered | <i>Panicum hirstii</i>          |            |
| Knieskern's beaked-rush     | Threatened | <i>Rhynchospora knieskernii</i> | Endangered |
| Knotted spike rush          | Endangered | <i>Eleocharis equisetoides</i>  |            |
| Koehn's toothcup            | Endangered | <i>Ammannia latifolia</i>       |            |
| Lace-lip ladies'-tresses    | Endangered | <i>Spiranthes laciniata</i>     |            |
| Lancaster flat-sedge        | Endangered | <i>Cyperus lancastricensis</i>  |            |
| Long-awn smoke grass        | Endangered | <i>Muhlenbergia capillaris</i>  |            |
| Long's bittercress          | Endangered | <i>Cardamine longii</i>         |            |
| Long's woolgrass            | Endangered | <i>Scirpus longii</i>           |            |
| Low rough aster             | Endangered | <i>Aster radula</i>             |            |

|                            |            |  |            |
|----------------------------|------------|--|------------|
| Minute duckweed            | Endangered | <i>Lemna perpusilla</i>                            |            |
| Narrow-leaf vervain        | Endangered | <i>Verbena simplex</i>                             |            |
| New Jersey rush            | Endangered | <i>Juncus caesariensis</i>                         |            |
| Pickering's morning-glory  | Endangered | <i>Stylisma pickeringii</i> va. <i>pickeringii</i> |            |
| Pickering's reed grass     | Endangered | <i>Calamagrostis pickeringii</i>                   |            |
| Pine Barren bellwort       | Endangered | <i>Uvularia puberula</i> var. <i>nitida</i>        |            |
| Pine Barren boneset        | Endangered | <i>Eupatorium resinosum</i>                        |            |
| Red goosefoot              | Endangered | <i>Chenopodium rubrum</i>                          |            |
| Reversed bladderwort       | Endangered | <i>Utricularia resupinata</i>                      |            |
| Rough cotton grass         | Endangered | <i>Eriophorum tenellum</i>                         |            |
| Rough flat sedge           | Endangered | <i>Cyperus retrofractus</i>                        |            |
| Sand yellow-eyed grass     | Endangered | <i>Xyris caroliniana</i>                           |            |
| Sandplain flx              | Endangered | <i>Linum intercursum</i>                           |            |
| Seabeach amaranth          | Threatened | <i>Amaranthus pumilus</i>                          | Endangered |
| Sea-beach evening primrose | Endangered | <i>Oenothera humifusa</i>                          |            |

|                           |            |                                  |            |
|---------------------------|------------|----------------------------------|------------|
| Sea-beach knotweed        | Endangered | <i>Polygonum glucum</i>          |            |
| Sea milkwort              | Endangered | <i>Glaux maritima</i>            |            |
| Seaside buttercup         | Endangered | <i>Ranunculus cymbalaria</i>     |            |
| Sensitive joint-vetch     | Threatened | <i>Aeschynomene virginica</i>    | Endangered |
| Sessile-leaf tick-trefoil | Endangered | <i>Desmodium sessilifolium</i>   |            |
| Slender arrowhead         | Endangered | <i>Sagittaria teres</i>          |            |
| Slender water-milfoil     | Endangered | <i>Myriophyllum tenellum</i>     |            |
| Small everlasting         | Endangered | <i>Gnaphalium helleri</i>        |            |
| Small-head beaked-rush    | Endangered | <i>Rhynchospora microcephala</i> |            |
| Southern arrowhead        | Endangered | <i>Sagittaria australis</i>      |            |
| Spreading pogonia         | Endangered | <i>Cleistes divaricata</i>       |            |
| Twisted spikerush         | Endangered | <i>Eleocharis tortilis</i>       |            |
| Two-flower bladderwort    | Endangered | <i>Utricularia biflora</i>       |            |
| Virginia buchflower       | Endangered | <i>Melanthium virginicum</i>     |            |
| Virginia false-gromwell   | Endangered | <i>Onosmodium virginianum</i>    |            |

|                              |            |                                       |            |
|------------------------------|------------|---------------------------------------|------------|
| Virginia thistle             | Endangered | <i>Cirsium virginianum</i>            |            |
| Whorled nut-rush             | Endangered | <i>Scleria verticillata</i>           |            |
| Whorled water-milfoil        | Endangered | <i>Myriophyllum verticillatum</i>     |            |
| Wrinkled jointgrass          | Endangered | <i>Coelorachis rugosa</i>             |            |
| Yellow fringeless orchid     | Endangered | <i>Platanthera integra</i>            |            |
| Swamp pink                   | Threatened | <i>Helonias bullata</i>               |            |
| <b>Animals</b>               |            |                                       |            |
| <b><i>Insects</i></b>        |            |                                       |            |
| Silver-bordered fritillary   | Threatened | <i>Boloria selene myrina</i>          |            |
| American burying beetle      | Endangered | <i>Nicrophorus americanus</i>         | Endangered |
| Arogos skipper               | Endangered | <i>Atrytone arogos arogos</i>         |            |
| Northeast beach tiger beetle | Threatened | <i>Cincindela dorsalis dorsalis</i>   | Threatened |
| Frosted elfin                | Threatened | <i>Callophrys irus</i>                |            |
| <b><i>Amphibians</i></b>     |            |                                       |            |
| Cope's gray treefrog         | Endangered | <i>Hyla chrysoscelis</i>              |            |
| Eastern mud salamander       | Threatened | <i>Pseudotriton montanus montanus</i> |            |

|                          |            |                                    |            |
|--------------------------|------------|------------------------------------|------------|
| Eastern tiger salamander | Endangered | <i>Ambystoma tigrinum tigrinum</i> |            |
| Long-tailed salamander   | Threatened | <i>Eurycea longicauda</i>          |            |
| Pine Barrens treefrog    | Endangered | <i>Hyla andersonii</i>             |            |
| <b><i>Reptiles</i></b>   |            |                                    |            |
| Bog turtle               | Threatened | <i>Clemmys muhlenbergii</i>        | Endangered |
| Corn snake               | Endangered | <i>Elaphe guttata guttata</i>      |            |
| Northern pine snake      | Threatened | <i>Pituophis melanoleucas</i>      |            |
| Timber rattlesnake       | Endangered | <i>Crotalus horridus horridus</i>  |            |
| Wood turtle              | Threatened | <i>Clemmys insculpta</i>           |            |
| <b><i>Mammals</i></b>    |            |                                    |            |
| Bobcat                   | Endangered | <i>Lynx rufus</i>                  |            |
| <b><i>Birds</i></b>      |            |                                    |            |
| American bittern         | Endangered | <i>Botaurus lentiginosus</i>       |            |
| Bald eagle               | Threatened | <i>Haliaeetus leucocephalus</i>    | Endangered |
| Barred owl               | Threatened | <i>Strix varia</i>                 |            |

|                           |            |                                   |            |
|---------------------------|------------|-----------------------------------|------------|
| Black-crowned night-heron | Threatened | <i>Nycticorax nycticorax</i>      |            |
| Black rail                | Threatened | <i>Laterallus jamaicensis</i>     |            |
| Black skimmer             | Endangered | <i>Rynchops niger</i>             |            |
| Grasshopper sparrow       | Threatened | <i>Ammodramus savannarum</i>      |            |
| Cooper's hawk             | Threatened | <i>Accipiter cooperii</i>         |            |
| Least tern                | Endangered | <i>Sterna antillarum</i>          |            |
| Northern harrier          | Endangered | <i>Circus cyaneus</i>             |            |
| Osprey                    | Threatened | <i>Pandion haliaetus</i>          |            |
| Peregrine falcon          | Endangered | <i>Falco peregrinus</i>           |            |
| Piping plover             | Threatened | <i>Charadrius melodus</i>         | Endangered |
| Podilymbus podiceps       | Endangered | <i>Podilymbus podiceps</i>        |            |
| Red knot                  | Threatened | <i>Calidris cantus</i>            |            |
| Red-shouldered hawk       | Endangered | <i>Buteo lineatus</i>             | Threatened |
| Red-headed woodpecker     | Threatened | <i>Melanerpes erythrocephalus</i> |            |
| Roseate tern              | Endangered | <i>Sterna dougallii dougallii</i> | Endangered |

|                            |            |                              |
|----------------------------|------------|------------------------------|
| Sedge wren                 | Endangered | <i>Cistothorus platensis</i> |
| Upland sandpiper           | Endangered | <i>Bartramia longicauda</i>  |
| Versper sparrow            | Endangered | <i>Pooecetes gramineus</i>   |
| Yellow-crowned night-heron | Threatened | <i>Nyctanassa violaceus</i>  |

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From the New Jersey National Heritage Program, U.S. Fish and Wildlife Service, and New Jersey Division of Fish and Wildlife.

**Appendix 22. Federal listing of threatened and endangered species for the State of New Jersey.**

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| <b>COMMON NAME</b>       | <b>SCIENTIFIC NAME</b>                    |
|--------------------------|---|
| <b>Plants</b>            |   |
| American chaffseed       | <i>Schwalbea americana</i> (E)            |
| Knieskern's beaked-rush  | <i>Rhynchospora knieskernii</i> (T)       |
| Seabeach amaranth        | <i>Amaranthus pumilus</i> (T)             |
| Sensitive joint-vetch    | <i>Aeschynomene virginica</i> (T)         |
| Small whorled pogonia    | <i>Isotria medeoloides</i> (T)            |
| Swamp pink               | <i>Helonias bullata</i> (T)               |
| <b>Animals</b>           |   |
| Indiana bat              | <i>Myotis sodalis</i> (E)                 |
| Bald eagle               | <i>Haliaeetus leucocephalus</i> (T)       |
| Piping plover            | <i>Charadrius melodus</i> (T)             |
| Eastern puma             | <i>Puma (=Felis) concolor couguar</i> (E) |
| Bog turtle               | <i>Clemmys muhlenbergii</i> (T)           |
| Hawksbill sea turtle     | <i>Eretmochelys imbricata</i> (E)         |
| Kemp's Ridley sea turtle | <i>Lepidochelys kempii</i> (E)            |
| Leatherback sea turtle   | <i>Dermochelys coriacea</i> (E)           |
| Loggerhead sea turtle    | <i>Caretta caretta</i> (T)                |

|                                 |  |
|---------------------------------|--|
| Green Turtle                    | <i>Chelonia mydas</i> (T)              |
| Northeastern beach tiger beetle | <i>Cicindela dorsalis dorsalis</i> (T) |
| Dwarf wedge mussel              | <i>Alasmidonta heterodon</i> (E)       |
| Shortnose sturgeon              | <i>Acipenser brevirostrum</i> (E)      |
| Roseate tern                    | <i>Sterna dougallii dougallii</i> (E)  |
| Finback whale                   | <i>Balaenoptera physalus</i> (E)       |
| Humpback whale                  | <i>Megaptera novaeangliae</i> (E)      |
| Right whale                     | <i>Balaena glacialis</i> (E)           |
| Gray eastern wolf               | <i>Canis lupus</i> (E)                 |

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E = Endangered

T = Threatened

Data from the U.S. Fish and Wildlife Service

**Appendix B**

**NERRS Regulations**

Code of Federal Regulations

**Title 15, Volume 3, Revised as of January 1, 2003**  
**From the U.S. Government Printing Office via GPO Access**  
*[CITE: 15CFR921]*

TITLE 15--COMMERCE AND FOREIGN TRADE

CHAPTER IX--NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION,  
DEPARTMENT OF COMMERCE

PART 921--NATIONAL ESTUARINE RESEARCH RESERVE SYSTEM  
REGULATIONS

**Subpart A--General**

[921.1 Mission, goals and general provisions.](#)

[921.2 Definitions.](#)

[921.3 National Estuarine Research Reserve System Biogeographic Classification Scheme and Estuarine Typologies.](#)

[921.4 Relationship to other provisions of the Coastal Zone Management Act and the Marine Protection, Research and Sanctuaries Act.](#)

**Subpart B--Site Selection, Post Site Selection and Management Plan Development**

[921.10 General.](#)

[921.11 Site selection and feasibility.](#)

[921.12 Post site selection.](#)

[921.13 Management plan and environmental impact statement development.](#)

**Subpart C--Acquisition, Development and Preparation of the Final Management Plan**

[921.20 General.](#)

[921.21 Initial acquisition and development awards.](#)

**Subpart D--Reserve Designation and Subsequent Operation**

[921.30 Designation of National Estuarine Research Reserves.](#)

[921.31 Supplemental acquisition and development awards.](#)

[921.32 Operation and management: Implementation of the management plan.](#)

[921.33 Boundary changes, amendments to the management plan, and addition of multiple-site components.](#)

**Subpart E--Ongoing Oversight, Performance Evaluation and Withdrawal of Designation**

[921.40 Ongoing oversight and evaluations of designated National Estuarine Research Reserves.](#)

[921.41 Withdrawal of designation.](#)

**Subpart F--Special Research Projects**

[921.50 General.](#)

[921.51 Estuarine research guidelines.](#)

[921.52 Promotion and coordination of estuarine research.](#)

**Subpart G--Special Monitoring Projects**

[921.60 General.](#)

**Subpart H--Special Interpretation and Education Projects**

[921.70 General.](#)

**Subpart I--General Financial Assistance Provisions**

[921.80 Application information.](#)

[921.81 Allowable costs.](#)

[921.82 Amendments to financial assistance awards.](#)

[Appendix I to Part 921--Biogeographic Classification Scheme](#)

[Appendix II to Part 921--Typology of National Estuarine Research Reserves](#)

Authority: Section 315 of the Coastal Zone Management Act, as amended (16 U.S.C. 1461).

*Source: 58 FR 38215, July 15, 1993, unless otherwise noted.*

### **Sec. 921.1 Mission, goals and general provisions.**

(a) The mission of the National Estuarine Research Reserve Program is the establishment and management, through Federal-state cooperation, of a national system (National Estuarine Research Reserve System or System) of estuarine research reserves (National Estuarine Research Reserves or Reserves) representative of the various regions and estuarine types in the United States. National Estuarine Research Reserves are established to provide opportunities for long-term research, education, and interpretation.

(b) The goals of the Program are to:

1. Ensure a stable environment for research through long-term protection of National Estuarine Research Reserve resources;
2. Address coastal management issues identified as significant through coordinated estuarine research within the System;
3. Enhance public awareness and understanding of estuarine areas and provide suitable opportunities for public education and interpretation;
4. Promote Federal, state, public and private use of one or more Reserves within the System when such entities conduct estuarine research; and
5. Conduct and coordinate estuarine research within the System, gathering and making available information necessary for improved understanding and management of estuarine areas.

(c) National Estuarine Research Reserves shall be open to the public to the extent permitted under state and Federal law. Multiple uses are allowed to the degree compatible with each Reserve's overall purpose as provided in the management plan (see Sec. 921.13) and consistent with paragraphs (a) and (b) of this section. Use levels are set by the state where the Reserve is located and analyzed in the management plan. The Reserve management plan shall describe the uses and establish priorities among these uses. The plan shall identify uses requiring a state permit, as well as areas where uses are encouraged or prohibited. Consistent with resource protection and research objectives, public access and use may be restricted to certain areas or components within a Reserve.

(d) Habitat manipulation for research purposes is allowed consistent with the following limitations. Manipulative research activities must be specified in the management plan, be consistent with the mission and goals of the program (see paragraphs (a) and (b) of this section) and the goals and objectives set forth in the Reserve's management plan, and be limited in nature and extent to the minimum manipulative activity necessary to accomplish the stated research objective. Manipulative research activities with a significant or long-term impact on Reserve resources require the prior approval of the state and the National Oceanic and Atmospheric Administration (NOAA). Manipulative research activities which can reasonably be expected to have a significant adverse impact on the estuarine resources and habitat of a Reserve, such that the activities themselves or their resulting short- and long-term consequences compromise the representative character and integrity of a Reserve, are prohibited. Habitat manipulation for resource management purposes is prohibited except as specifically approved by NOAA as: (1) A

restoration activity consistent with paragraph (e) of this section; or (2) an activity necessary for the protection of public health or the preservation of other sensitive resources which have been listed or are eligible for protection under relevant Federal or state authority (e.g., threatened/endangered species or significant historical or cultural resources) or if the manipulative activity is a long-term pre-existing use (i.e., has occurred prior to designation) occurring in a buffer area. If habitat manipulation is determined to be necessary for the protection of public health, the preservation of sensitive resources, or if the manipulation is a long-term pre-existing use in a buffer area, then these activities shall be specified in the Reserve management plan in accordance with Sec. 921.13(a)(10) and shall be limited to the reasonable alternative which has the least adverse and shortest term impact on the representative and ecological integrity of the Reserve.

(e) Under the Act an area may be designated as an estuarine Reserve only if the area is a representative estuarine ecosystem that is suitable for long-term research. Many estuarine areas have undergone some ecological change as a result of human activities (e.g., hydrological changes, intentional/unintentional species composition changes--introduced and exotic species). In those areas proposed or designated as National Estuarine Research Reserves, such changes may have diminished the representative character and integrity of the site. Although restoration of degraded areas is not a primary purpose of the System, such activities may be permitted to improve the representative character and integrity of a Reserve. Restoration activities must be carefully planned and approved by NOAA through the Reserve management plan. Historical research may be necessary to determine the "natural" representative state of an estuarine area (i.e., an estuarine ecosystem minimally affected by human activity or influence). Frequently, restoration of a degraded estuarine area will provide an excellent opportunity for management oriented research.

(f) NOAA may provide financial assistance to coastal states, not to exceed, per Reserve, 50 percent of all actual costs or \$5 million whichever amount is less, to assist in the acquisition of land and waters, or interests therein. NOAA may provide financial assistance to coastal states not to exceed 70 percent of all actual costs for the management and operation of, the development and construction of facilities, and the conduct of educational or interpretive activities concerning Reserves (see subpart I). NOAA may provide financial assistance to any coastal state or public or private person, not to exceed 70 percent of all actual costs, to support research and monitoring within a Reserve. Notwithstanding any financial assistance limits established by this Part, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carried out with this assistance, as long as such funds are available. Predesignation, acquisition and development, operation and management, special research and monitoring, and special education and interpretation awards are available under the National Estuarine Reserve Program. Predesignation awards are for site selection/feasibility, draft management plan preparation and conduct of basic characterization studies. Acquisition and development awards are intended primarily for acquisition of interests in land, facility construction and to develop and/or upgrade research, monitoring and education programs. Operation and management awards

provide funds to assist in implementing, operating and managing the administrative, and basic research, monitoring and education programs, outlined in the Reserve management plan. Special research and monitoring awards provide funds to conduct estuarine research and monitoring projects with the System. Special educational and interpretive awards provide funds to conduct estuarine educational and interpretive projects within the System.

(g) Lands already in protected status managed by other Federal agencies, state or local governments, or private organizations may be included within National Estuarine Research Reserves only if the managing entity commits to long-term management consistent with paragraphs (d) and (e) of this section in the Reserve management plan. Federal lands already in protected status may not comprise a majority of the key land and water areas of a Reserve (see Sec. 921.11(c)(3)).

(h) To assist the states in carrying out the Program's goals in an effective manner, NOAA will coordinate a research and education information exchange throughout the National Estuarine Research Reserve System. As part of this role, NOAA will ensure that information and ideas from one Reserve are made available to others in the System. The network will enable Reserves to exchange information and research data with each other, with universities engaged in estuarine research, and with Federal, state, and local agencies. NOAA's objective is a system- wide program of research and monitoring capable of addressing the management issues that affect long-term productivity of our Nation's estuaries.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].*

## **Sec. 921.2 Definitions**

(a) Act means the Coastal Zone Management Act of 1972, as amended, 16 U.S.C. 1451 et seq.

(b) Assistant Administrator means the Assistant Administrator for Ocean Services and Coastal Zone Management or delegee.

(c) Coastal state means a state of the United States, in or bordering on, the Atlantic, Pacific, or Arctic Ocean, the Gulf of Mexico, Long Island Sound, or one or more of the Great Lakes. For the purposes of these regulations the term also includes Puerto Rico, the Virgin Islands, Guam, the Commonwealth of the Northern Marianas Islands, the Trust Territories of the Pacific Islands, and American Samoa (see 16 U.S.C. 1453(4)).

(d) State agency means an instrumentality of a coastal state to whom the coastal state has delegated the authority and responsibility for the creation and/or management/operation of a National Estuarine Research Reserve. Factors indicative of this authority may include the power to receive and expend funds on behalf of the Reserve, acquire and sell or convey real and personal property interests, adopt rules for the protection of the Reserve, enforce rules applicable to the Reserve, or develop and implement research and education programs for the reserve. For the purposes of these regulations, the terms ``coastal state" and ``State agency" shall be synonymous.

(e) Estuary means that part of a river or stream or other body of water having unimpaired connection with the open sea, where the sea water is measurably diluted with fresh water derived from land drainage. The term also includes estuary-type areas with measurable freshwater influence and having unimpaired connections with the open sea, and estuary-type areas of the Great Lakes and their connecting waters (see 16 U.S.C. 1453(7)).

(f) National Estuarine Research Reserve means an area that is a representative estuarine ecosystem suitable for long-term research, which may include all of the key land and water portion of an estuary, and adjacent transitional areas and uplands constituting to the extent feasible a natural unit, and which is set aside as a natural field laboratory to provide long-term opportunities for research, education, and interpretation on the ecological relationships within the area (see 16 U.S.C. 1453(8)) and meets the requirements of 16 U.S.C. 1461(b). This includes those areas designated as National Estuarine Sanctuaries or Reserves under section 315 of the Act prior to enactment of the Coastal Zone Act Reauthorization Amendments of 1990 and each area subsequently designated as a National Estuarine Research Reserve.

### **Sec. 921.3 National Estuarine Research Reserve System Biogeographic Classification Scheme and Estuarine Typologies.**

(a) National Estuarine Research Reserves are chosen to reflect regional differences and to include a variety of ecosystem types. A biogeographic classification scheme based on regional variations in the nation's coastal zone has been developed. The biogeographic classification scheme is used to ensure that the National Estuarine Research Reserve System includes at least one site from each region. The estuarine typology system is utilized to ensure that sites in the System reflect the wide range of estuarine types within the United States.

(b) The biogeographic classification scheme, presented in appendix I, contains 29 regions. Figure 1 graphically depicts the biogeographic regions of the United States.

(c) The typology system is presented in appendix II..

### **Sec. 921.4 Relationship to other provisions of the Coastal Zone Management Act, and to the Marine Protection, Research and Sanctuaries Act.**

(a) The National Estuarine Research Reserve System is intended to provide information to state agencies and other entities involved in addressing coastal management issues. Any coastal state, including those that do not have approved coastal management programs under section 306 of the Act, is eligible for an award under the National Estuarine Research Reserve Program (see Sec. 921.2(c)).

(b) For purposes of consistency review by states with a federally approved coastal management program, the designation of a National Estuarine Research Reserve is deemed to be a Federal activity, which, if directly affecting the state's coastal zone, must be undertaken in a manner consistent to the maximum extent practicable with the approved state coastal management program as provided by section 1456(c)(1) of the Act, and implementing regulations at 15 CFR part 930, subpart C. In accordance with section 1456(c)(1) of the Act and the applicable regulations NOAA will be responsible for certifying that designation of the Reserve is consistent with the state's approved coastal management program. The state must concur with or object to the certification. It is recommended that the lead state agency for Reserve designation consult, at the earliest practicable time, with the appropriate state officials concerning the consistency of a proposed National Estuarine Research Reserve.

(c) The National Estuarine Research Reserve Program will be administered in close coordination with the National Marine Sanctuary Program (Title III of the Marine Protection, Research and Sanctuaries Act, as amended, 16 U.S.C. 1431-1445), also administered by NOAA. Title III authorizes the Secretary of Commerce to designate discrete areas of the marine environment as National Marine Sanctuaries to protect or restore such areas for their conservation, recreational, ecological, historical, research,

educational or esthetic values. National Marine Sanctuaries and Estuarine Research Reserves may not overlap, but may be adjacent.

### **Sec. 921.10 General.**

(a) A coastal state may apply for Federal financial assistance for the purpose of site selection, preparation of documents specified in Sec. 921.13 (draft management plan (DMP) and environmental impact statement (EIS)), and the conduct of limited basic characterization studies. The total Federal share of this assistance may not exceed \$100,000. Federal financial assistance for preacquisition activities under Sec. 921.11 and Sec. 921.12 is subject to the total \$5 million for which each Reserve is eligible for land acquisition. Notwithstanding the above, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carried out with this assistance, as long as such funds are available. In the case of a biogeographic region (see appendix I) shared by two or more coastal states, each state is eligible for Federal financial assistance to establish a separate National Estuarine Research Reserve within their respective portion of the shared biogeographic region. Each separate National Estuarine Research Reserve is eligible for the full complement of funding. Financial assistance application procedures are specified in subpart I.

(b) In developing a Reserve program, a state may choose to develop a multiple-site Reserve reflecting a diversity of habitats in a single biogeographic region. A multiple-site Reserve allows the state to develop complementary research and educational programs within the individual components of its multi-site Reserve. Multiple-site Reserves are treated as one Reserve in terms of financial assistance and development of an overall management framework and plan. Each individual site of a proposed multiple-site Reserve shall be evaluated both separately under Sec. 921.11(c) and collectively as part of the site selection process. A coastal state may propose to establish a multiple-site Reserve at the time of the initial site selection, or at any point in the development or operation of the Reserve. If the state decides to develop a multiple-site National Estuarine Research Reserve after the initial acquisition and development award is made for a single site, the proposal is subject to the requirements set forth in Sec. 921.33(b). However, a state may not propose to add one or more sites to an already designated Reserve if the operation and management of such Reserve has been found deficient and uncorrected or the research conducted is not consistent with the Estuarine Research Guidelines referenced in Sec. 921.51. In addition, Federal funds for the acquisition of a multiple-site Reserve remain limited to \$5,000,000 (see Sec. 921.20). The funding for operation of a multiple-site Reserve is limited to the maximum allowed for any one Reserve per year (see Sec. 921.32(c)) and preacquisition funds are limited to \$100,000 per Reserve. Notwithstanding the above, when financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, such assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available.

*[58 FR 38215, July 15, 1993, as amended at 63 FR 26717, May 14, 1998].*

**Sec. 921.11 Site selection and feasibility.**

(a) A coastal state may use Federal funds to establish and implement a site selection process which is approved by NOAA.

(b) In addition to the requirements set forth in subpart I, a request for Federal funds for site selection must contain the following programmatic information:

1. A description of the proposed site selection process and how it will be implemented in conformance with the biogeographic classification scheme and typology (Sec. 921.3);
2. An identification of the site selection agency and the potential management agency; and
3. A description of how public participation will be incorporated into the process (see Sec. 921.11(d)).

(c) As part of the site selection process, the state and NOAA shall evaluate and select the final site(s). NOAA has final authority in approving such sites. Site selection shall be guided by the following principles:

1. The site's contribution to the biogeographical and typological balance of the National Estuarine Research Reserve System. NOAA will give priority consideration to proposals to establish Reserves in biogeographic regions or subregions or incorporating types that are not represented in the system. (see the biogeographic classification scheme and typology set forth in Sec. 921.3 and appendices I and II);
2. The site's ecological characteristics, including its biological productivity, diversity of flora and fauna, and capacity to attract a broad range of research and educational interests. The proposed site must be a representative estuarine ecosystem and should, to the maximum extent possible, be an estuarine ecosystem minimally affected by human activity or influence (see Sec. 921.1(e)).
3. Assurance that the site's boundaries encompass an adequate portion of the key land and water areas of the natural system to approximate an ecological unit and to ensure effective conservation. Boundary size will vary greatly depending on the nature of the ecosystem. Reserve boundaries must encompass the area within which adequate control has or will be established by the managing entity over human activities occurring within the Reserve. Generally, Reserve boundaries will encompass two areas: Key land and water areas (or "core area") and a buffer zone. Key land and water areas and a buffer zone will likely require significantly different levels of control (see Sec. 921.13(a)(7)). The term "key land and water areas" refers to that core area within the Reserve that is so vital to the functioning of the estuarine ecosystem that it must be under a level of control sufficient to

ensure the long-term viability of the Reserve for research on natural processes. Key land and water areas, which comprise the core area, are those ecological units of a natural estuarine system which preserve, for research purposes, a full range of significant physical, chemical and biological factors contributing to the diversity of fauna, flora and natural processes occurring within the estuary. The determination of which land and water areas are "key" to a particular Reserve must be based on specific scientific knowledge of the area. A basic principle to follow when deciding upon key land and water areas is that they should encompass resources representative of the total ecosystem, and which if compromised could endanger the research objectives of the Reserve. The term buffer zone refers to an area adjacent to or surrounding key land and water areas and essential to their integrity. Buffer zones protect the core area and provide additional protection for estuarine-dependent species, including those that are rare or endangered. When determined appropriate by the state and approved by NOAA, the buffer zone may also include an area necessary for facilities required for research and interpretation. Additionally, buffer zones should be established sufficient to accommodate a shift of the core area as a result of biological, ecological or geomorphological change which reasonably could be expected to occur. National Estuarine Research Reserves may include existing Federal or state lands already in a protected status where mutual benefit can be enhanced. However, NOAA will not approve a site for potential National Estuarine Research Reserve status that is dependent primarily upon the inclusion of currently protected Federal lands in order to meet the requirements for Reserve status (such as key land and water areas). Such lands generally will be included within a Reserve to serve as a buffer or for other ancillary purposes; and may be included, subject to NOAA approval, as a limited portion of the core area;

4. The site's suitability for long-term estuarine research, including ecological factors and proximity to existing research facilities and educational institutions;
5. The site's compatibility with existing and potential land and water uses in contiguous areas as well as approved coastal and estuarine management plans; and
6. The site's importance to education and interpretive efforts, consistent with the need for continued protection of the natural system.

(d) Early in the site selection process the state must seek the views of affected landowners, local governments, other state and Federal agencies and other parties who are interested in the area(s) being considered for selection as a potential National Estuarine Research Reserve. After the local government(s) and affected landowner(s) have been contacted, at least one public meeting shall be held in the vicinity of the proposed site. Notice of such a meeting, including the time, place, and relevant subject matter, shall be announced by the state through the area's principal newspaper at least 15 days prior to the date of the meeting and by NOAA in the Federal Register.

(e) A state request for NOAA approval of a proposed site (or sites in the case of a multi-site Reserve) must contain a description of the proposed site(s) in relationship to each of the site selection principals (Sec. 921.11(c)) and the following information:

1. An analysis of the proposed site(s) based on the biogeographical scheme/typology discussed in Sec. 921.3 and set forth in appendices I and II;
2. A description of the proposed site(s) and its (their) major resources, including location, proposed boundaries, and adjacent land uses. Maps are required;
3. A description of the public participation process used by the state to solicit the views of interested parties, a summary of comments, and, if interstate issues are involved, documentation that the Governor(s) of the other affected state(s) has been contacted. Copies of all correspondence, including contact letters to all affected landowners must be appended;
4. A list of all sites considered and a brief statement of the reasons why a site was not preferred; and
5. A nomination of the proposed site(s) for designation as a National Estuarine Research Reserve by the Governor of the coastal state in which the state is located.

(f) A state proposing to reactivate an inactive site, previously approved by NOAA for development as an Estuarine Sanctuary or Reserve, may apply for those funds remaining, if any, provided for site selection and feasibility (Sec. 921.11a)) to determine the feasibility of reactivation. This feasibility study must comply with the requirements set forth in Sec. 921.11 (c) through (e).

#### **Sec. 921.12 Post site selection.**

(a) At the time of the coastal state's request for NOAA approval of a proposed site, the state may submit a request for funds to develop the draft management plan and for preparation of the EIS. At this time, the state may also submit a request for the remainder of the predesignation funds to perform a limited basic characterization of the physical, chemical and biological characteristics of the site approved by NOAA necessary for providing EIS information to NOAA. The state's request for these post site selection funds must be accompanied by the information specified in subpart I and, for draft management plan development and EIS information collection, the following programmatic information:

1. A draft management plan outline (see Sec. 921.13(a) below); and
2. An outline of a draft memorandum of understanding (MOU) between the state and NOAA detailing the Federal-state role in Reserve management during the initial period of Federal funding and expressing the state's long-term commitment to operate and manage the Reserve.

(b) The state is eligible to use the funds referenced in Sec. 921.12(a) after the proposed site is approved by NOAA under the terms of Sec. 921.11.

### **Sec. 921.13 Management plan and environmental impact statement development.**

(a) After NOAA approves the state's proposed site and application for funds submitted pursuant to Sec. 921.12, the state may begin draft management plan development and the collection of information necessary for the preparation by NOAA of an EIS. The state shall develop a draft management plan, including an MOU. The plan shall set out in detail:

1. Reserve goals and objectives, management issues, and strategies or actions for meeting the goals and objectives;
2. An administrative plan including staff roles in administration, research, education/interpretation, and surveillance and enforcement;
3. A research plan, including a monitoring design;
4. An education/interpretive plan;
5. A plan for public access to the Reserve;
6. A construction plan, including a proposed construction schedule, general descriptions of proposed developments and general cost estimates. Information should be provided for proposed minor construction projects in sufficient detail to allow these projects to begin in the initial phase of acquisition and development. A categorical exclusion, environmental assessment, or EIS may be required prior to construction;
7. (i) An acquisition plan identifying the ecologically key land and water areas of the Reserve, ranking these areas according to their relative importance, and including a strategy for establishing adequate long-term state control over these areas sufficient to provide protection for Reserve resources to ensure a stable environment for research. This plan must include an identification of ownership within the proposed Reserve boundaries, including land already in the public domain; the method(s) of acquisition which the state proposes to use--acquisition (including less-than-fee simple options) to establish adequate long-term state control; an estimate of the fair market value of any property interest--which is proposed for acquisition; a schedule estimating the time required to complete the process of establishing adequate state control of the proposed research reserve; and a discussion of any anticipated problems. In selecting a preferred method(s) for establishing adequate state control over areas within the proposed boundaries of the Reserve, the state shall perform the following steps for each parcel determined to be part of the key land and water areas (control over which is necessary to protect the integrity of the Reserve for research purposes), and for those parcels required for research and interpretive support facilities or buffer purposes:
  - (A) Determine, with appropriate justification, the minimum level of control(s) required [e.g., management agreement, regulation, less-than-fee simple property interest (e.g., conservation easement), fee simple property acquisition, or a combination of these approaches]. This does not preclude the future necessity of increasing the level of state control;
  - (B) Identify the level of existing state control(s);
  - (C) Identify the level of additional state control(s), if any, necessary to meet the

minimum requirements identified in paragraph (a)(7)(i)(A) of this section; (D) Examine all reasonable alternatives for attaining the level of control identified in paragraph (a)(7)(i)(C) of this section, and perform a cost analysis of each; and (E) Rank, in order of cost, the methods (including acquisition) identified in paragraph (a)(7)(i)(D) of this section.

(ii) An assessment of the relative cost-effectiveness of control alternatives shall include a reasonable estimate of both short-term costs (e.g., acquisition of property interests, regulatory program development including associated enforcement costs, negotiation, adjudication, etc.) and long-term costs (e.g., monitoring, enforcement, adjudication, management and coordination). In selecting a preferred method(s) for establishing adequate state control over each parcel examined under the process described above, the state shall give priority consideration to the least costly method(s) of attaining the minimum level of long-term control required. Generally, with the possible exception of buffer areas required for support facilities, the level of control(s) required for buffer areas will be considerably less than that required for key land and water areas. This acquisition plan, after receiving the approval of NOAA, shall serve as a guide for negotiations with landowners. A final boundary for the reserve shall be delineated as a part of the final management plan;

8. A resource protection plan detailing applicable authorities, including allowable uses, uses requiring a permit and permit requirements, any restrictions on use of the research reserve, and a strategy for research reserve surveillance and enforcement of such use restrictions, including appropriate government enforcement agencies;
9. If applicable, a restoration plan describing those portions of the site that may require habitat modification to restore natural conditions;
10. If applicable, a resource manipulation plan, describing those portions of the Reserve buffer in which long-term pre-existing (prior to designation) manipulation for reasons not related to research or restoration is occurring. The plan shall explain in detail the nature of such activities, shall justify why such manipulation should be permitted to continue within the reserve buffer; and shall describe possible effects of this manipulation on key land and water areas and their resources;
11. A proposed memorandum of understanding (MOU) between the state and NOAA regarding the Federal-state relationship during the establishment and development of the National Estuarine Research Reserve, and expressing a long-term commitment by the state to maintain and manage the Reserve in accordance with section 315 of the Act, 16 U.S.C. 1461, and applicable regulations. In conjunction with the MOU, and where possible under state law, the state will consider taking appropriate administrative or legislative action to ensure the long-term protection and operation of the National Estuarine Research Reserve. If other MOUs are necessary (such as with a Federal agency, another state agency or private organization), drafts of such MOUs must be included in the plan. All necessary MOU's shall be signed prior to Reserve designation; and

12. If the state has a federally approved coastal management program, a certification that the National Estuarine Research Reserve is consistent to the maximum extent practicable with that program. See Secs. 921.4(b) and 921.30(b).

(b) Regarding the preparation of an EIS under the National Environmental Policy Act on a National Estuarine Research Reserve proposal, the state and NOAA shall collect all necessary information concerning the socioeconomic and environmental impacts associated with implementing the draft management plan and feasible alternatives to the plan. Based on this information, the state will draft and provide NOAA with a preliminary EIS.

(c) Early in the development of the draft management plan and the draft EIS, the state and NOAA shall hold a scoping meeting (pursuant to NEPA) in the area or areas most affected to solicit public and government comments on the significant issues related to the proposed action. NOAA will publish a notice of the meeting in the Federal Register at least 15 days prior to the meeting. The state shall be responsible for publishing a similar notice in the local media.

(d) NOAA will publish a Federal Register notice of intent to prepare a draft EIS. After the draft EIS is prepared and filed with the Environmental Protection Agency (EPA), a Notice of Availability of the draft EIS will appear in the Federal Register. Not less than 30 days after publication of the notice, NOAA will hold at least one public hearing in the area or areas most affected by the proposed national estuarine research reserve. The hearing will be held no sooner than 15 days after appropriate notice of the meeting has been given in the principal news media by the state and in the Federal Register by NOAA. After a 45-day comment period, a final EIS will be prepared by the state and NOAA.

### **Sec. 921.20 General.**

The acquisition and development period is separated into two major phases. After NOAA approval of the site, draft management plan and draft MOU, and completion of the final EIS, a coastal state is eligible for an initial acquisition and development award(s). In this initial phase, the state should work to meet the criteria required for formal research reserve designation; e.g., establishing adequate state control over the key land and water areas as specified in the draft management plan and preparing the final management plan. These requirements are specified in Sec. 921.30. Minor construction in accordance with the draft management plan may also be conducted during this initial phase. The initial acquisition and development phase is expected to last no longer than three years. If necessary, a longer time period may be negotiated between the state and NOAA. After Reserve designation, a state is eligible for a supplemental acquisition and development award(s) in accordance with Sec. 921.31. In this post-designation acquisition and development phase, funds may be used in accordance with the final management plan to construct research and educational facilities, complete any remaining land acquisition, for program development, and for restorative activities identified in the final management

plan. In any case, the amount of Federal financial assistance provided to a coastal state with respect to the acquisition of lands and waters, or interests therein, for any one National Estuarine Research Reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein or \$5,000,000, whichever amount is less, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].*

### **Sec. 921.21 Initial acquisition and development awards.**

(a) Assistance is provided to aid the recipient prior to designation in:

1. Acquiring a fee simple or less-than-fee simple real property interest in land and water areas to be included in the Reserve boundaries (see Sec. 921.13(a)(7); Sec. 921.30(d));
2. Minor construction, as provided in paragraphs (b) and (c) of this section;
3. Preparing the final management plan; and
4. Initial management costs, e.g., for implementing the NOAA approved draft management plan, hiring a Reserve manager and other staff as necessary and for other management-related activities. Application procedures are specified in subpart I.

(b) The expenditure of Federal and state funds on major construction activities is not allowed during the initial acquisition and development phase. The preparation of architectural and engineering plans, including specifications, for any proposed construction, or for proposed restorative activities, is permitted. In addition, minor construction activities, consistent with paragraph (c) of this section also are allowed. The NOAA-approved draft management plan must, however, include a construction plan and a public access plan before any award funds can be spent on construction activities.

(c) Only minor construction activities that aid in implementing portions of the management plan (such as boat ramps and nature trails) are permitted during the initial acquisition and development phase. No more than five (5) percent of the initial acquisition and development award may be expended on such activities. NOAA must make a specific determination, based on the final EIS, that the construction activity will not be detrimental to the environment.

(d) Except as specifically provided in paragraphs (a) through (c) of this section, construction projects, to be funded in whole or in part under an acquisition and development award(s), may not be initiated until the Reserve receives formal designation (see Sec. 921.30). This requirement has been adopted to ensure that substantial progress

in establishing adequate state control over key land and water areas has been made and that a final management plan is completed before major sums are spent on construction. Once substantial progress in establishing adequate state control/acquisition has been made, as defined by the state in the management plan, other activities guided by the final management plan may begin with NOAA's approval.

(e) For any real property acquired in whole or part with Federal funds for the Reserve, the state shall execute suitable title documents to include substantially the following provisions, or otherwise append the following provisions in a manner acceptable under applicable state law to the official land record(s):

1. Title to the property conveyed by this deed shall vest in the [recipient of the award granted pursuant to section 315 of the Act, 16 U.S.C. 1461 or other NOAA approved state agency] subject to the condition that the designation of the [name of National Estuarine Reserve] is not withdrawn and the property remains part of the federally designated [name of National Estuarine Research Reserve]; and
2. In the event that the property is no longer included as part of the Reserve, or if the designation of the Reserve of which it is part is withdrawn, then NOAA or its successor agency, after full and reasonable consultation with the State, may exercise the following rights regarding the disposition of the property:
  - (i) The recipient may retain title after paying the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the current fair market value of the property;
  - (ii) If the recipient does not elect to retain title, the Federal Government may either direct the recipient to sell the property and pay the Federal Government an amount computed by applying the Federal percentage of participation in the cost of the original project to the proceeds from the sale (after deducting actual and reasonable selling and repair or renovation expenses, if any, from the sale proceeds), or direct the recipient to transfer title to the Federal Government. If directed to transfer title to the Federal Government, the recipient shall be entitled to compensation computed by applying the recipient's percentage of participation in the cost of the original project to the current fair market value of the property; and
  - (iii) Fair market value of the property must be determined by an independent appraiser and certified by a responsible official of the state, as provided by Department of Commerce regulations at 15 CFR part 24, and Uniform Relocation Assistance and Real Property Acquisition for Federal and Federally assisted programs at 15 CFR part 11.

(f) Upon instruction by NOAA, provisions analogous to those of Sec. 921.21(e) shall be included in the documentation underlying less-than-fee-simple interests acquired in whole or part with Federal funds.

(g) Federal funds or non-Federal matching share funds shall not be spent to acquire a real property interest in which the state will own the land concurrently with another entity unless the property interest has been identified as a part of an acquisition strategy

pursuant to Sec. 921.13(7) which has been approved by NOAA prior to the effective date of these regulations.

(h) Prior to submitting the final management plan to NOAA for review and approval, the state shall hold a public meeting to receive comment on the plan in the area affected by the estuarine research reserve. NOAA will publish a notice of the meeting in the Federal Register at least 15 days prior to the public meeting. The state shall be responsible for having a similar notice published in the local newspaper(s).

### **Sec. 921.30 Designation of National Estuarine Research Reserves.**

(a) The Under Secretary may designate an area proposed for designation by the Governor of the state in which it is located, as a National Estuarine Research Reserve if the Under Secretary finds:

1. The area is a representative estuarine ecosystem that is suitable for long-term research and contributes to the biogeographical and typological balance of the System;
2. Key land and water areas of the proposed Reserve, as identified in the management plan, are under adequate state control sufficient to provide long-term protection for reserve resources to ensure a stable environment for research;
3. Designation of the area as a Reserve will serve to enhance public awareness and understanding of estuarine areas, and provide suitable opportunities for public education and interpretation;
4. A final management plan has been approved by NOAA;
5. An MOU has been signed between the state and NOAA ensuring a long-term commitment by the state to the effective operation and implementation of the area as a National Estuarine Research Reserve;
6. All MOU's necessary for reserve management (i.e., with relevant Federal, state, and local agencies and/or private organizations) have been signed; and
7. The coastal state in which the area is located has complied with the requirements of subpart B.

(b) NOAA will determine whether the designation of a National Estuarine Research Reserve in a state with a federally approved coastal zone management program directly affects the coastal zone. If the designation is found to directly affect the coastal zone, NOAA will make a consistency determination pursuant to Sec. 307(c)(1) of the Act, 16 U.S.C. 1456, and 15 CFR part 930, subpart C. See Sec. 921.4(b). The results of this consistency determination will be published in the Federal Register when the notice of designation is published. See Sec. 921.30(c).

(c) NOAA will publish the notice of designation of a National Estuarine Research Reserve in the Federal Register. The state shall be responsible for having a similar notice published in the local media.

(d) The term state control in Sec. 921.30(a)(3) does not necessarily require that key land and water areas be owned by the state in fee simple. Acquisition of less-than-fee simple interests e.g., conservation easements) and utilization of existing state regulatory measures are encouraged where the state can demonstrate that these interests and measures assure adequate long-term state control consistent with the purposes of the research reserve (see also Secs. 921.13(a)(7); 921.21(g)). Should the state later elect to purchase an interest in such lands using NOAA funds, adequate justification as to the need for such acquisition must be provided to NOAA.

### **Sec. 921.31 Supplemental acquisition and development awards.**

After National Estuarine Research Reserve designation, and as specified in the approved management plan, a coastal state may request a supplemental acquisition and/or development award(s) for acquiring additional property interests identified in the management plan as necessary to strengthen protection of key land and water areas and to enhance long-term protection of the area for research and education, for facility and exhibit construction, for restorative activities identified in the approved management plan, for administrative purposes related to acquisition and/or facility construction and to develop and/or upgrade research, monitoring and education/interpretive programs. Federal financial assistance provided to a National Estuarine Research Reserve for supplemental development costs directly associated with facility construction (i.e., major construction activities) may not exceed 70 percent of the total project cost, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs. NOAA must make a specific determination that the construction activity will not be detrimental to the environment. Acquisition awards for the acquisition of lands or waters, or interests therein, for any one reserve may not exceed an amount equal to 50 percent of the costs of the lands, waters, and interests therein of \$5,000,000, whichever amount is less, except when the financial assistance is provided from amounts recovered as result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of all actual costs of activities carrier out with this assistance, as long as such funds are available. In the case of a biogeographic region (see appendix I) shared by two or more states, each state is eligible independently for Federal financial assistance to establish a separate National Estuarine Research Reserve within their respective portion of the shared biogeographic region. Application procedures are specified in subpart I. Land acquisition must follow the procedures specified in Secs. 921.13(a)(7), 921.21(e) and (f) and 921.81.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12540, Mar. 17, 1997; 63 FR 26717, May 14, 1998].*

### **Sec. 921.32 Operation and management: Implementation of the management plan.**

(a) After the Reserve is formally designated, a coastal state is eligible to receive Federal funds to assist the state in the operation and management of the Reserve including the management of research, monitoring, education, and interpretive programs. The purpose of this Federally funded operation and management phase is to implement the approved final management plan and to take the necessary steps to ensure the continued effective operation of the Reserve.

(b) State operation and management of the Reserves shall be consistent with the mission, and shall further the goals of the National Estuarine Research Reserve program (see Sec. 921.1).

(c) Federal funds are available for the operation and management of the Reserve. Federal funds provided pursuant to this section may not exceed 70 percent of the total cost of operating and managing the Reserve for any one year, except when the financial assistance is provided from amounts recovered as a result of damage to natural resources located in the coastal zone, in which case the assistance may be used to pay 100 percent of the costs. In the case of a biogeographic region (see Appendix I) shared by two or more states, each state is eligible for Federal financial assistance to establish a separate Reserve within their respective portion of the shared biogeographic region (see Sec. 921.10).

(d) Operation and management funds are subject to the following limitations:

1. Eligible coastal state agencies may apply for up to the maximum share available per Reserve for that fiscal year. Share amounts will be announced annually by letter from the Sanctuary and Reserves Division to all participating states. This letter will be provided as soon as practicable following approval of the Federal budget for that fiscal year.
2. No more than ten percent of the total amount (state and Federal shares) of each operation and management award may be used for construction-type activities.

*[58 FR 38215, July 15, 1993, as amended at 62 FR 12541, Mar. 17, 1997].*

### **Sec. 921.33 Boundary changes, amendments to the management plan, and addition of multiple-site components.**

(a) Changes in the boundary of a Reserve and major changes to the final management plan, including state laws or regulations promulgated specifically for the Reserve, may be made only after written approval by NOAA. NOAA may require public notice, including notice in the Federal Register and an opportunity for public comment before approving a boundary or management plan change. Changes in the boundary of a Reserve involving the acquisition of properties not listed in the management plan or final EIS require public notice and the opportunity for comment; in certain cases, a categorical exclusion, an environmental assessment and possibly an environmental impact statement may be

required. NOAA will place a notice in the Federal Register of any proposed changes in Reserve boundaries or proposed major changes to the final management plan. The state shall be responsible for publishing an equivalent notice in the local media. See also requirements of Secs. 921.4(b) and 921.13(a)(11).

(b) As discussed in Sec. 921.10(b), a state may choose to develop a multiple-site National Estuarine Research Reserve after the initial acquisition and development award for a single site has been made. NOAA will publish notice of the proposed new site including an invitation for comments from the public in the Federal Register. The state shall be responsible for publishing an equivalent notice in the local newspaper(s). An EIS, if required, shall be prepared in accordance with section Sec. 921.13 and shall include an administrative framework for the multiple-site Reserve and a description of the complementary research and educational programs within the Reserve. If NOAA determines, based on the scope of the project and the issues associated with the additional site(s), that an environmental assessment is sufficient to establish a multiple-site Reserve, then the state shall develop a revised management plan which, concerning the additional component, incorporates each of the elements described in Sec. 921.13(a). The revised management plan shall address goals and objectives for all components of the multi-site Reserve and the additional component's relationship to the original site(s).

(c) The state shall revise the management plan for a Reserve at least every five years, or more often if necessary. Management plan revisions are subject to (a) above.

(d) NOAA will approve boundary changes, amendments to management plans, or the addition of multiple-site components, by notice in the Federal Register. If necessary NOAA will revise the designation document (findings) for the site.

#### **Sec. 921.40 Ongoing oversight and evaluations of designated National Estuarine Research Reserves.**

(a) The Sanctuaries and Reserve Division shall conduct, in accordance with section 312 of the Act and procedures set forth in 15 CFR part 928, ongoing oversight and evaluations of Reserves. Interim sanctions may be imposed in accordance with regulations promulgated under 15 CFR part 928.

(b) The Assistant Administrator may consider the following indicators of non-adherence in determining whether to invoke interim sanctions:

1. Inadequate implementation of required staff roles in administration, research, education/interpretation, and surveillance and enforcement. Indicators of inadequate implementation could include: No Reserve Manager, or no staff or insufficient staff to carry out the required functions.
2. Inadequate implementation of the required research plan, including the monitoring design. Indicators of inadequate implementation could include: Not

- carrying out research or monitoring that is required by the plan, or carrying out research or monitoring that is inconsistent with the plan.
3. Inadequate implementation of the required education/interpretation plan. Indicators of inadequate implementation could include: Not carrying out education or interpretation that is required by the plan, or carrying out education/interpretation that is inconsistent with the plan.
  4. Inadequate implementation of public access to the Reserve. Indicators of inadequate implementation of public access could include: Not providing necessary access, giving full consideration to the need to keep some areas off limits to the public in order to protect fragile resources.
  5. Inadequate implementation of facility development plan. Indicators of inadequate implementation could include: Not taking action to propose and budget for necessary facilities, or not undertaking necessary construction in a timely manner when funds are available.
  6. Inadequate implementation of acquisition plan. Indicators of inadequate implementation could include: Not pursuing an aggressive acquisition program with all available funds for that purpose, not requesting promptly additional funds when necessary, and evidence that adequate long-term state control has not been established over some core or buffer areas, thus jeopardizing the ability to protect the Reserve site and resources from offsite impacts.
  7. Inadequate implementation of Reserve protection plan. Indicators of inadequate implementation could include: Evidence of non-compliance with Reserve restrictions, insufficient surveillance and enforcement to assure that restrictions on use of the Reserve are adhered to, or evidence that Reserve resources are being damaged or destroyed as a result of the above.
  8. Failure to carry out the terms of the signed Memorandum of Understanding (MOU) between the state and NOAA, which establishes a long-term state commitment to maintain and manage the Reserve in accordance with section 315 of the Act. Indicators of failure could include: State action to allow incompatible uses of state-controlled lands or waters in the Reserve, failure of the state to bear its fair share of costs associated with long-term operation and management of the Reserve, or failure to initiate timely updates of the MOU when necessary.

#### **Sec. 921.41 Withdrawal of designation.**

The Assistant Administrator may withdraw designation of an estuarine area as a National Estuarine Research Reserve pursuant to and in accordance with the procedures of section 312 and 315 of the Act and regulations promulgated thereunder.

# Appendix C - 1

## State Legal Authorities

### Coastal Area Facility Review Act

## Chapter 19 — Coastal Protection, Etc.

### 13:19-1. Short title

This act shall be known and may be cited as the Coastal Area Facility Review Act.

### 13:19-2. Legislative findings and declaration

The Legislature finds and declares that New Jersey's bays, harbors, sounds, wetlands, inlets, the tidal portions of fresh, saline or partially saline streams and tributaries and their adjoining upland fastland drainage area nets, channels, estuaries, barrier beaches, near shore waters and intertidal areas together constitute an exceptional, unique, irreplaceable and delicately balanced physical, chemical and biologically acting and interacting natural environmental resource called the coastal area, that certain portions of the coastal area are now suffering serious adverse environmental effects resulting from existing development activity impacts that would preclude or tend to preclude those multiple uses which support diversity and are in the best long-term, social, economic, aesthetic and recreational interests of all people of the State; and that, therefore, it is in the interest of the people of the State that all of the coastal area should be dedicated to those kinds of land uses which promote the public health, safety and welfare, protect public and private property, and are reasonably consistent and compatible with the natural laws governing the physical, chemical and biological environment of the coastal area.

It is further declared that the coastal area and the State will suffer continuing and ever-accelerating serious adverse economic, social and aesthetic effects unless the State assists, in accordance with the provisions of this act, in the assessment of impacts, stemming from the future location and kinds of developments within the coastal area, on the delicately balanced environment of that area.

The Legislature further recognizes 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 economic position of the inhabitants of that area within the framework of a comprehensive environmental design strategy which preserves the most ecologically sensitive and fragile area from inappropriate development and provides adequate environmental safeguards for the construction of any developments in the coastal area.

### 13:19-3. Coastal area; boundaries

As used in this act:

"Beach" means a gently sloping unvegetated area of sand or other unconsolidated material found on tidal shorelines, including ocean, inlet, bay and river shorelines, and that extends landward from the mean high water line to either: the vegetation line; a man-made feature generally parallel to the ocean, inlet, bay or river waters such as a retaining structure, seawall, bulkhead, road or boardwalk, except that sandy areas that extend fully under and landward of an elevated boardwalk are considered to be beach areas; or the seaward or bayward foot of dunes, whichever is closest to the ocean, inlet, bay or river waters;

"Commercial development" means a development designed, constructed or intended to accommodate commercial or office uses. "Commercial development" shall include, but need not be limited to, any establishment used for the wholesale or retail

sale of food or other merchandise, or any establishment used for providing professional, financial, or other commercial services;

"Commissioner" means the Commissioner of Environmental Protection;

"Department" means the Department of Environmental Protection;

"Development" means the construction, relocation, or enlargement of any building or structure and all site preparation therefor, the grading, excavation or filling on beaches or dunes, and shall include residential development, commercial development, industrial development, and public development;

"Dune" means a wind- or wave-deposited or man-made formation of vegetated sand that lies generally parallel to and landward of the beach, and between the upland limit of the beach and the foot of the most inland slope of the dune. Dune includes the foredune, secondary and tertiary dune ridges, as well as man-made dunes, where they exist;

"Dwelling unit" means a house, townhouse, apartment, cooperative, condominium, cabana, hotel or motel room, a room in a hospital, nursing home or other residential institution, mobile home, campsite for a tent or recreational vehicle or any other habitable structure of similar size and potential environmental impact, except that dwelling unit shall not mean a vessel as defined in section 2 of P.L. 1962, c.73 (C. 12:7-34.37);

"Governmental agency" means the Government of the United States, the State of New Jersey, or any other state, or a political subdivision, authority, agency or instrumentality thereof, and shall include any interstate agency or authority;

"Industrial development" means a development that involves a manufacturing or industrial process, and shall include, but need not be limited to, electric power production, food and food by-product processing, paper production, agri-chemical production, chemical processes, storage facilities, metallurgical processes, mining and excavation processes, and processes utilizing mineral products;

"Person" means any individual, corporation, company, association, society, firm, partnership, joint stock company, or governmental agency;

"Public development" means a solid waste facility, including an incinerator and landfill, wastewater treatment plant, public highway, airport, an above or underground pipeline designed to transport petroleum, natural gas, or sanitary sewage, and a public facility, and shall not mean a seasonal or temporary structure related to the tourism industry, an educational facility or power lines;

"Public highway" means a public highway as defined in section 3 of P.L. 1984, c.73 (C.27:1B-3);

"Reconstruction" means the repair or replacement of a building, structure, or other part of a development;

"Residential development" means a development that provides one or more dwelling units.

13:19-4. Coastal area; boundaries

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The "coastal area" shall consist of all that certain area lying between the line as hereinafter described and the line formed by the State's seaward (Raritan Bay and Atlantic ocean) territorial jurisdiction on the east thereof, the State's bayward (Delaware Bay) territorial jurisdiction on the south and southwest thereof, and the State's riverward (Delaware River) territorial jurisdiction on the west thereto. Beginning at the confluence of Cheesequake Creek with the Raritan Bay; thence southwesterly along the center line

of Cheesequake Creek to its intersection with the Garden State Parkway; thence southeasterly along the Garden State Parkway to Exit 117 at State Highway 36; thence northeasterly along State Highway 36 to the intersection of Middle Road (County 516); thence easterly along Middle Road to the intersection of Palmer Avenue (County 7); thence northeasterly on Main Street to the intersection of State Highway 36; thence easterly on State Highway 36 to the intersection of Navesink Avenue; thence southerly on Navesink Avenue to the intersection of Monmouth Avenue at Navesink; thence westerly on Monmouth Avenue to its intersection with Browns Dock Road; thence southerly on Browns Dock Road to its intersection with Cooper Road; thence southwesterly on Cooper Road to the intersection of State Highway 35; thence southerly on State Highway 35 to its intersection with State Highway 71; thence southeasterly on State Highway 71 to its crossing of the Central Railroad of New Jersey tracks, now the Consolidated Rail Corporation (Conrail)/New Jersey Transit Corporation (NJ Transit); thence southerly along the Central Railroad of New Jersey tracks (now Conrail/NJ Transit) to its intersection of 6th Avenue (County 2); thence westerly on 6th Avenue (County 2) to the intersection of State Highway 33; thence westerly along State Highway 33 to the crossing of State Highway 18; thence southerly on State Highway 18 to its intersection of Marconi Road; thence southeasterly on Marconi Road to Adrienne Road, continuing south on Adrienne Road to Belmar Boulevard; thence easterly on Belmar Boulevard and 16th Avenue to the intersection of State Highway 71; thence southerly on State Highway 71 to the intersection of State Highway 35; thence northwesterly along State Highway 35 to State Highway 34 at the Brielle Circle; thence northwesterly along State Highway 34 to the Garden State Parkway at Exit 96; thence southwesterly along the Garden State Parkway to the intersection of the Monmouth, Ocean County boundary; thence westerly along that boundary to the intersection of the Central Railroad of New Jersey tracks (now Conrail); thence southwesterly along the tracks of the Central Railroad of New Jersey (now Conrail) to its junction with the tracks of the Pennsylvania Railroad near Whiting; thence easterly along the tracks of the Pennsylvania Railroad to its intersection with the Garden State Parkway near South Toms River; thence southerly along the Garden State Parkway to its intersection with the boundary of the Bass River State Forest; thence southerly, and thence westerly, along the Bass River State Forest to its intersection with the Garden State Parkway in Bass River Township; thence southerly along the Garden State Parkway to its intersection with Alt. 559, and thence northwesterly along Alt. 559 to its intersection with County Road 559 at Gravelly Run; thence northwesterly along County Road 559 to its intersection with U.S. 40 and S.R. 50 at Mays Landing; thence westerly along combined U.S. 40 and S.R. 50 to its intersection with S.R. 40; thence westerly along S.R. 40 to its intersection with S.R.50; thence southerly on S.R. 50 to its intersection with Buck Hill Road near Buck Hill; thence westerly along Buck Hill (River Road also Head of River Road and Aetna Drive) Road to its intersection with S.R. 49; thence southeasterly along S.R. 49 to its intersection with S.R. 50; thence southeasterly along S.R. 50 to its intersection with County Road 585 (now County Road 610); thence southwesterly along County Road 585 (now County Road 610) to its intersection with S.R. 47 at Dennisville; thence northwesterly along S.R. 47 to its intersection with State Road 49 at Millville; thence through Millville along State Road 49 to its intersection with County Road 610 (Cedar Street) thence southwesterly along County Road 610 (Cedar Street) to its intersection with County Road 555 (Race Street); thence southerly along County Road 555 (Race Street) to its intersection with County Road 27 (now County Road 627);

thence southerly along County Road 27 (now County Road 627) to its intersection with County Road 70 (now County Road 670); thence southerly on County Road 70 (now County Road 670) to the Center of Mauricetown; thence through Mauricetown westerly on County Road 548 (now County Road 676) to its intersection with the tracks of the Central Railroad of New Jersey (now Conrail); thence northwesterly on the tracks of the Central Railroad of New Jersey (now Conrail) to its intersection with County Road 98 (now County Road 698); thence easterly along County Road 98 (now County Road 698) to the intersection with County Road 38 (now County Road 638); thence northerly along County Road 38 (now County Road 638) to its intersection with S.R. 49 east of Bridgeton; thence westerly along S.R. 49 through Bridgeton to its intersection with West Avenue; thence south on West Avenue to its intersection with County Road 5 (Roadstown Road) (now County Road 626); thence westerly along County Road 5 (Roadstown Road) (now County Road 626) to Roadstown; thence northwesterly along the Roadstown Road to County Road 47 (now County Road 647); thence southwestwardly along County Road 47 (now County Road 647) to its intersection with County Road 19 (now County Road 623); thence along County Road 19 (now County Road 623) northwesterly to Gum Tree Corner; thence northwesterly along County Road 19 (now County Road 623) from Gum Tree Corner across Stowe Creek to its intersection with Salem County Road 59 (now County Road 623) (Hancock's Bridge Road); thence northwesterly along County Road 59 (now County Road 623) to its intersection with County Road 51 (now County Road 651) at Coopers Branch; thence northeasterly along County Road 51 (now County Road 651) to its intersection with S.R. 49 at Quinton; thence northwesterly along S.R. 49 to its intersection with County Road 50 (now County Road 650); thence southwestwardly along County Road 50 (now County Road 650) to its intersection with County Road 58 (now County Road 658); thence southerly on County Road 58 (now County Road 658) to its intersection with County Road 24 (now County Road 624); thence westerly along County Road 24 (now County Road 624) to its intersection with County Road 65 (now County Road 637); thence northeasterly along County Road 65 (now County Road 637) to its intersection with County Road 665 (Walnut Street); thence northeasterly along County Road 65 (now County Road 665) (Walnut Street) to its intersection with County Road 4 (now County Road 633); thence westerly along County Road 4 (now County Road 633) to its intersection with County Road 627; thence northerly along County Road 627 to its intersection with County Road 661; thence easterly along County Road 661 to its intersection with State Road 49; thence northerly along State Road 49 (Front Street) to its intersection with County Road 57 (now County Road 657); thence easterly along County Road 57 (now County Road 657) to its intersection with State Road 45; thence northerly along State Road 45 to its intersection with County Road 540 at Pointers; thence northerly and northwesterly along County Road 540 (Pointers Auburn Road/ Deepwater-Slapes Corner Road) to its intersection with the New Jersey Turnpike; thence westerly along the New Jersey Turnpike to its intersection with County Road 33 (now County Road 551); thence southerly along County Road 33 (now County Road 551) to its intersection with State Road 49; thence southeasterly along S.R. 49 to its intersection with County Road 26 (now County Road 632); thence northwesterly along County Road 26 (now County Road 632) to the Killcohook National Wildlife Refuge; thence northwesterly along this northeasterly boundary to the limits of the State's territorial jurisdiction on the Delaware River; provided, however, that the coastal area shall not include all that certain area in Cape May county lying within a line beginning at

the intersection of S.R. 47 and County Road 54 (now County Road 654); thence westerly on County Road 54 (now County Road 654); to the intersection of County Road 3 (now County Road 603); thence southeasterly on County Road 3 (now County Road 603) through the intersection of County Road 3 (now County Road 603) with County Road 13 (now County Road 639) to the intersection with County Road 47 (now County Road 647); thence easterly and northerly along County Road 47 (now County Road 647) to its intersection with U.S. Route 9; thence northerly along U.S. Route 9 to its intersection with State Road 47; thence westerly along State Road 47 to its intersection with County Road 54 (now County Road 654).

### 13:19-5. Construction of facility in coastal area; permit; exemptions

A permit issued pursuant to P.L.1973, c.185 (C.13:19-1 et seq.) shall be required for:

a. A development located in the coastal area on any beach or dune;

b. A development located in the coastal area between the mean high water line of any tidal waters, or the landward limit of a beach or dune, whichever is most landward, and a point 150 feet landward of the mean high water line of any tidal waters or the landward limit of a beach or dune, whichever is most landward, that would result, either solely or in conjunction with a previous development, in:

(1) A development if there is no intervening development with an above ground structure, excluding any shore protection structure or sand fencing, that is either completed or under active construction between the proposed site of the development and the mean high water line of any tidal waters;

(2) A residential development having three or more dwelling units if there is an intervening development with an above ground structure, excluding any shore protection structure or sand fencing, that is either completed or under active construction between the proposed site of the dwelling units and the mean high water line of any tidal waters;

(3) A commercial development having five or more parking spaces if there is an intervening development with an above ground structure, excluding any shore protection structure or sand fencing, that is either completed or under active construction between the proposed site of the commercial development and the mean high water line of any tidal waters; or

(4) A public development or industrial development;

c. A development located in the coastal area between a point greater than 150 feet landward of the mean high water line of any tidal waters or the landward limit of a beach or dune, whichever is most landward, and a point 500 feet landward of the mean high water line of any tidal waters or the landward limit of a beach or dune, whichever is most landward, which is located within the boundaries of a municipality which meets the criteria of a "qualifying municipality" pursuant to section 1 of P.L.1978, c.14 (C.52:27D-

178), or which is located within the boundaries of a city of the fourth class with a population of over 30,000 persons according to the latest federal decennial census, that would result, either solely or in conjunction with a previous development, in:

- (1) A residential development having 25 or more dwelling units;
- (2) A commercial development having 50 or more parking spaces; or
- (3) A public development or industrial development;

d. A development located in the coastal area at a point beyond 500 feet landward of the mean high water line of any tidal waters or the landward limit of a beach or dune, whichever is most landward, and which is located within the boundaries of a municipality which meets the criteria of a "qualifying municipality" pursuant to section 1 of P.L.1978, c.14 (C.52.27D-178), or which is located within the boundaries of a city of the fourth class with a population of over 30,000 persons according to the latest federal decennial census, that would result, either solely or in conjunction with a previous development, in:

- (1) A residential development having 75 or more dwelling units;
- (2) A commercial development having 150 or more parking spaces; or
- (3) A public development or industrial development; or

e. Except as otherwise provided in subsection c. and subsection d. of this section, a development in the coastal area at a point beyond 150 feet landward of the mean high water line of any tidal waters or the landward limit of a beach or dune, whichever is most landward, that would result, either solely or in conjunction with a previous development, in:

- (1) A residential development having 25 or more dwelling units;
- (2) A commercial development having 50 or more parking spaces; or
- (3) A public development or industrial development.

#### 13:19-5.1 Issuance of general permit; criteria

Notwithstanding any other provision of law, rule or regulation to the contrary, the commissioner is authorized to issue a general permit in lieu of a permit issued pursuant to section 5 of P.L.1973, c.185 (C.13:19-5). The department shall adopt rules and regulations which identify the activities subject to general permit review, and which establish the criteria for the approval or disapproval of a general permit issued pursuant to this section. The department shall approve, approve with conditions, or disapprove an application for a general permit pursuant to this section in accordance with P.L.1975, c.232 (C.13:1D-29 et seq.).

### 13:19-5.2 Construction not requiring permit

A permit shall not be required pursuant to section 5 of P.L.1973, c.185 (C.13:19-5) for:

a. A development which has received preliminary site plan approval pursuant to the "Municipal Land Use Law," P.L.1975, c.291 (C.40:55D-1 et seq.) or a final municipal building or construction permit on or prior to the effective date of this section, or a residential development which has received preliminary subdivision approval or minor subdivision approval on or prior to the effective date of this section where no subsequent site plan approval is required, provided that, in any of the cases identified above, construction begins within three years of the effective date of this section, and continues to completion with no lapses in construction activity of more than one year. This subsection shall not apply to any development that required a permit pursuant to P.L.1973, c.185 (C.13:19-1 et seq.) prior to the effective date of this section;

b. The reconstruction of any development that is damaged or destroyed, in whole or in part, by fire, storm, natural hazard or act of God, provided that such reconstruction is in compliance with existing requirements or codes of municipal, State and federal law;

c. The enlargement of any development if the enlargement does not result in:

(1) the enlargement of the footprint of the development; or

(2) an increase in the number of dwelling units within the development;

d. The construction of a patio, deck or similar structure at a residential development;

e. Services provided, within the existing public right-of-way, by any governmental entity which involve:

(1) the routine reconstruction, substantially similar functional replacement, or maintenance or repair of public highways;

(2) public highway lane widening, intersection and shoulder improvement projects which do not increase the number of travel lanes; or

(3) public highway signing, lighting, guiderail and other nonintrusive safety projects; or

f. The expansion of an existing, functional amusement pier, provided such expansion does not exceed the footprint of the existing, functional amusement pier by more than 25 percent, and provided such expansion is located in the area beyond 150 feet landward of the mean high water line, beach or dune, whichever is most landward.

A development subject to any exemption provided in this section shall be required to satisfy all other applicable requirements of law.

### 13:19-5.3. Waiver of permit for grading or excavating dune

The commissioner may waive the permit requirement for development in the coastal area pursuant to P.L.1973, c.185 (C.13:19-1 et seq.) for any development that involves the grading or excavation of a dune by a governmental agency if the commissioner finds that such a waiver is warranted as a result of a storm, natural disaster or similar act of God.

### 13:19-6.

Any person proposing to construct or cause to be constructed, or to undertake or cause to be undertaken, as the case may be, a development in the coastal area shall file an application for a permit, if so required pursuant to section 5 of P.L.1973, c.185 (C.13:19-5), with the commissioner, on forms and with any information the commissioner may prescribe. The application shall include an environmental impact statement which shall provide the information needed to evaluate the effects of a proposed development upon the environment of the coastal area. The department shall adopt rules and regulations that set forth the contents required in an environmental impact statement, and the conditions under which the commissioner may vary the content requirements of an environmental impact statement or waive the requirement that an environmental impact statement be submitted.

### 13:19-7. [Repealed]

### 13:19-8. Application; declaration of completeness; time of hearing

a. Within 20 days following receipt of an application, the commission shall notify the applicant in writing regarding its completeness. The commissioner may declare the application to be complete for filing or may notify the applicant of specific deficiencies. The commissioner, within 15 days following the receipt of additional information to correct deficiencies, shall notify the applicant of the completeness of the amended application. The application shall not be considered to be filed until it has been declared by the commissioner.

b. The commissioner, within 15 days of declaring the application complete for filing, shall set a date for the hearing. The date for the hearing shall be set not later than 60 days after the application is declared complete for filing.

### 13:19-9. Issuance of permit; grounds

a. The commissioner, or a member of the department designated by the commissioner, may hold a hearing to afford interested parties the opportunity to present, orally or in writing, their position concerning the filed application and any data they may have developed in reference to the environmental or other relevant effects of the proposed development. The department shall adopt rules and regulations which set forth the conditions under which a hearing is to be held. If no hearing is held, the

department shall provide for a 30-day comment period and shall provide sufficient public notice as to the commencement of the comment period.

b. The commissioner, within 15 days after the hearing, if one is held, or 15 days after the close of the comment period if no hearing is held, may require an applicant to submit any additional information necessary for the complete review of the application.

c. The department shall approve, approve with conditions, or disapprove an application for a permit pursuant to P.L. 1973, c. 185 (C. 13:19-1 et seq.) within 60 days after the hearing, if one is held, or within 60 days after the close of the comment period if no hearing is held. In the event the commissioner requires additional information as provided in subsection b. of this section, the department shall approve, approve with conditions, or disapprove an application within 90 days following receipt of the additional information.

13:19-10. Denial of permit; conditional permit; additional grounds; nuclear electricity generating facility

The commissioner shall review filed applications, including any environmental impact statement and all information presented at public hearings or during the comment period, or submitted during the application review period. A permit may be issued pursuant to this act only upon a finding that the proposed development:

a. Conforms with all applicable air, water and radiation emission and effluent standards and all applicable water quality criteria and air quality standards.

b. Prevents air emissions and water effluents in excess of the existing dilution, assimilative, and recovery capacities of the air and water environments at the site and within the surrounding region.

c. Provides for the collection and disposal of litter, recyclable material and solid waste in such a manner as to minimize adverse environmental effects and the threat to the public health, safety, and welfare.

d. Would result in minimal feasible impairment of the regenerative capacity of water aquifers or other ground or surface water supplies.

e. Would cause minimal feasible interference with the natural functioning of plant, animal, fish, and human life processes at the site and within the surrounding region.

f. Is located or constructed so as to neither endanger human life or property nor otherwise impair the public health, safety, and welfare.

g. Would result in minimal practicable degradation of unique or irreplaceable land types, historical or archeological areas, and existing public scenic attributes at the site and within the surrounding region.

13:19-11. Inapplicability of requirement for low and moderate income housing provision

Notwithstanding the applicant's compliance with the criteria listed in section 10 of P.L.1973, c.185 (C.13:19-10), if the commissioner finds that the proposed development would violate or tend to violate the purpose and intent of this act as specified in section 2 of P.L.1973, c.185 (C.13:19-2), or that the proposed development would materially contribute to an already serious and unacceptable level of environmental degradation or resource exhaustion, the commissioner may deny the permit application, or the commissioner may issue a permit subject to such conditions as the commissioner finds reasonably necessary to promote the public health, safety and welfare, to protect public and private property, wildlife and marine fisheries, and to preserve, protect and enhance the natural environment. The construction and operation of a nuclear electricity generating facility shall, however, not be approved by the commissioner unless the commissioner finds that the proposed method for disposal of radioactive waste material to be produced or generated by the facility will be safe, conforms to standards established by the Nuclear Regulatory Commission and will effectively remove danger to life and the environment from such waste material.

#### 13:19-11.1 Inapplicability of requirement for low and moderate income housing provision

Notwithstanding the provisions of any rule or regulation to the contrary, the department shall not require the provision for low and moderate income housing as a condition for approval of an application to construct or undertake a development in the coastal area pursuant to the provisions of P.L.1973, c.185 (C.13:19-1 et seq.).

#### 13:19-12. [Repealed]

#### 13:19-13. Coastal area review board; power to hear appeals

[Editor's note: This section was repealed by sections 25 and 26 of P.L.1993, c.190 effective on the completion date defined in 13:19-13.1.]

There is hereby created the Coastal Area Review Board, in but not of the Department of Environmental Protection, which shall consist of three voting members who shall be the Commissioner of Environmental Protection or his designated representative, the Commissioner of Commerce and Economic Development or his designated representative and the Commissioner of Community Affairs or his designated representative. No vote on a permit request shall be taken unless all voting members are present.

The Coastal Area Review Board shall have the power to hear appeals from decisions of the commissioner pursuant to section 12 of P.L. 1973, c. 185 (13:19-12). The board may affirm or reverse the decision of the Commissioner with respect to applicability of any provision of this act to a proposed use; it may modify any permit granted by the commissioner, grant a permit denied by him, deny a permit granted by him, or confirm his grant of a permit. The board shall review filed applications, including the environmental impact statement and all information presented at public hearings and any other information the commissioner makes available to the board prior to the affirmation or reversal of a decision of the commissioner.

### 13:19-13.1. Abolishment of Coastal Area Review Board

a. The Coastal Area Review Board established pursuant to section 13 of P.L.1973, c.185 (C.13:19-13) is, upon the completion date of its duties, abolished, and all powers, functions and duties thereof shall terminate. Any appeal pending before the Coastal Area Review Board prior to the enactment date of this act may be decided by the board. Any appeal initiated on or after the enactment date of this act shall be referred to the Office of Administrative Law.

b. For the purposes of this section, "completion date," with respect to the Coastal Area Review Board, shall mean the date upon which all decisions on appeal to the board from decisions by the commissioner pursuant to P.L.1973, c.185 (C.13:19-1 et seq.), have been rendered by the board, as certified by the voting members thereof. Notice of the certification of the completion date shall be published by the board in the New Jersey Register.

### 13:19-14. Transfer of permit with conveyance by applicant

In the event of rental, lease, sale or other conveyances by an applicant to whom a permit is issued, such permit, with any conditions, shall be continued in force and shall apply to the new tenant, lessee, owner, or assignee so long as there is no change in the nature of the development set forth in the original application.

### 13:19-15. Effect of denial on future application

The denial of an application shall in no way adversely affect the future submittal of a new application.

### 13:19-16. [Repealed]

#### 13:19-16.1 Shore protection fund; funding; use

1.

a. There is created in the Department of the Treasury a special non-lapsing fund to be known as the "Shore Protection Fund." The moneys in the fund are dedicated and shall only be used to carry out the purposes enumerated in subsection b. of this section. The fund shall be credited with all revenues collected and deposited in the fund pursuant to section 4 of P.L. 1968, c. 49 (C.46:15-8), all interest received from the investment of moneys in the fund, and any moneys which, from time to time, may otherwise become available for the purposes of the fund. Pending the use thereof pursuant to the provisions of subsection b. of this section, the moneys deposited in the fund shall be held in interest-bearing accounts in public depositories, as defined pursuant to section 1 of P.L.1970, c. 236 (C.17:9-41), and may be invested or reinvested in such securities as are approved by the State Treasurer. Interest or other income earned on moneys deposited into the fund shall be credited to the fund for use as set forth in this act for other moneys in the fund.

b. Moneys deposited in the "Shore Protection Fund" shall be used for shore protection projects associated with the protection, stabilization, restoration or maintenance of the shore, including monitoring studies and land acquisition, consistent with the New Jersey Shore Protection Master Plan prepared pursuant to section 5 of P.L.1978, c. 157, and may include the nonfederal share of any State-federal project, provided however that the Commissioner of Environmental Protection and Energy may, pursuant to appropriations made by law, allocate moneys deposited in the fund for shore protection projects of an emergency nature, in the event of storm, stress of weather or similar act of God. Two percent of the moneys annually deposited in the fund shall be allocated and annually appropriated for the purposes of funding the Coastal Protection Technical Assistance Service established pursuant to section 1 of P.L.1993, c. 174 (C.18A:64L-1), of which amount up to \$100,000 annually may be utilized for funding coastal engineering research and development to be conducted by Stevens Institute of Technology in response to requests therefor made by State or local governmental entities.

#### 13:19-17. Rules and regulations

a. The department shall, pursuant to the provisions of the "Administrative Procedure Act," P.L.1968, c.410 (C.52:14B-1 et seq.), adopt rules and regulations to effectuate the purposes of this act.

b. Within one year of the enactment date of P.L.1993, c.190 (C.), the department, in consultation with the State Planning Commission and county and municipal governments located in the coastal area, as defined in section 4 of P.L.1973, c.185 (C.13:19-4), shall adopt new rules and regulations to implement P.L.1993, c.190 (C. ). Any rules or regulations adopted pursuant to this subsection shall be closely coordinated with the provisions of the State Development and Redevelopment Plan adopted pursuant to P.L.1985, c.398 (C.52:18A-196 et seq.) and the federal "Coastal Zone Management Act of 1972," 16 U.S.C. §1451 et seq.

#### 13:19-18. Violations; injunctions; penalty

a. Whenever the department finds that a person has violated any provision of P.L.1973, c.185 (C.13:19-1 et seq.), or any regulation, rule, permit, or order adopted or issued by the department pursuant thereto, the department may:

(1) Issue an order requiring the person found to be in violation to comply in accordance with subsection b. of this section;

(2) Bring a civil action in accordance with subsection c. of this section;

(3) Levy a civil administrative penalty in accordance with subsection d. of this section; or

(4) Bring an action for a civil penalty in accordance with subsection e. of this section.

Pursuit of any of the remedies specified under this section shall not preclude the seeking of any other remedy specified.

b. Whenever the department finds that a person has violated any provision of P.L.1973, c.185, or any regulation or rule adopted, or permit or order issued, by the department pursuant to that act, the department may issue an order specifying the provision or provisions of the act, regulation, rule, permit, or order of which the person is in violation, citing the action which constituted the violation, ordering abatement of the violation, and giving notice to the person of his right to a hearing on the matters contained in the order. The ordered party shall have 20 days from receipt of the order within which to deliver to the department a written request for a hearing. After the hearing and upon finding that a violation has occurred, the department may issue a final order. If no hearing is requested, then the order shall become final after the expiration of the 20-day period. A request for hearing shall not automatically stay the effect of the order.

c. The department may institute an action or proceeding in the Superior Court for injunctive and other relief, including the appointment of a receiver, for any violation of P.L.1973, c.185, or any regulation or rule adopted, or permit or order issued, by the department pursuant to that act, and the court may proceed in the action in a summary manner.

Such relief may include, singly or in combination:

(1) A temporary or permanent injunction;

(2) Assessment of the violator for any cost incurred by the department in removing, correcting or terminating the adverse effects upon the land or upon water or air quality resulting from any violation of any provision of P.L.1973, c.185, or any regulation or rule adopted, or permit or order issued, by the department pursuant to that act, for which the action under this subsection may have been brought.

d. The department is authorized to assess, in accordance with a uniform policy adopted therefor, a civil administrative penalty of not more than \$25,000 for each violation. No assessment may be levied pursuant to this subsection until after the violator has been notified by certified mail, personal service or any other means authorized under the New Jersey Court Rules. The notice shall include a reference to the section or provision of P.L.1973, c.185, the regulation, rule, permit, or order issued by the department pursuant to that act that has been violated, a concise statement of the facts alleged to constitute a violation, a statement of the amount of the civil administrative penalties to be imposed, including any interest that may accrue thereon if the penalty is not paid when due, and a statement of the party's right to a hearing. The ordered party shall have 20 calendar days from receipt of the notice within which to deliver to the department a written request for a hearing. After the hearing and upon finding that a violation has occurred, the department may issue a final order after assessing the amount of the fine specified in the notice. If no hearing is requested, the notice shall become a final order after the expiration of the 20-day period. Payment of the assessment is due when a final order is issued or the notice becomes a final order. The department may compromise any civil administrative penalty assessed under this

section in an amount the department determines appropriate. A civil administrative penalty assessed, including a portion thereof required to be paid pursuant to a payment schedule approved by the department, which is not paid within 30 days of the date that payment of the penalty is due, shall be subject to an interest charge on the amount of the penalty, or portion thereof, which shall accrue as of the date payment is due. If the penalty is contested, no additional interest charge shall accrue on the amount of the penalty until after the date on which a final order is issued.

Interest charges assessed and collectible pursuant to this subsection shall be based on the rate of interest on judgments provided in the New Jersey Rules of Court. For the purposes of this subsection, the date that a penalty is due is the date that written notice of the penalty is received by the person responsible for payment thereof, or such later date as may be specified in the notice.

e. Any person who violates the provisions of P.L.1973, c.185, any rule or regulation adopted pursuant thereto, or any permit or order issued by the department pursuant to that act, an administrative order issued pursuant to subsection b. of this section or a court order issued pursuant to subsection c. of this section, or who fails to pay a civil administrative penalty in full pursuant to subsection d. of this section, shall be subject, upon order of a court, to a civil penalty of not more than \$25,000 for each violation, and each day during which a violation continues shall constitute an additional, separate, and distinct offense.

Any penalty established pursuant to this subsection may be imposed and collected with costs in a summary proceeding pursuant to "the penalty enforcement law," N.J.S.2A:58-1 et seq. The Superior Court and the municipal court shall have jurisdiction to enforce the provisions of "the penalty enforcement law" in connection with this act.

f. There is created in the department a special nonlapsing fund, to be known as the "Cooperative Coastal Monitoring Enforcement Fund." Except as otherwise provided in this section, all monies from penalties, fines, or recoveries of costs collected by the department pursuant to this section on and after the effective date of this section, shall be deposited in the fund. Interest earned on monies deposited in the fund shall be credited to the fund. Unless otherwise specifically provided by law, monies in the fund shall be utilized by the department for the cost of providing aircraft overflights for coastal monitoring, surveillance and enforcement activities conducted by the department and for the cost of administering P.L.1973, c.185 (C.13:19-1 et seq.). The department shall submit annually to the Legislature a report which provides an accounting of all monies deposited in the fund and the purposes for which monies in the fund are disbursed.

13:19-19. Act as supplemental and additional to other laws; application of Wetlands Act

The provisions of this act shall not be regarded as to be in derogation of any powers now existing and shall be regarded as supplemental and in addition to powers conferred by other laws, including the authority of the department to regulate waterfront development pursuant to R.S.12:5-1 et seq. and municipal zoning authority. The provisions of this act shall not apply to those portions of the coastal areas regulated pursuant to enforceable orders under P.L.1970, c.272 (C.13:9A-1 et seq.).

13:19-20. Construction of act

This act shall be liberally construed to effectuate the purpose and intent thereof.

#### 13:19-21. Severability

If any provision of this act or the application thereof to any person or circumstances is held invalid, the remainder of the act and the application of such provision to persons or circumstances other than those to which it is held invalid, shall not be affected thereby.

#### 13:19-22. New Jersey adopt a beach act; short title

This act shall be known, and may be cited, as the "New Jersey Adopt a Beach Act."

#### 13:19-23. Legislative findings and determinations

The Legislature finds and determines:

a. The presence of debris, litter, floatable waste, and other refuse in the ocean waters has an adverse impact on the quality of those waters and on sea mammals and other marine life;

b. Programs involving public participation can be an integral part of a Statewide strategy to combat the deleterious effects of ocean pollution, and can contribute to the goal of achieving a pollution free environment with the hope that in the future, cleanups of this nature will no longer be required;

c. "Adopt a beach" programs, which provide for citizen cleanups of beaches and shores of debris, litter, floatable waste, and other refuse, have been enthusiastically received in other states, and have proved useful in the continuing effort to remove potential pollutants from ocean waters; and

d. It is in the public interest and in furtherance of the general welfare of the people of this State to establish an "Adopt a Beach" program in the Department of Environmental Protection.

#### 13:19-24. Definitions

As used in this act:

"Department" means the Department of Environmental Protection.

"Program volunteer" means any group, organization, business, or individual who has adopted a section of beach or shore for cleanup in accordance with this act.

#### 13:19-25. Adopt a beach program; purpose

The department shall, within 180 days of the effective date of this act, establish an "Adopt a Beach" program. The purpose of the program shall be to utilize volunteer

labor in a cooperative effort with State and local government to periodically clear the public beaches and shores of the State of debris, litter, floatable waste, and other refuse.

#### 13:19-26. Duties and powers of department

##### a. The department shall:

(1) Develop a packet of information and instructions, and, within the limits of funds made available therefor, provide cleanup supplies, for use by program volunteers in cleaning up beaches and shores in accordance with this act;

(2) Coordinate with program volunteers and appropriate local government officials in arranging for the disposal, and to the maximum extent practicable and feasible, the recycling, of debris, litter, floatable waste, and other refuse collected by program volunteers;

(3) Advertise and promote the "Adopt a Beach" program, and develop and utilize such slogans, symbols, and mascots as the department may deem expedient for such purposes;

(4) Coordinate the operation of the "Adopt a Beach" program with the responsibilities of the department and the Department of Education to prepare and distribute educational materials concerning the deleterious effects of plastics and other forms of pollution on the marine environment pursuant to the "Clean Ocean Education Act," P.L.1988, c. 62 (C. 58:10A-52 et seq.);

(5) Cooperate with the Department of Corrections on any program established by law or by that department that utilizes prisoners to clean up or maintain beaches or shores;

(6) Provide notice of the provisions of this act to every coastal municipality in the State; and

(7) Organize, coordinate, and designate the dates for two annual coastwide beach and shore cleanups, one in the Spring and one in the Fall, in which all program volunteers shall be asked to participate, and which shall be in addition to any other cleanup activities that program volunteers may undertake.

##### b. The department may:

(1) Prepare or use from existing environmental advocacy group sources, data cards to be distributed to program volunteers to record information on the amounts and types of debris, litter, floatable waste, and other refuse collected, and such other information as the department may deem useful;

(2) Utilize the information derived from data cards distributed to program volunteers to formulate recommendations to the Governor and the Legislature for

administrative or legislative action to effectuate the goal of preventing ocean pollution;  
and

(3) Issue to each program volunteer an adoption certificate, and, within the limits of funds made available therefor, provide a sign indicating the name of the participating group, organization, business, or individual for placement, if not otherwise prohibited by law or municipal ordinance, at an appropriate point on the public road providing access to the section of beach or shore adopted by the program volunteer, or at such other point as the department may prescribe.

13:19-27. Adoption process; assignment of section of beach; size of section; period of adoption

a. Any group, organization, business, or individual interested in adopting a section of beach or shore for cleanup in accordance with this act shall notify the department. Such notification may include a request to adopt, if possible, a specified section of beach or shore. Upon receipt of a notification of interest, the department shall: (1) assign an appropriate section of beach or shore to that group, organization, business, or individual for adoption; (2) notify the group, organization, business, or individual of that assignment and provide thereto the materials required to be prepared pursuant to paragraph (1) of subsection a. of section 5 of this act.

b. Upon receipt from the department of notification of its assigned section of beach or shore, the program volunteer shall notify the clerk of the municipality within which the assigned section of beach or shore is located so that the municipality will be aware of the program volunteer's activities and may, at its discretion, provide assistance.

c.

(1) An adopted section of beach or shore shall be approximately one mile in length, but other lengths may be permitted depending upon the desires and capabilities of the program volunteer, the amount of waste that may be expected to be collected, or the accessibility of the section of beach or shore.

(2) The adoption period for a section of beach or shore shall be one year, but a program volunteer may renew its participation in the program by notifying the department annually at such time as shall be specified therefor by the department.

13:19-28. Clean up of adopted beach by others permitted

Nothing in this act shall be construed to prohibit any person from cleaning up any section of beach or shore, regardless of whether or not it has been adopted for cleanup in accordance with this act.

13:19-29. Immunity of government entities and employees from liability; waiver by program volunteer

a. No department, agency, bureau, board, commission, authority, or other entity of the State, or of any county or municipality, and no employee thereof, shall be liable to any person for any injury or damages that may be caused or sustained by a program volunteer during an "Adopt a Beach" event or activity.

As a condition of participating in the program, a prospective program volunteer shall sign a waiver releasing the department, the State, and any other appropriate governmental entity, and all employees thereof, from liability for any injury or damages that may be caused or sustained by that volunteer during an "Adopt a Beach" event or activity.

b. A program volunteer shall not be considered a "public employee" or "State employee" for purposes of the "New Jersey Tort Claims Act," N.J.S. 59:1-1 et seq., or otherwise be accorded any of the protections set forth therein.

#### 13:19-30. Donations to program

Any person may donate to the department, or to a county or municipality, funds, supplies, or services for use in the "Adopt a Beach" program, and the department and any county or municipality are authorized to accept such donations.

#### 13:19-31. [Federal shore protection and disaster relief aid eligibility—information and education]

The Legislature finds and declares that the New Jersey shore is a valuable environmental and economic resource, and that every effort should be made to ensure the continued viability of the shoreline; that periodic storms threaten to destroy portions of the shore and property located upland of the shore, especially in areas where beach and dune maintenance has been neglected; that although federal shore protection and disaster relief aid has helped to mitigate the adverse effects of subsequent storms on particular beachfronts, many beaches remain ineligible for these types of federal aid due to ignorance of the eligibility requirements; and that many shore municipalities could qualify for federal aid in the future if they implement the basic beach maintenance techniques specified in federal guidelines.

The Legislature therefore determines that it is altogether fitting and proper for the State to provide informational and educational services to shore municipalities concerning the eligibility requirements for federal shore protection and disaster relief aid.

#### 13:19-32. [Federal shore protection and disaster relief aid—guidance documents]

a. The Department of Environmental Protection shall prepare a guidance document which provides information to coastal municipalities on eligibility requirements for receiving federal monies related to shore protection projects and disaster aid. The document shall provide detailed information which describes the policies, programs or other actions required of a municipality to qualify for these federal monies, and shall include a section which explains what a municipality must do to create and maintain an engineered beach.

b. Upon completion of the guidance document, the Department of Environmental Protection shall notify all coastal municipalities of the availability of the guidance document. The department shall provide copies of the guidance document to a municipality upon request.

c. As used in this act, "coastal municipality" means any municipality located within the coastal area as defined in section 4 of P.L.1973, c. 185 (C. 13:19-4).

## **Appendix C – 2**

### **State Legal Authorities**

### **Coastal Zone Management Act**

THIS IS A COURTESY COPY OF THIS RULE. ALL OF THE DEPARTMENT'S RULES ARE COMPILED IN TITLE 7 OF THE NEW JERSEY ADMINISTRATIVE CODE.

**NOTE:** The rationale sections of these rules have been filed with the Office of Administrative Law, but are not reprinted in the Chapter. The rationale sections can be reviewed at the Office of Administrative Law, Quakerbridge Plaza, Bldg. 9, PO Box 301, Trenton, New Jersey 08625-0301.

## **N.J.A.C. 7:7E**

### **COASTAL ZONE MANAGEMENT RULES**

#### **Statutory authority:**

N.J.S.A. 12:5-3, 13:1D-29 et seq., 13:9A-1 et seq., and 13:19-1 et seq.

#### **Date last amended:**

December 17, 2007

**For regulatory history and effective dates see the New Jersey Administrative Code**

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THIS IS A COURTESY COPY OF THIS RULE. ALL OF THE DEPARTMENT'S RULES ARE COMPILED IN TITLE 7 OF THE NEW JERSEY ADMINISTRATIVE CODE.

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**SUBCHAPTER 1. INTRODUCTION**

**7:7E-1.1 Purpose and scope**

(a) This chapter presents the substantive rules of the Department of Environmental Protection regarding the use and development of coastal resources, to be used primarily by the Land Use Regulation Program in the Department in reviewing permit applications under the Coastal Area Facility Review Act (CAFRA), N.J.S.A. 13:19-1 et seq. (as amended to July 19, 1993), Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., Waterfront Development Law, N.J.S.A. 12:5-3, Water Quality Certification (401 of the Federal Clean Water Act), and Federal Consistency Determinations (307 of the Federal Coastal Zone Management Act). Requests for Water Quality Certification shall also be reviewed in accordance with other applicable statutes and regulations administered by the Department including the Surface Water Quality Standards, N.J.A.C. 7:9B. The rules also provide a basis for recommendations by the Program to the Tidelands Resource Council on applications for riparian grants, leases and licenses.

(b) In 1977, the Commissioner of the Department of Environmental Protection submitted to the Governor and Legislature the Coastal Management Strategy for New Jersey-CAFRA Area (September 1977), prepared by the Department as required by CAFRA, N.J.S.A. 13:19-16, and submitted for public scrutiny in late 1977. The Department revised the Coastal Management Strategy for public review as the New Jersey Coastal Management Program-Bay and Ocean Shore Segment and Final Environmental Impact Statement (EIS) for Federal approval. In August 1978 the Governor submitted the revised New Jersey Coastal Management Program-Bay and Ocean Shore Segment and Final EIS for Federal approval, which was received in September 1978. In May 1980, the Department submitted further revisions, published as the Proposed New Jersey Coastal Management Program and Draft Environmental Impact Statement for Federal approval, which was received in September 1980. The Coastal Zone Management rules (Rules) constitute the substantive core of the program.

(c) By revising and readopting these policies as administrative rules, according to the Administrative Procedure Act, the Department aims to increase the predictability of the Department's coastal decision-making by limiting administrative discretion, as well as to ensure the enforceability of the Coastal Zone Management rules of the coastal management program of the State of New Jersey prepared under the Federal Coastal Zone Management Act. Further, the Department interprets the "public health, safety and welfare" clause in CAFRA (N.J.S.A. 13:19-10f) and the Wetlands Act of 1970 (N.J.S.A. 13:19A-4d) to include a full consideration of the national interests in the wise use of coastal resources.

(d) The coastal land and water areas of New Jersey are diverse. The same development placed in different locations will have different impacts on the coastal ecosystem and built environment as well as different social and economic implications. Decisions on uses of coastal resources shall be made using the three step process consisting of the Location Rules (subchapters 2 through 6), the Use Rules (subchapter 7), and the Resource Rules (subchapter 8) of this chapter. Depending upon the proposed use, project design, location, and surrounding region, different specific rules in each of the three steps may be applicable in the coastal decision-making process. The Coastal Zone Management rules address a wide range of land and water types (locations), present and

potential land and water uses, and natural, cultural, social and economic resources in the coastal zone. The Department does not, however, expect each proposed use of coastal resources to involve all Location Rules, Use Rules, and Resource Rules. Rather, the applicable rules are expected to vary from proposal to proposal. Decisions on the use of coastal resources in the Hackensack Meadowlands District will be made by the New Jersey Meadowlands Commission, as lead agency, and by the Department, consistent with the Hackensack Meadowlands District Master Plan, its adopted components and management programs.

**7:7E-1.2 Jurisdiction**

(a) General: This chapter shall apply to six categories, as defined in N.J.A.C. 7:7E-1.2(c) through (h), of actions or decisions by the Department on uses of coastal resources within or affecting the coastal zone:

1. Coastal Permits;
2. Program Management Actions;
3. Consistency Determinations;
4. Financial assistance;
5. Department management actions affecting the coastal zone; and
6. Department planning actions affecting the coastal zone.

(b) Geographic scope of the New Jersey coastal zone: This chapter shall apply geographically to the New Jersey coastal zone, which is defined as:

1. The coastal area defined in the Coastal Area Facility Review Act (CAFRA), N.J.S.A. 13:19-1 et seq.;
2. Coastal waters, which are any tidal waters of the State and all lands lying thereunder. Coastal waters of the State of New Jersey extend from the mean high water line out to the three geographical mile limit of the New Jersey territorial sea, and elsewhere to the interstate boundaries of the States of New York, and Delaware and the Commonwealth of Pennsylvania ;
3. All lands outside of the coastal area as defined by CAFRA extending from the mean high water line of a tidal water body to the first paved public road, railroad or surveyable property line existing on September 26, 1980 generally parallel to the waterway, provided that the landward boundary of the upland area shall be no less than 100 feet and no more than 500 feet from the mean high water line;
4. All areas containing tidal wetlands; and
5. The Hackensack Meadowlands District as defined by N.J.S.A. 13:17-4.

(c) Coastal Permits: This chapter shall apply to all:

1. Waterfront Development permits (N.J.S.A. 12:5-3);
2. Tidal wetlands permits (N.J.S.A. 13:9A-1 et seq.); and
3. CAFRA permits (N.J.S.A. 13:19-1 et seq.).

(d) Program management actions: This chapter shall apply to all actions of the Land Use Regulation Program within the coastal zone to the extent statutorily permissible:

1. Permits for use of a floodway (N.J.S.A. 58:16A-50 et seq.);

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2. Promulgation of regulations concerning land use in flood hazard areas (N.J.S.A. 58:16A-50 et seq.);

3. Certification pursuant to Section 401 of the Federal Clean Water Act, 33 U.S.C. 1251 et seq. (Water Quality Certification); and

4. Permits for activities regulated pursuant to the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.).

(e) Consistency determinations: This chapter shall apply to decisions on the consistency or compatibility of proposed actions by Federal, State, and local agencies within or affecting the coastal zone, including, but not limited to, determinations of Federal consistency under Section 307 of the Federal Coastal Zone Management Act, 16 U.S.C. 1451 et seq., determinations of consistency or compatibility under the Coastal Zone Management Act, comments on Draft and Final Environmental Impact Statements prepared under the National Environmental Policy Act, 42 U.S.C. 4321 et seq., and comments on other public and private plans, programs, projects and policies.

(f) Financial assistance decisions: This chapter shall apply to State aid financial assistance decisions by the Department under the Shore Protection Program and Green Acres Program within the coastal zone, to the extent permissible under existing statutes and regulations.

(g) Department management activities: In addition to the management activities noted at N.J.A.C. 7:7E-1.1, this chapter shall apply, to the extent statutorily permissible, to the following Department management actions including permit decisions, approvals, certifications and conveyances, in or affecting the coastal zone:

1. Tidelands Resource Council: Conveyances of State owned tidelands (N.J.S.A. 12:3-1 et seq.);

2. Division of Water Quality:

i. Point source discharges under the New Jersey Pollutant Discharge Elimination System (N.J.S.A. 58:10A-1 et seq.);

ii. Wastewater treatment works, sewage collection systems, and outfall sewers (N.J.S.A. 5:10A-6);

iii. Wastewater Treatment Construction Grants (N.J.S.A. 26:2E-1 et seq., P.L. 1985, c.329, and N.J.S.A. 58:11B-1 et seq.);

iv. Sewerage connection ban exemptions (N.J.S.A. 58:10A-4);

v. Designation of Critical Sewerage Areas (N.J.S.A. 58:11-44);

vi. Fifty or more Sewerage (septic) Facilities (N.J.S.A. 58:11-23); and

vii. Sewerage Facilities in Critical Areas (N.J.S.A. 58:11-45).

3. Land Use Regulation Program:

i. Activities within Freshwater Wetlands (N.J.S.A. 13:9B-1 et seq.); and

ii. Activities under the Flood Hazard Area Control Act (N.J.S.A. 58:16A-50 et seq.);

4. Water Supply Administration:

i. Diversion of surface and/or subsurface or percolating waters for public and private water supply (N.J.S.A. 58:1A et seq.);

ii. Diversions for water supply (N.J.S.A. 58:1A et seq.);

iii. Drilling of wells (N.J.S.A. 58:4A-14);

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- iv. Construction of new or modified public water supply sources, treatment plants, and distribution systems (N.J.S.A. 58:12A-1 et seq.); and
- v. Installation of or maintenance of a physical connection between an approved public potable water supply and an unapproved supply (N.J.S.A. 58:11-9.1 to 9.11 and 58:12A-1 et seq.);
- 5. Bureau of Non-Point Pollution Control: Discharge of stormwater to surface waters for industrial and other facilities (N.J.S.A. 58:10A-1 et seq.);
- 6. Air Quality Regulation:
  - i. Construction, installation or alteration of control apparatus or equipment (N.J.S.A. 26:2C-9.2);
  - ii. Operation of control apparatus or equipment (N.J.S.A. 26:2C-9.2); and
  - iii. Variances to exceed air quality standards (N.J.S.A. 26:2C-9.2);
- 7. Division of Solid and Hazardous Waste Management of Solid Waste facilities (N.J.S.A. 13:1E-1 et seq.);
- 8. Green Acres and Division of Parks and Forestry:
  - i. Regulations concerning use of State-owned lands (N.J.S.A. 13:1L-19);
  - ii. Designation of State-owned lands for inclusion in the Natural Area system (N.J.S.A. 13:1B-15.12a et seq.);
  - iii. Allocations of Green Acres Grants (N.J.S.A. 13:8A-19 et seq.); and
  - iv. Inclusion of river areas in the Wild and Scenic Rivers System (N.J.S.A. 13:8-45 et seq.).
- 9. Division of Fish and Wildlife: Regulations concerning use of land and water areas under the control of the Division (N.J.S.A. 13:1B-30 et seq., 23:1-1 et seq., 23:4-28);
- 10. Natural and Historic Resources, Engineering and Construction: Management of dams (N.J.S.A. 58:4-1); and
- 11. All Divisions: Management of State-owned lands by the Department.

(h) Department planning actions: This chapter shall provide the basic policy direction for the following planning actions undertaken by the Department in the coastal zone as the lead state agency for Coastal Management under Section 306 of the Federal Coastal Zone Management Act.

- 1. Land Use Regulation Program:
  - i. Coastal zone management;
- 2. Natural and Historic Resources Programs:
  - i. Navigational dredging; and
  - ii. Shore protection.
- 3. Division of Watershed Management:
  - i. Areawide water quality management ("208");
  - ii. Allocation of planning grants for the development of local stormwater management ordinances (P.L. 1981, c.32, and N.J.S.A. 40:55D-1 et seq.)
- 4. Air Quality Regulation: Air quality planning.
- 5. Division of Solid and Hazardous Waste: Solid and hazardous waste management.
- 6. Green Acres and Division of Parks and Forestry: Planning for public acquisition of coastal lands.
- 7. Division of Water Quality: Issuance of environmental decision documents for environmental infrastructure facilities that receive State financial assistance ( P.L. 1985,

c.329, N.J.A.C. 7:22-10)

8. Office of Policy, Planning and Science: Implementation and coordination of the Federal Coastal Zone Management Program.

### **7:7E-1.3 Severability**

If any provision of this chapter or the application of this chapter to any person or circumstances is held invalid, the remainder of the chapter and the application of such provision to persons or circumstances other than those to which it is held invalid shall not be affected thereby.

### **7:7E-1.4 Review, revision, and expiration**

The Department shall periodically review this chapter, consider the various national, State, and local interests in coastal resources and developments seeking coastal locations, and propose and adopt appropriate revisions to this chapter. Under the requirements of the Federal Coastal Zone Management Act, the Department expects to conduct an annual review of the rules and expects to revise, amend or readopt the rules before the five-year deadline under Executive Order No. 66 of 1978 for periodic review of administrative rules.

### **7:7E-1.5 Coastal decision-making process**

(a) The Coastal Zone Management rules represent the consideration of various conflicting, competing, and contradictory local, State, and national interests in diverse coastal resources and in diverse uses of coastal locations. Numerous balances have been struck among these interests in defining these rules, which reduce but do not presume to eliminate all conflicts among competing interests. One reason for this intentional balancing and conflict reducing approach is that coastal management involves explicit consideration of a broad range of concerns, in contrast to other resource management programs which have a more limited scope of concern. Decision-making on individual proposed actions using the Coastal Zone Management rules must therefore consider all three steps in the process, and weigh, evaluate, and interpret inevitably complex interests, using the framework established by the rules. In this process, interpretations of terms, such as "prudent," "feasible," "minimal," "practicable," and "maximum extent," as used in a specific rule or combinations of the rules may vary, depending upon the context of the proposed use, location, and design. Finally, these principles should not be understood as authorizing arbitrary decision-making or unrestrained administrative discretion. Rather, the limited flexibility intentionally built into the Coastal Zone Management rules provides a mechanism for incorporating professional judgment by the Department officials, as well as recommendations and comments by applicants, public agencies, specific interest groups, corporations, and citizens into the coastal decision-making process.

1. In the application of administrative discretion, the Department officials will be guided by eight basic coastal policies which summarize the direction of the specific rules.

i. Protect and enhance the coastal ecosystem.

ii. Concentrate rather than disperse the pattern of coastal residential, commercial, industrial, and resort development, encourage the preservation of open space, and ensure the availability of suitable waterfront areas for water dependent activities.

iii. Employ a method for decision making which allows each coastal location to be evaluated in terms of both the advantages and the disadvantages it offers for development.

iv. Protect the health, safety and welfare of people who reside, work and visit the coastal zone.

v. Promote public access to the waterfront through protection and creation of meaningful access points and linear walkways and at least one waterfront park in each waterfront municipality.

vi. Maintain active port and industrial facilities, and provide for necessary expansion in adjacent sites.

vii. Maintain and upgrade existing energy facilities, and site additional energy facilities in a manner consistent with the rules of this Coastal Management Program.

viii. Encourage residential, commercial, and recreational mixed-use redevelopment of the developed waterfront.

(b) The Department shall issue a permit pursuant to the Coastal Area Facility Review Act (CAFRA) only upon a finding as required by N.J.S.A. 13:19-10 that the development:

1. Conforms with all applicable air, water and radiation emission and effluent standards and all applicable water quality criteria and air quality standards;

2. Prevents air emissions and water effluents in excess of the existing dilution, assimilative, and recovery capacities of the air and water environments at the site and within the surrounding region;

3. Provides for the collection and disposal of litter, recyclable and solid waste in such a manner as to minimize adverse environmental effects and the threat to the public health, safety, and welfare;

4. Would result in minimal feasible impairment of the regenerative capacity of water aquifers or other ground or surface water supplies;

5. Would cause minimal feasible interference with the natural functioning of plant, animal, fish, and human life processes at the site and within the surrounding region;

6. Is located or constructed so as to neither endanger human life or property nor otherwise impair the public health, safety, and welfare; and

7. Would result in minimal practicable degradation of unique or irreplaceable land types, historical or archaeological areas, and existing public scenic attributes at the site and within the surrounding region.

#### **7:7E-1.6 Mitigation**

(a) Mitigation shall be selectively considered on a case-by-case basis as compensation for the loss or degradation of a particular natural resource. In general, mitigation should be similar in type and location to the resource disturbed or destroyed, that is, replacement in kind within the same watershed. The Department will, however, consider proposals for mitigation that differ in type and/or location from the disturbed or destroyed resource provided the mitigation would provide a major contribution to meeting the basic coastal policies (N.J.A.C. 7:7E-1.5( a)1). Requirements for mitigation of a particular resource are addressed more specifically in each applicable Special Area Rules (N.J.A.C. 7:7E-3.1 through 3.49).

(b) Rationale: See the note at the beginning of this Chapter.

**7:7E-1.7 Correspondence with the Department**

Correspondence related to this chapter may be submitted to the Department at the following address:

Land Use Regulation Program  
New Jersey Department of Environmental Protection  
501 E. State Street  
PO Box 439  
Trenton, New Jersey 08625-0439

**7:7E-1.8 Definitions**

(a) The Coastal Zone Management rules are stated in terms of actions that are encouraged, required, acceptable, conditionally acceptable, discouraged, or prohibited. Some rules include specific conditions that must be met in order for an action to be deemed acceptable. Within the context of the Coastal Zone Management rules and the principles defined in N.J.A.C. 7:7E-1.5(a), the following words have the following meanings.

"Acceptable" means that a proposed use of coastal resources is likely to be approved.

"Action", "activity", "project", "proposal", or "use" are used interchangeably to describe the proposed use of coastal resources that is under scrutiny using the Coastal Zone Management rules.

"Area": See definition for "site" below.

"Bulkhead" means a vertical shore protection structure installed to withstand the forces of waves and currents. A bulkhead is not a "revetment" or a "gabion" as defined elsewhere in this section.

"CAFRA area" means the "coastal area" defined in the Coastal Area Facility Review Act at N.J.S.A. 13:19-4.

"Coastal permit" or "permit" means a permit or authorization, including a Federal Consistency and Water Quality Certificate, issued by the Department under N.J.A.C. 7:7 pursuant to any of the following statutes: the Waterfront Development Law, N.J.S.A. 12:5-3, the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., the Coastal Area Facility Review Act (CAFRA), N.J.S.A. 13:19-1 et seq.; Section 307 of the Federal Coastal Zone Management Act, 16 §§1451 et seq.; or Section 401 of the Federal Water Pollution Control Act, 33 U.S.C. §§1251 et seq.

"Commercial development" means a development designed, constructed or intended to accommodate commercial, retail or office uses. "Commercial development" shall

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include, but need not be limited to, any establishment used for the wholesale or retail sale of food or other merchandise, or any establishment used for providing professional, financial or other commercial services.

"Conditionally acceptable" means that a proposed use of coastal resources is likely to be acceptable, provided that conditions specified in the rules are satisfied.

"Conservation restriction" means a restriction, easement, covenant, or condition, in any deed, will or other instrument, other than a lease, executed by or on behalf of the owner of the land, appropriate to retaining land or water areas predominantly in their natural state, scenic or open or wooded condition, or for conservation of soil or wildlife, or for outdoor recreation or park use, or for public access to tidal waterways and their shores, or as suitable habitat for fish or wildlife, to forbid or limit any or all of the following:

1. Construction or placing of buildings, roads, signs, billboards or other advertising, or other structures on or above the ground;
2. Dumping or placing of soil or other substance or material as landfill, or dumping or placing of trash, waste or unsightly or offensive materials;
3. Removal or destruction of trees, shrubs or other vegetation;
4. Excavation, dredging or removal of loam, peat, gravel, soil, rock or other mineral substance;
5. Surface use except for the purposes permitting the land or water area to remain predominantly in its natural condition;
6. Activities detrimental to drainage, flood control, water conservation, erosion control or soil conservation, or fish and wildlife habitat preservation; and
7. Other acts or uses detrimental to the retention of land or water areas according to the purposes of this chapter.

"Development" means any activity for which a Wetlands Act of 1970 Permit, Waterfront Development Permit, or Federal consistency determination is required, including site preparation and clearing. Development, for an application under the CAFRA, means the construction, relocation, or enlargement of any building or structure and all site preparation therefor, the grading, excavation or filling on beaches and dunes, and shall include residential development, commercial development, industrial development and public development. Development under CAFRA and the Waterfront Development Law does not include repairs or maintenance such as replacing siding, windows or roofs, unless such repairs or maintenance are associated with enlargements which are not exempt under CAFRA pursuant to N.J.A.C. 7:7-2.1(c)4 or the Waterfront Development Law pursuant to N.J.A.C. 7:7-2.3(d). Development under CAFRA does not include debris removal or cleanup provided such activities do not involve excavation, grading, or filling on beaches and dunes.

"Discouraged" means that a proposed use of coastal resources is likely to be rejected or denied as the Department has determined that such uses of coastal resources should be deterred. In cases where the Department considers the proposed use to be in the public interest despite its discouraged status, the Department may permit the use provided that

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mitigating or compensating measures can be taken so that there is a net gain in quality and quantity of the coastal resource of concern.

"Dwelling unit" means a house, townhouse, apartment, cooperative, condominium, cabana, hotel or motel room, a patient/client room in a hospital, nursing home or other residential institution, mobile home, campsite for a tent or recreational vehicle, floating home or any habitable structure of similar size and potential environmental impact, except that dwelling unit shall not mean a vessel as defined in section 2 of P.L. 1962, c.73 (N.J.S.A. 12:7-34.37).

"11-digit hydrologic unit code area" means an area within which water drains to a particular receiving surface water body, which area is identified by an 11-digit hydrologic unit boundary designation, as shown on the map included in the United States Geological Survey, Water Resources Investigations Report 95-4134, 1995, entitled "Development of a 14-digit Hydrologic Coding Scheme and Boundary Data Set for New Jersey." The HUC codes for New Jersey can be downloaded from [www.njgeodata.state.nj.us](http://www.njgeodata.state.nj.us). The HUC 11 data is entitled "subwatersheds." Software designed for use with Geographic Information Systems (GIS) will be required to view that downloaded data.

"Encouraged" means that a proposed use of coastal resources is acceptable and is a use, by its purpose, location, design, and effect, that the Department has determined should be fostered and supported in the coastal zone.

"Gabion" means a shore protection structure that is comprised of wire mesh basket(s) or mattress(es) filled with rock and used in multiples as a structural unit installed to withstand the forces of waves and currents. A gabion is not a "bulkhead" or a "revetment" as defined elsewhere in this section.

"Habitable structure" means a structure that is able to receive a certificate of occupancy from the municipal construction code official, or can be demonstrated to have been legally occupied as a dwelling unit for the most recent five years.

"Impervious cover" means any structure, surface, or improvement that reduces and/or prevents absorption of stormwater into land. Porous paving, paver blocks, gravel, crushed stone, crushed shell, elevated structures (including boardwalks), and other similar structures, surfaces, or improvements are considered impervious cover. Grass, lawns, or any other vegetation are not considered impervious cover.

"Linear development" means a development with the basic function of connecting two points, such as a road, drive, public walkway, railroad, sewerage pipe, stormwater management pipe, gas pipeline, water pipeline, or electric, telephone or other transmission line.

"Location": See definition for "site" below.

"Major commercial development" means a commercial development with a

cumulative building area of greater than 100,000 square feet.

"Mean high water" (MHW) is a tidal datum that is the arithmetic mean of the high water heights observed over a specific 19-year Metonic cycle (the National Tidal Datum Epoch). For the New Jersey coast, the two high waters of each tidal day are included in the mean. This datum is available from the Department, Bureau of Tidelands Management.

"Mean high water line" (MHWL) is the intersection of the land with the water surface at the elevation of mean high water. The elevation of mean high water varies along the oceanfront and the tidal bays and streams in the coastal zone.

1. For practical purposes, the mean high water line is often referred to as the "ordinary" high water line, which is typically identified as the limit of wet sand or debris line on a beach, or by a stain line on a bulkhead or piling. However, for the purpose of establishing regulatory jurisdiction pursuant to the Coastal Area Facility Review Act (CAFRA) and the Waterfront Development Law, the surveyed mean high water elevation will be used.

"Minor commercial development" means a commercial development with a cumulative building area of 100,000 square feet or less.

"Navigable" means deep enough and wide enough to afford passage to watercraft, including canoes, at high tide. Navigability will also apply to areas upstream of obstructions (for example, culverts), provided that the water course is still tidally influenced in the upstream area.

"Program" means the Department of Environmental Protection's Land Use Regulation Program.

"Prohibited" means that a proposed use of coastal resources is unacceptable and that the Department will use its legal authority to reject or deny the proposal.

"Reconstruction" means the repair or replacement of a building, structure or other parts of a development, provided that such repair or replacement does not increase or change the location of the footprint of the preexisting development, does not increase the area covered by buildings and/or asphalt or concrete pavement and does not result in a change in the use of the development. Reconstruction of docks and piers means repair or replacement in the same location and size of the preexisting structure. Reconstruction does not include repairs or maintenance, such as replacing siding, windows or roofs, unless such repairs or maintenance are associated with enlargements which are not exempt pursuant to N.J.A.C. 7:7-2.1(c)4.

"Revetment" means a sloped shore protection structure consisting of a facing made of stone, placed on a bank, bluff, or shoreline to withstand the forces of waves and currents. A revetment is not a "gabion" or "bulkhead" as defined elsewhere in this section.

"Site" means the lot or lots upon which a proposed development is to be constructed.

"Spring tide" means a tide that occurs at or near the time of new and full moon and which rises highest (Spring High Tide) and falls lowest (Spring Low Tide) from the mean level.

"Spring high water line" is the intersection of the land with the water surface at the elevation of spring high tide.

"Water dependent" means development that cannot physically function without direct access to the body of water along which it is proposed. Uses, or portions of uses, that can function on sites not adjacent to the water are not considered water dependent regardless of the economic advantages that may be gained from a waterfront location. Maritime activity, commercial fishing, public waterfront recreation and marinas are examples of water dependent uses, but only the portion of the development requiring direct access to the water is water dependent. The test for water dependency shall assess both the need of the proposed use for access to the water and the capacity of the proposed water body to satisfy the requirements and absorb the impacts of the proposed use. A proposed use will not be considered water dependent if either the use can function away from the water or if the water body proposed is unsuitable for the use. For example, in a maritime operation, a dock or quay and associated unloading area would be water dependent, but an associated warehouse would not be water dependent.

1. Examples of water dependent uses include: docks, piers, marina activities requiring access to the water, such as commissioning and decommissioning new and used boats, boat repairs and short term parking for boaters, storage for boats which are too large to be feasibly transported by car trailer (generally greater than 24 feet), rack systems for boat storage, industries such as fish processing plants and other commercial fishing operations, port activities requiring the loading and unloading of vessels, and water-oriented recreation.

2. Water dependent uses exclude, for example: housing, hotels, motels, restaurants, warehouses, manufacturing facilities (except for those which receive and quickly process raw materials by ship), dry boat storage for boats that can be transported by car trailer, long-term parking, parking for persons not participating in a water-dependent activity, boat sales, automobile junk yards, and non-water oriented recreation such as roller rinks and racquetball courts.

"Water oriented" means development that serves the general public and derives economic benefit from direct access to the water body along which it is proposed. (Industrial uses need not serve the general public.) A hotel or restaurant, since it serves the public, could be water-oriented if it takes full advantage of a waterfront location. An assembly plant could be water oriented if overland transportation is possible but water-borne receipt of raw materials and shipment of finished products is economically advantageous. Housing is not water-oriented despite the economic premium placed on waterfront housing, because it only benefits those who can afford to buy or rent the housing units.

“Watershed management area” means an aggregation of the 11-digit hydrologic unit codes designated by the Department as a watershed management area and shown on the map entitled “New Jersey’s Watersheds, Watershed Management Areas, and Water Regions,” dated April 2000, as amended and supplemented. The map of watershed management areas may be obtained from the Department’s Division of Watershed Management at (609) 984-0058, or may be viewed on the internet at [www.state.nj.us/dep/gis](http://www.state.nj.us/dep/gis).

## **SUBCHAPTER 2. (RESERVED)**

## **SUBCHAPTER 3. SPECIAL AREAS**

### **7:7E-3.1 Purpose and scope**

(a) Special Areas are areas that are so naturally valuable, important for human use, hazardous, sensitive to impact, or particular in their planning requirements, as to merit focused attention and special management rules. This subchapter divides Special Areas into four categories:

1. Special Water Areas, N.J.A.C. 7:7E-3.2 through 3.15, extend landward to the spring high water line or the level of normal flow in non-tidal waters;
2. Special Water's Edge Areas, N.J.A.C. 7:7E-3.16 through 3.32, are divided into three subcategories depending on their location. Special Water's Edge Areas in (a)2i and ii below are found only next to tidal waters, while Coastwide Special Water's Edge Areas are found adjacent to tidal as well as non-tidal waters;
  - i. Oceanfront, and Raritan and Delaware Bayfronts, N.J.A.C. 7:7E-3.16 through 3.19;
  - ii. Barrier and Bay Islands, N.J.A.C. 7:7E-3.20 and 7:7E-3.21; and
  - iii. Coastwide Special Water's Edge Areas, N.J.A.C. 7:7E-3.22 through 3.32;
3. Special Land Areas, N.J.A.C. 7:7E-3.33 through 3.35, generally are landward of the Special Water's Edge Areas; and
4. Coastwide Special Areas, N.J.A.C. 7:7E-3.36 through 3.49, may include Special Water Areas, Special Water's Edge Areas or Special Land Areas.

(b) All land or water areas, except certain Special Water's Edge Areas, are subject to either the General Land Area rules at N.J.A.C. 7:7E-5 and either N.J.A.C. 7:7E-5A or 5B or the General Water Area rules at N.J.A.C. 7:7E-4. In addition, certain land or water areas are subject to one or more Special Area rules. All Special Water's Edge Areas are subject to one or more Special Area rules. In some cases, a portion of a site is subject to both General Area rules and Special Area rules. Where the applicable General Area rules and Special Area rules conflict, the Special Area rules shall govern.

### **7:7E-3.2 Shellfish habitat**

(a) Shellfish habitat is defined as an estuarine bay or river bottom which has a history of production for hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), eastern oysters (*Crassostrea virginica*), bay scallops (*Argopecten irradians*), or blue mussels (*Mytilus edulis*), or otherwise listed below in this section. A shellfish habitat areas is defined as an area which meets one or more of the following criteria:

1. The area has a current shellfish density equal to or greater than 0.20 shellfish per square foot;

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2. The area has a history of natural shellfish production according to data available to the New Jersey Bureau of Shellfisheries, or is depicted as having high or moderate commercial value in the Distribution of Shellfish Resources in Relation to the New Jersey Intracoastal Waterway (US Department of the Interior, 1963), "Inventory of New Jersey's Estuarine Shellfish Resources" (Division of Fish, Game and Wildlife, Bureau of Shellfisheries, 1983-present); and/or the "Inventory of Delaware Bays and Estuarine Shellfish Resources" (Division of Fish, Game and Wildlife, Bureau of Shellfisheries, 1993);

3. The area is designated by the State of New Jersey as a shellfish culture areas as authorized by N.J.S.A. 50:1 et seq. Shellfish culture areas include estuarine areas presently leased by the State for shellfish aquaculture activities or hard clam relay, transplant and transfer as well as those areas suitable for future shellfish aquaculture development; or

4. The area is designated as productive at N.J.A.C. 7:25-24, Leasing of Atlantic and Delaware Bay Bottom for Aquaculture.

(b) Any area determined by the Department to be contaminated by toxins is excluded from this definition. The Final Short List, prepared by the Department pursuant to the Federal Clean Water Act 33 U.S.C. 1313(c)(1), identifies these known contaminated areas. Also excluded from this definition are those sites for which the Department is presented with clear and convincing evidence that the sites lack the physical features necessary for the support of a shellfish population, excluding those waterways listed at N.J.A.C. 7:7E-7.3(d)10 and (j) below.

(c) The water located under any boat mooring facility (including docks and associated structures) is automatically condemned and reduced to "prohibited" status pursuant to N.J.A.C. 7:12-2.1(a)1ii. Development which would result in the destruction, condemnation (downgrading of the shellfish growing water classification) or contamination of shellfish habitat is prohibited, unless the proposed development is a dock, pier, or boat mooring constructed in accordance with (d)3 below.

1. The term "destruction" includes actions of filling to create fast land, overboard dumping or disposal of solids or spoils which would smother shellfish populations, or create unsuitable conditions for shellfish colonization or the creation of bottom depressions with anoxic conditions.

(d) Construction of a dock, pier or boat moorings in shellfish habitat is prohibited, except for the following:

1. Public fishing piers owned and controlled by a public agency for the sole purpose of providing access for fishing;

2. In waters which have been classified as prohibited for the purpose of harvesting shellfish; and

3. A single noncommercial dock, pier, or boat mooring associated with a single family dwelling provided the proposed dock, pier, or boat mooring meets the requirements at (d)3i through v below. If a lot has frontage on both a natural waterway and a man-made lagoon, as defined at N.J.A.C. 7:7-1.3, the dock, pier, or boat mooring shall be located within the lagoon, unless locating the dock, pier or boat mooring on the

lagoon would not otherwise comply with the Recreational docks and piers rule at N.J.A.C. 7:7E-4.5 or any other provisions of this chapter.

i. The proposed dock, pier or boat mooring is:

(1) Constructed of non-polluting or other inert material, such as natural lumber or other untreated wood, concrete, plastic or vinyl; and

(2) Designed and constructed in a manner that reduces the size of the structure to limit the area of shellfish habitat condemned and reduces adverse impacts to the marine ecosystem to the extent practicable. Reduction of the area of shellfish habitat condemned and adverse impacts to the marine ecosystem may include, for example, adjustment of the dimensions and location of the proposed dock, pier, or boat mooring to reduce the total area covered by the structure while ensuring that the requirements of this chapter are met.

ii. Unless the Department determines that a different length dock or pier is appropriate in order to ensure that the requirements of this chapter are met, the dock or pier shall not extend beyond, and a boat mooring shall not be located beyond, a straight line drawn between the outermost end of decking of the nearest adjacent existing legal dock or pier to each side of the dock, pier or boat mooring, except:

(1) If the dock, pier or boat mooring is associated with a lot that has frontage on both a man-made lagoon and a natural waterway and the dock, pier or boat mooring is to be located on the natural waterway as required under (d)3 above, the dock or pier shall not extend beyond, or the boat mooring shall not extend beyond, the outermost end of decking of the nearest adjacent dock or pier on the natural waterway; or

(2) To meet the requirements of the submerged vegetation habitat rule at N.J.A.C. 7:7E-3.6, a dock or pier shall be extended to the minimum length necessary, or the boat mooring shall be located where necessary to ensure that at mean low water a minimum water depth of four feet is present in the designated slips of the dock, pier or boat mooring;

iii. The dock, pier or boat mooring shall have no more than two designated slips. Boats shall not be moored at any area other than the two boat slips designated in the Department permit and/or the plan approved under that permit;

iv. Only one dock, pier or boat mooring shall be constructed per buildable single family lot pursuant to this subsection. Where two or more lots have been assembled for the purpose of building a single family dwelling, only one dock, pier or boat mooring shall be constructed pursuant to this subsection;

v. No dredging shall be performed in conjunction with the construction or use fo the dock, pier, or boat mooring; and vi. Mitigation shall be performed in accordance with the following:

(1) A conservation restriction shall be placed on the subject property governing the construction or reconstruction of a shoreline protection structure, as follows:

(A) If the dock, pier or boat mooring is associated with an unbulkheaded shoreline, the conservation restriction shall prohibit the construction of a shoreline protection structure other than stone rip-rap or other similar sloped revetment; or

(B) If the dock, pier or boat mooring is associated with a previously bulkheaded shoreline, the conservation restriction shall prohibit replacement, reconstruction or rehabilitation of the bulkhead with anything other than non-polluting or other inert material; and

(2) A monetary contribution shall be provided to the Department's dedicated account

for Shellfish Habitat Mitigation. The amount of each monetary contribution provided under this section shall be based upon the areas of shellfish habitat condemned due to coverage by the structure and boat moorings, the documented shellfish density on the property, and the commercial value of the shellfish resource.

(e) New dredging (defined at N.J.A.C. 7:7E-4.7) within shellfish habitat is prohibited, except when it is necessary to maintain the use of public launching facilities (ramps) with 25 or more trailer parking spaces or marina facilities with 25 or more dockage units, consisting of either dry dock storage or wet slips. New dredging for existing marinas or for the expansion of such facilities is conditionally acceptable provided that:

1. The expanded portion of the marina, other than the access channel, will not be located within the shellfish habitat;
2. The marina provides on site restrooms, a marine sanitation disposal device and pumpout station; and
3. The width, depth and length of the to-be dredged channel and boat basin are limited to the minimum dimensions needed to service the existing or expanded facilities.

(f) Maintenance dredging (defined at N.J.A.C. 7:7E-4.6) within shellfish habitat is conditionally acceptable, provided the disturbance to shellfish habitat is minimized to the greatest extent possible.

(g) New dredging adjacent to shellfish habitat is discouraged in general, but may be conditionally acceptable if it can be demonstrated that the proposed dredging activities will not adversely affect shellfish habitat, population or harvest. If the Department determines dredging to be acceptable, dredging shall be managed pursuant to N.J.A.C. 7:7E-4.7 so as not to cause significant mortality of the shellfish due to increased turbidity and sedimentation, resuspension of toxic chemicals, or any other occurrence which will interfere with the natural functioning of the shellfish habitat.

(h) For the purpose of this rule all docks and piers, except public fishing piers defined in (d)1 above, are considered boat mooring facilities.

(i) Development required for national security for which there exists no other prudent and feasible alternative site is acceptable under this rule, provided that the shellfish resource is salvaged and mitigated pursuant to a plan approved in writing by the Department. The applicant is responsible for all the expenses of resource salvaging and mitigation. All such programs shall be coordinated with the appropriate shellfish management agency.

(j) N.J.A.C. 7:7E-7.3(d)10 shall also apply to development of boat mooring facilities of five or more slips on the Navesink, Shrewsbury, and Manasquan Rivers and St. George's Thorofare.

(k) Rationale: See the note at the beginning of this subchapter.

### **7:7E-3.3 Surf clam areas**

(a) Surf clam areas are coastal waters which can be demonstrated to support significant commercially harvestable quantities of surf clams (*Spisula solidissima*), or areas important for recruitment of surf clam stocks. This includes areas where fishing is prohibited for research sanctuary or conservation purposes by N.J.A.C. 7:25-12.1(d)4. Surf clams are a marine fish and therefore are also subject to the marine fish and fisheries rule, N.J.A.C. 7:7E-8.2.

(b) Development which would result in the destruction, condemnation, or contamination of surf clam areas is prohibited except for the following:

1. Development that is of national interest provided:
  - i. There are no prudent and feasible alternative sites; and
  - i. Impacts to the surf clam area are minimized.
2. Sand and gravel mining to obtain material for beach nourishment provided:
  - i. The beach nourishment project is in the public interest;
  - ii. There are no prudent and feasible alternative offshore borrow site that would result in less impact to marine fish and fisheries;
  - iii. The impacts to surf clam areas are minimized through the following:
    - (1) The beach nourishment project is designed to minimize the volume of sand borrowed from the surf clam area;
    - (2) The borrow cut is designed to minimize the area disturbed, for example, by designing a deeper cut;
    - (3) The borrow site is located to avoid those more productive surf clam areas; and
    - (4) When appropriate, notice shall be provided to clambers in advance of the mining operation to allow for surf clam harvest; and
  - iv. The sand mining is not located within a surf clam conservation area as defined at N.J.A.C. 7:25-12.

(c) Rationale: See note at the beginning of this subchapter.

#### **7:7E-3.4 Prime fishing areas**

(a) Prime fishing areas include tidal water areas and water's edge areas which have a demonstrable history of supporting a significant local quantity of recreational or commercial fishing activity. The area includes all coastal jetties and groins, public fishing piers or docks and artificial reefs. Prime fishing areas also include all red line delineated features within the coastal waters illustrated in: B.L. Freeman and L.A. Walford (1974) *Angler's Guide to the United States Atlantic Coast Fish; Fishing Grounds and Fishing Facilities*, Section III and IV or as indicated on New Jersey's Specific Sport and Commercial Fishing Grounds Chart (page 14) contained in "New Jersey's Recreational and Commercial Ocean Fishing Grounds." Long and Figley (1984); recently developed artificial reefs off the New Jersey coast as identified in Figley (1989) "A Guide to Fishing and Diving New Jersey's Artificial Reefs", and The Fishing Grounds of Raritan, Sandy Hook and Delaware Bays as determined in Figley and McCloy (1988) "New Jersey's Recreational and Commercial Fishing Grounds of Raritan Bay, Sandy Hook Bay and Delaware Bay and The Shellfish Resources of Raritan Bay and Sandy Hook Bay". While this information source applies only to the Delaware and

Raritan Bay and Atlantic Ocean shorefronts, Prime Fishing Areas do occur throughout the coastal zone.

(b) Standards relevant to prime fishing areas are as follows:

1. Permissible uses of prime fishing areas include recreational and commercial finfishing and shellfishing, as presently regulated by the Department's Division of Fish and Wildlife, scuba diving and other water related recreational activities.
2. Prohibited uses include sand or gravel submarine mining which would alter existing bathymetry to a significant degree so as to reduce the high fishery productivity of these areas. Disposal of domestic or industrial wastes must meet applicable State and Federal effluent limitations and water quality standards.

(c) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.5 Finfish migratory pathways**

(a) Finfish migratory pathways are waterways (rivers, streams, creeks, bays and inlets) which can be determined to serve as passageways for diadromous fish to or from seasonal spawning areas, including juvenile anadromous fish which migrate in autumn and those listed by H.E. Zich (1977) "New Jersey Anadromous Fish Inventory" NJDEP Miscellaneous Report No. 41, and including those portions of the Hudson and Delaware Rivers within the coastal zone boundary.

1. Species of concern include: alewife or river herring (*Alosa pseudoharengus*), blueback herring (*Alosa sapidissima*), American shad (*Alosa aspidissima*), striped bass (*Monroe saxatilis*), Atlantic sturgeon (*Acipenser oxyrinchus*), Shortnose sturgeon (*Acipenser brevirostrum*) and American eel (*Anguilla rostrata*).

(b) Development, such as dams, dikes, spillways, channelization, tide gates and intake pipes, which creates a physical barrier to the movement of fish along finfish migratory pathways is prohibited, unless acceptable mitigating measures such as fish ladders, erosion control, or oxygenation are used.

(c) Development which lowers water quality to such an extent as to interfere with the movement of fish along finfish migratory pathways or to violate State and Delaware River Basin Commission water quality standards is prohibited.

1. Mitigating measures are required for any development which would result in: lowering dissolved oxygen levels, releasing toxic chemicals, raising ambient water temperature, impinging or suffocating fish, entrainment of fish eggs, larvae or juveniles, causing siltation, or raising turbidity levels during migration periods.

(d) Water's edge development which incorporates migration access structures, such as functioning fish ladders, will be conditionally acceptable, provided that the Department's, Division of Fish and Wildlife approves the design of the access structure. As of January, 1994, the Department's Division of Fish and Wildlife is evaluating anadromous fish spawning areas for potential enhancement work. This may include building of fish ladders, removal of obstructions, stocking, and other means. A development proposal shall be consistent with these Department efforts.

(e) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.6 Submerged vegetation habitat**

(a) A Submerged vegetation special area consists of water areas supporting or documented as previously supporting rooted, submerged vascular plants such as widgeon grass (*Ruppia maritima*), sago pondweed (*Potamogeton pectinatus*), horned pondweed (*Zannichellia palustris*) and eelgrass (*Zostera marina*). In New Jersey, submerged vegetation is most prevalent in the shallow portions of the Navesink, Shrewsbury, Manasquan and Metedeconk Rivers, and in Barnegat, Manahawkin and Little Egg Harbor Bays. Other submerged vegetation species in lesser quantities include, but are not limited to, the following: water weed (*Elodea nuttalli*), *Eriocaulon parkeri*, *Liaeopsis chinensis*, *Naja flexilis*, *Nuphar variegatum*, *Potamogeton crispus*, *Potamogeton epihydrus*, *Potamogeton perfoliatus*, *Potamogeton pusillus*, *Scirpus subterminalis* and *Vallisneria americana*. Detailed maps of the distribution of the above species for New Jersey, and a method for delineation, are available from DEP in the New Jersey Submerged Aquatic Vegetation Distribution Atlas (Final Report), February, 1980, conducted by Earth Satellite Corporation and also on "Eelgrass Inventory" maps prepared by the Division of Fish and Wildlife, Bureau of Shellfisheries, 1983. If the Department is presented with clear and convincing evidence that a part of its mapped habitat lacks the physical characteristics necessary for supporting or continuing to support the documented submerged vegetation species, such a site would be excluded from the habitat definition.

(b) Development in submerged vegetation habitat is prohibited except for the following:

1. Trenching for utility pipelines and submarine cables in the public interest, provided there is no practicable or feasible alternative alignment, the impact area is minimized and that, following pipeline or cable installation, the disturbed area is restored to its preconstruction contours and conditions. This may include subsequent monitoring and replanting of the disturbed area if these species have not recolonized the disturbed area within three years. The use of directional drilling techniques for utility installations is strongly encouraged, rather than the use of trenching;

2. New dredging of navigation channels maintained by the State or Federal government provided that there is no practicable or feasible alternative to avoid the vegetation; and that impacts to the habitat area (for example dredging width, length and depth) are minimized to the maximum extent practicable. Mitigation will be required for destruction of one acre or more which posses submerged aquatic vegetation;

3. Maintenance dredging as defined at N.J.A.C. 7:7E-4.6, of previously authorized, existing navigation channels maintained by the State or Federal government and associated disposal areas provided that there is no practicable or feasible alternative to avoid the vegetation and that impacts to the habitat area are minimized to the maximum extent practicable;

4. New and maintenance dredging as defined at N.J.A.C. 7:7E-4.6 and 4.7, of previously authorized operating marinas and any necessary access channels to the expanded portion of such marinas (this exception does not include the boat basin of the expanded portion of the marina) and existing launching facilities with 25 or more

dockage, storage or trailer parking units and their associated access channels, provided the proposed areas to be dredged (such as channel length, depths and widths) are minimized to the maximum extent practicable;

5. Maintenance dredging as defined at N.J.A.C. 7:7E-4.6, to regain access to existing private docks, piers, boat ramps and mooring piles not associated with marinas that were previously dredged to an authorized channel and/or mooring depth, width and length, provided there is no practicable or feasible alternative on site that would avoid dredging in submerged vegetation habitat;

6. Construction of a single noncommercial dock or pier provided that:

i. There are no practicable or feasible alternatives to avoid impacts to submerged vegetation habitat at the site;

ii. The width of the structure will not exceed four feet, except for that portion of the structure adjacent to the mooring area, where the width and length may not exceed six and 20 feet, respectively;

iii. The pier shall have no more than two designated slips. No boats may be moored at a non-designated pier/dock area;

iv. No more than one pier shall be placed for every building lot and each building lot shall have a forty foot or greater frontage on the water. Where more than one lot has been assembled for the purpose of building, only one pier will be allowed;

v. No dredging shall be performed in conjunction with the use of the dock or pier;

vi. A minimum water depth of four feet at mean low water must be present in the area where the boats will be moored; and

vii. There is no alternative mooring area at the site that would have less impact on the submerged aquatic vegetation; and

7. The extension of existing piers or floating docks through submerged vegetation habitat to water at least four feet deep at mean low water, for the purpose of eliminating dredging or boating through submerged vegetation habitat, provided the width of the extended portion of the pier does not exceed four feet (except for the portion of the pier adjacent to the mooring area where the width shall not exceed six feet), there will be no increase in the number of boat moorings, and no dredging will be performed in conjunction with the use of the structure.

(c) Development in upland or water areas adjacent to submerged vegetation habitat or in submerged vegetation habitat which results in erosion or turbidity increases in the waters supporting submerged vegetation or prop or hull scour through use of the development is prohibited unless mitigating measures are provided.

(d) Compensation for unavoidable, permanent significant impacts to submerged vegetation habitats, when required, shall consist of the establishment of self-sustaining habitat for the appropriate species in accordance with scientifically-documented transplanting methods. Monitoring and replanting shall be carried out biannually to demonstrate persistence of the compensatory habitat for a minimum of three years. The following must be documented for any area proposed for seagrass habitat restoration: that the area previously supported seagrass but no longer does; the specific cause(s) of seagrass elimination; and that the specific condition(s) or action(s) responsible for elimination of seagrass has since ceased. Priority will be given to in-kind restoration of

seagrass habitat in as close proximity as possible to the impacted site. No compensation credit will be given for attempts to plant seagrass within unvegetated interpatch areas of existing seagrass habitat or for attempts to increase bottom coverage within existing seagrass beds (defined as an area where seagrass rhizomes overlap, or where seagrass shoots intermingle within less than one square meter).

(e) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.7 Navigation channels**

(a) Navigation channels are tidal water areas including the Atlantic Ocean, inlets, bays, rivers and tidal guts with sufficient depth to provide safe navigation. Navigation channels include all areas between the top of the channel slopes on either side. These navigation channels are often marked with buoys or stakes. Major navigation channels are shown on NOAA/National Ocean Service Charts.

(b) Standards relevant to navigation channels are as follows:

1. Development which would cause terrestrial soil and shoreline erosion and siltation in navigation channels shall utilize appropriate mitigation measures.
2. Development which would result in loss of navigability is prohibited.
3. Any construction which would extend into a navigation channel is prohibited.
4. The placement of structures within 50 feet of any authorized navigation channel is discouraged, unless it can be demonstrated that the proposed structure will not hinder navigation.

(c) Rationale See note at the beginning of this Chapter.

### **7:7E-3.8 Canals**

(a) Canals are navigation channels for boat traffic through land areas which are created by cutting and dredging or other human construction technique sometimes enlarging existing natural surface water channels. The Cape May, Point Pleasant, and Delaware and Raritan Canals are the principal examples in the New Jersey Coastal zone.

(b) In canals presently used for navigation, any use that would interfere with existing or proposed canal boat traffic is prohibited.

(c) In the Delaware and Raritan Canal, and in the surrounding Review Zone established by the Delaware and Raritan Canal Commission, development must be consistent with the rules and regulations of the Review Zone of the Delaware and Raritan Canal State Park (N.J.A.C. 7:45).

(d) Rationale: See note at the beginning of this Chapter.

### **7:7E-3.9 Inlets**

(a) Inlets are natural channels through barrier islands allowing movement of fresh and salt water between the ocean and the back bay system. Inlets naturally have delta fans of sediment seaward and landward, deposited by the ebb and flow of the tide.

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1. The seaward limit of an inlet is defined as the seaward extent of the ebb delta fan. The landward limit is defined as the inland extent of the flood delta fan.

2. If there is doubt about the extent of these fans, the applicant shall submit up-to-date bathymetric surveys and Department staff will determine the boundary on a case-by-case basis.

(b) Development in inlets shall comply with the following:

1. Filling is prohibited; and
2. Submerged infrastructure is discouraged.

(c) Rationale: See note at the beginning of this Chapter.

#### **7:7E-3.10 Marina moorings**

(a) Marina moorings are areas of water that provide mooring, docking and boat maneuvering room as well as access to land and navigational channels for five or more recreational boats.

(b) Non-water dependent development in a marina mooring area is prohibited.

(c) Any use that would detract from existing or proposed recreational boating use in marina mooring areas is discouraged.

(d) Rationale: See note at the beginning of this subchapter.

#### **7:7E-3.11 Ports**

(a) Ports are water areas having, or lying immediately adjacent to, concentrations of shoreside marine terminals and transfer facilities for the movement of waterborne cargo (including fluids), and including facilities for loading, unloading and temporary storage.

1. Port locations in New Jersey include, among others, Newark, Elizabeth, Bayonne, Jersey City, Weehawken, Hoboken, Woodbridge, Perth Amboy, Camden, Gloucester City, Paulsboro and Salem.

2. Standards for a docking facility or concentration of docks for a single industrial or manufacturing facility are found at N.J.A.C. 7:7E-4.4, Docks and piers for cargo and commercial fisheries.

(b) Any use which would preempt or interfere with port uses of this water area is prohibited.

(c) Aquaculture and dumping of solid waste or semi-solid waste is prohibited.

(d) Boat ramps for recreational boating are conditionally acceptable provided the ramp complies with all Special Areas Rules (N.J.A.C. 7:7E-3) and provided it does not interfere with the port use.

(e) Docks and piers for cargo movements are encouraged.

(f) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.12 Submerged infrastructure routes**

(a) A submerged infrastructure route is the corridor in which a pipe or cable runs on or below a submerged land surface.

(b) Any activity which would increase the likelihood of infrastructure damage or breakage, or interfere with maintenance operations is prohibited.

(c) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.13 Shipwreck and artificial reef habitats**

(a) The shipwreck and artificial reef habitats special area includes all permanently submerged or abandoned remains of vessels, and other structures including but not limited to, artificial reefs, anchors, quarry rocks or lost cargo, which serve as a special marine habitat or are fragile historic and cultural resources. An artificial reef is a man-made imitation of a natural reef created by placing hard structures on the sea floor for the purpose of enhancing fish habitat and fish stock. In time, an artificial reef will attain many of the biological and ecological attributes of a natural reef. Artificial reefs do not include shore protection structures, pipelines and other structures not constructed for the sole purpose of fish habitat.

1. Known sites include those shown either on National Ocean Survey (N.O.S.) Charts listed at N.J.A.C. 7:7E-3.7(a), the navigation channel rule, or listed in the following publications: W. Krotee and R. Krotee, *Shipwrecks Off the New Jersey Coast* (1966), B.L. Freeman and L.A. Walford, *Angler's Guide to the United States Atlantic Coast Fish, Fishing Grounds, and Fishing Facilities* (1974); and, B. Preim, J. Carlson, B. Figley, *A Guide to Fishing and Diving New Jersey Reefs*, (2000). In addition to known sites, unidentified remains of vessels may exist within tidal waters. Shipwrecks may also be considered historic or archaeological resources pursuant to N.J.A.C. 7:7E-3.36.

2. Shipwreck and artificial reef habitats may be subject to the marine fish and fisheries rule, N.J.A.C. 7:7E-8.2.

(b) Acceptable uses of shipwreck and artificial reef habitats include finfishing, shellfishing, and scuba diving.

(c) Any use, except archeological research, which would significantly adversely affect the usefulness of this special area as a fish habitat is prohibited. Persons conducting archeological research which significantly affects the usefulness of a shipwreck for fisheries purpose shall compensate for this loss by creation of an artificial reef of equal habitat value.

(d) Rationale: See note at the beginning of this subchapter.

**7:7E-3.14 Wet borrow pits**

(a) Wet borrow pits are scattered artificially created lakes that are the results of surface mining for coastal minerals extending below groundwater level to create a

permanently flooded depression. This includes, but is not limited to, flooded sand, gravel and clay pits, and stone quarries. Where a wet borrow pit is also a wetland and/or wetlands buffer, the Wetlands rule, N.J.A.C. 7:7E-3.27, and/or Wetlands Buffers rule, N.J.A.C. 7:7E-3.28, shall apply.

(b) All proposed dredging and filling activities shall comply with any applicable Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A). In addition, such activities must receive a Water Quality Certificate pursuant to N.J.S.A. 58:10A et seq. and Section 401 of the Federal Clean Water Act if a Federal permit is required for the activities.

(c) Proposed uses which would promote the wildlife habitat and scenic amenity values of wet borrow pits are encouraged.

(d) Surface mining is conditionally acceptable provided condition (b) above and the Mining rule, N.J.A.C. 7:7E-7.8, are met.

(e) Recreational use of wet borrow pits is acceptable provided that wildlife habitat disturbance is minimized.

(f) Disposal of dredged material is discouraged, but may be acceptable in limited cases, provided condition (b) above is met and that:

1. The dredged material is clean and non-toxic, an appropriate particle size for the site, and will not disturb groundwater flow or quality;
2. At least half of the water area in existence at the time of the first coastal permit application for filling of the pit remains as surface water in a pattern designed to maximize wildlife habitat value and create wetland areas, except that the entire lake may be filled if necessary to prevent the lake from acting as a channel for salt water intrusion into aquifers.

(g) Filling of wet borrow pits for construction is conditionally acceptable provided that:

1. The fill is clean and will not degrade groundwater quality;
2. At least half of the water area in existence at the time of the first coastal permit application for filling of the pit is left as open water;
3. Land-water edges are maximized and vegetated to promote native wildlife;
4. A water quality buffer zone of at least 50 feet is designated in accordance with (j) below around remaining water areas;
5. A program for water quality monitoring and maintenance is included with the application; and
6. Recreational uses in water and water quality buffer areas minimize wildlife disturbance.

(h) Discharge of liquid or solid waste, other than clean dredge fill of acceptable particle size, is prohibited.

(i) All proposed uses directly adjacent to wet borrow pits shall grade all banks at the immediate water's edge, except those in acceptable water access areas, to a slope not greater than 33 percent, and shall stabilize the surface and initiate succession of native vegetation adapted to water's edge conditions.

(j) A water quality buffer area is required around the perimeter of wet borrow pits. The minimum width of this buffer area will be 100 feet where soils are coarse (sands and gravels) and 50 feet elsewhere. Recreational use of the water quality buffer is acceptable provided that the disturbance is limited in extent and wildlife habitat disturbance is minimized. The remainder of the buffer area shall be allowed to succeed naturally to water's edge. Structures and paving, except at limited water access points for recreational use, are prohibited in the water quality buffer.

(k) Rationale: See note at the beginning of this Chapter.

### **7:7E-3.15 Intertidal and subtidal shallows**

(a) Intertidal and subtidal shallows means all permanently or temporarily submerged areas from the spring high water line to a depth of four feet below mean low water.

(b) Development, filling, new dredging or other disturbance is discouraged but may be permitted in accordance with (c), (d), (e), and (f) below and with N.J.A.C. 7:7E-4.2 through 4.22.

(c) Maintenance dredging of intertidal and subtidal shallows is acceptable to maintain adequate water depths in accordance with N.J.A.C. 7:7E-4.6.

(d) New dredging in intertidal and subtidal shallows is discouraged, unless it complies with the following conditions:

1. There is a need for the proposed facility that requires the dredging that cannot be met by other similar facilities in reasonable proximity taking into account scope and purpose of the proposed facility;

2. There is no feasible alternative location for the proposed facility that requires the dredging, which would eliminate or reduce the amount of disturbance to intertidal and subtidal shallows without increasing impacts on other Special Areas; and

3. The proposed dredging and the facility that requires the dredging have been designed to minimize impacts to intertidal and subtidal shallows.

(e) The installation of submerged infrastructure within intertidal and subtidal shallows is conditionally acceptable, provided:

1. Directional drilling is used unless it can be demonstrated that the use of directional drilling is not feasible;

2. Where directional drilling is not feasible, there is no feasible alternative route that would not disturb intertidal and subtidal shallows;

3. The infrastructure is located deeply enough to avoid exposure or hazard; and

4. All trenches are backfilled to the preconstruction depth with naturally occurring sediment.

(f) The filling of intertidal and subtidal shallows for beach nourishment is conditionally acceptable provided it meets the requirements of the Filling rule at N.J.A.C. 7:7E-4.10(f) and the Coastal Engineering rule at N.J.A.C. 7:7E-7.11(d).

(g) Mitigation shall be required for the destruction of intertidal and subtidal shallows in accordance with (h) below. Mitigation proposals shall comply with the standards of N.J.A.C. 7:7E-3B. Mitigation shall not be required for the following:

1. Filling in accordance with N.J.A.C. 7:7E-4.10(c) and (e)1,2 and 3;
2. Maintenance dredging in accordance with N.J.A.C. 7:7E-4.6;
3. Beach nourishment in accordance with N.J.A.C. 7:7E-7.11(d);
4. New Dredging in accordance with N.J.A.C. 7:7E-4.7 to a depth not to exceed four feet below mean low water; and
5. Construction of a replacement bulkhead in accordance with N.J.A.C. 7:7E-7.11(e)2i or ii.

(h) Mitigation shall be required for the destruction of intertidal and subtidal shallows at a creation to lost ratio of 1:1 through the creation of intertidal and subtidal shallows on the site of the destruction. For the purposes of this section, creation means excavating upland to establish the characteristics, habitat and functions of an intertidal and subtidal shallow. Where on-site creation is not feasible, mitigation shall be accomplished as follows:

1. At a single family home or duplex property that is not part of a larger development, mitigation shall be in the form of a monetary contribution to the Wetlands Mitigation Fund. The monetary contribution shall be in the amount of the value of the land filled and the cost of creation of intertidal subtidal shallows of equal ecological value to those which are being lost; or
2. At a property other than a single family home or duplex property mitigation shall be performed in accordance with the following hierarchy:
  - i. If on site creation of intertidal and subtidal shallows is not feasible, then mitigation shall be required at a creation to loss ratio of 1:1 through the creation of intertidal and subtidal shallows within the same 11-digit hydrologic unit code area, as defined at N.J.A.C. 7:7E-1.8, as the destruction;
  - ii. If on site creation of intertidal and subtidal shallows is not feasible in accordance with (h)2i above, then mitigation shall be required at a creation to loss ratio of 1:1 through the creation of intertidal and subtidal shallows within an adjacent 11-digit hydrologic unit code area within the same watershed management area, as defined at N.J.A.C. 7:7E-1.8, as the destruction. An adjacent 11-digit hydrologic unit code area is one which shares a common boundary at any point on the perimeter of the 11-digit hydrologic unit code area where the destruction is located;
  - iii. If the creation of intertidal and subtidal shallows required in (h)2ii is not feasible, then mitigation shall be required at an enhancement to loss ratio of 2:1 through the enhancement of a wetland system which was previously more ecologically valuable but has become degraded due to factors such as siltation, impaired tidal circulation, or contamination with hazardous substances (degraded wetland system) on the site of the destruction. For the purposes of this section, enhancement means actions performed to

improve the characteristics, habitat and functions of an existing degraded wetland;

iv. If the enhancement of degraded wetlands required in (h)2iii above is not feasible, then mitigation shall be required at an enhancement to loss ratio of 2:1 through the enhancement of a degraded wetland system within the same 11-digit hydrologic unit code area as the destruction;

v. If the enhancement of degraded wetlands required in (h)2iv above is not feasible, then mitigation shall be required at an enhancement to loss ratio of 2:1 through the enhancement of a degraded wetland system within an adjacent 11-digit hydrologic unit code area within the same watershed management area as the destruction. An adjacent 11-digit hydrologic unit code area is one which shares a common boundary at any point on the perimeter of the 11-digit hydrologic unit code where the destruction is located;

iv. If the enhancement of degraded wetlands required in (h)2v above is not feasible, then mitigation shall be required in accordance with either of the following:

(1) Creation of intertidal and subtidal shallows at a creation to lost ratio of 1:1 within the same watershed management area; or

(2) Enhancement of degraded wetlands at an enhancement to loss ratio of 2:1 within the same watershed management area.

(i) Rationale: See note at the beginning of this chapter.

### **7:7E-3.16 Dunes**

(a) A dune is a wind or wave deposited or man-made formation of sand (mound or ridge), that lies generally parallel to, and landward of, the beach and the foot of the most inland dune slope. "Dune" includes the foredune, secondary or tertiary dune ridges and mounds, and all landward dune ridges and mounds, as well as man-made dunes, where they exist (see Appendix, Figure 1, incorporated herein by reference).

1. Formation of sand immediately adjacent to beaches that are stabilized by retaining structures, and/or snow fences, planted vegetation, and other measures are considered to be dunes regardless of the degree of modification of the dune by wind or wave action or disturbance by development.

2. A small mound of loose, windblown sand found in a street or on a part of a structure as a result of storm activity is not considered to be a "dune."

(b) Development is prohibited on dunes, except for development that has no practicable or feasible alternative in an area other than a dune, and that will not cause significant adverse long-term impacts on the natural functioning of the beach and dune system, either individually or in combination with other existing or proposed structures, land disturbances or activities. In addition, the removal of vegetation from any dune, and the excavation, bulldozing or alteration of dunes is prohibited, unless these activities are a component of a Department approved beach and dune management plan. Examples of acceptable activities are:

1. Demolition and removal of paving and structures;

2. Limited, designated access ways for pedestrian and authorized motor vehicles between public streets and the beach that provide for minimum feasible interference with the beach and dune system and are oriented so as to provide the minimum feasible threat

of breaching or overtopping as a result of a storm surge or wave runup (see N.J.A.C. 7:7E-3A);

3. Limited stairs, walkways, pathways, and boardwalks to permit access across dunes to beaches, in accordance with N.J.A.C. 7:7E-3A, provided they cause minimum feasible interference with the beach and dune system;

4. The planting of native vegetation to stabilize dunes in accordance with N.J.A.C. 7:7E-3A;

5. Sand fencing, either a brush type barricade or picket type, to accumulate sand and aid in dune formation in accordance with N.J.A.C. 7:7E-3A;

6. Shore protection structures which meet the Coastal Engineering rule at N.J.A.C. 7:7E-7.11(e); and

7. Linear development which meets the Rule on Location of Linear Development (N.J.A.C. 7:7E-6.1).

(c) The creation of dunes for the purpose of shore protection is strongly encouraged. According to the National Flood Insurance Program (NFIP) Regulations established by the Federal Emergency Management Agency (FEMA), primary frontal dunes will not be considered as effective barriers to base flood storm surges and associated wave action where the cross-sectional area of the primary frontal dune, as measured perpendicular to the shoreline and above the 100-year stillwater flood elevation and seaward of the dune crest, is equal to or less than 1,100 square feet. This standard represents the minimal dune volume to be considered effective in providing protection from the 100-year storm surge and associated wave action, and should represent a "design dune" goal.

(d) Rationale: See note at the beginning of this Chapter.

### **7:7E-3.17 Overwash areas**

(a) An overwash area is an area subject to accumulation of sediment, usually sand, that is deposited landward of the beach or dune by the rush of water over the crest of the beach berm, a dune or a structure. An overwash area may, through stabilization and vegetation, become a dune (see Appendix, Figure 1).

1. The seaward limit of the overwash area is the seaward toe of the former dune, or the landward limit of the beach, in the absence of a dune.

2. The landward limit of the overwash area is the inland limit of sediment transport.

3. Verifiable aerial photography and other appropriate sources may be used to identify the extent of overwash.

(b) Development is prohibited on overwash areas, except for development that has no prudent or feasible alternative in an area other than an overwash area, and that will not cause significant adverse long-term impacts on the natural functioning of the beach and dune system, either individually or in combination with other existing or proposed structures, land disturbances or activities. Examples of acceptable activities are:

1. Creation of dunes or expansion of existing dunes in accordance with N.J.A.C. 7:7E-3A;

2. Demolition and removal of paving and structures;

3. Limited, designated access ways for pedestrians and authorized motor vehicles between public streets and the beach that provide for the minimum feasible interference with the beach and dune system and are so oriented as to provide the minimum feasible threat of breaching or overtopping as a result of storm surge or wave runoff;

4. Shore protection structures which meet the Coastal Engineering rule at N.J.A.C. 7:7E-7.11(e);

5. Linear development which meets the Rule on Location of Linear Development (N.J.A.C. 7:7E-6.1);

6. Removal of newly deposited overwash fans from public roads and or developed lots; and

7. Construction of street-end beach accessways along the oceanfront, provided they are oriented at an angle against the predominant northeast storm approach, are limited in width to no more than ten feet, and are defined/stabilized with sand fencing. These standards should be included in all beach and dune management plans for oceanfront locations.

(c) A development may be permitted if, by creating a dune with buffer zone or expanding an existing dune landward, the classification of the site is changed so as to significantly diminish the possibility of future overwash. In determining overwash potential, the protective capacity of newly created dunes will be evaluated in terms of the "design dune" goal discussed in N.J.A.C. 7:7E-3.16(c).

(d) A single story, beach/tourism oriented commercial development located within a commercial boardwalk area existing on July 19, 1993 is conditionally acceptable provided that it meets the following conditions:

1. The site is located within an area currently used and zoned for beach related commercial use, and is landward of the boardwalk;

2. The height of the building does not exceed 15 feet measured from either the elevation of the existing ground or the boardwalk (depending on the specific site conditions) to the top of a flat roof or the mid-point of a sloped roof;

3. The facility is open to the general public and supports beach/tourism related activities, that is, retail, amusement and food services. Lodging facilities are excluded; and

4. The facility meets all the requirements of the Flood Hazard Area Rule, N.J.A.C. 7:7E-3.25.

(e) Any development determined to be acceptable at (b) through (d) above shall comply with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and 5B.

(f) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.18 Coastal high hazard areas**

(a) Coastal high hazard areas are flood prone areas subject to high velocity waters (V zones) as delineated on the Flood Insurance Rate Maps (FIRM) prepared by the Federal Emergency Management Agency (FEMA), and areas within 25 feet of oceanfront shore

protection structures, which are subject to wave run-up and overtopping. (see Appendix, Figure 2 incorporated herein by reference). The Coastal High Hazard Area extends from offshore to the inland limit of a primary frontal dune along an open coast and any other area subject to high velocity wave action from storms or seismic sources. The inland limit of the V zone is defined as the V zone boundary line as designated on the FIRM or the inland limit of the primary frontal dune, whichever is most landward.

(b) Residential development, including hotels and motels, is prohibited in coastal high hazard areas except for single family and duplex infill developments that meet the standards of N.J.A.C. 7:7E-7.2(e) or (f) or development in Atlantic City in accordance with (g) below.

(c) In general, commercial development is discouraged in coastal high hazard areas.

(d) Beach use related commercial development in coastal high hazard areas is conditionally acceptable within areas that are already densely developed, provided that:

1. The site is landward of the boardwalk;
2. The height of the building does not exceed 15 feet measured from either the elevation of the existing ground or the boardwalk (depending on the specific site conditions) to the top of a flat roof or the mid-point of a sloped roof;
3. The facility is open to the general public and supports beach/tourism related activities, that is, retail, amusement and food services. Lodging facilities are excluded; and
4. The facility complies with all the requirements at N.J.A.C. 7:7E-3.25, Flood hazard areas.

(e) Any development determined to be acceptable at (c) and (d) above shall comply with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and either N.J.A.C. 7:7E-5A or 5B.

(f) All permanent structures shall be set back a minimum of 25 feet from oceanfront shore protection structures, typically including bulkheads, revetments and seawalls and occasionally jetties and groins if constructed at inlets. This condition is applicable only to shore protection structures that are of sufficient height and strength to provide resistance to storm waves. This condition does not apply to development in accordance with (g) below.

(g) The following development in Atlantic City is acceptable in Coastal High Hazard Areas provided it meets the standards of N.J.A.C. 7:7E-3.49:

1. Development on or over existing ocean piers;
2. Pilings necessary to support development proposed on or over existing ocean piers; and
3. Development on or over the Boardwalk.

(h) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.19 Erosion Hazard Areas**

(a) Erosion hazard areas are shoreline areas that are eroding and/or have a history of erosion, causing them to be highly susceptible to further erosion, and damage from storms.

1. Erosion hazard areas may be identified by any one of the following characteristics:

- i. Lack of beaches;
- ii. Lack of beaches at high tide;
- iii. Narrow beaches;
- iv. High beach mobility;
- v. Foreshore extended under boardwalk;
- vi. Low dunes or no dunes;
- vii. Escarped foredune;
- viii. Steep beach slopes;
- ix. Cluffed bluffs as adjacent to beach;
- x. Exposed, damaged or breached jetties, groins, bulkheads or seawalls;
- xi. High long-term erosion rates; or
- xii. Pronounced downdrift effects of groins (jetties).

2. Erosion hazard areas extend inland from the edge of a stabilized upland area to the limit of the area likely to be eroded in 30 years for one to four unit dwelling structures, and 60 years for all other structures, including developed and undeveloped areas. This distance is measured from the crest of a bluff for coastal bluff areas, the most seaward established dune crest for unvegetated dune areas, the first vegetation line from the water for established vegetated dune areas, and the landward edge of a beach or the eight foot North American Datum (NAD), 1983, contour line, whichever is farther inland, for non-dune areas.

i. An established, unvegetated dune is a dune that has been in place for at least two winter seasons, or has been constructed with the approval of the Department.

ii. An established vegetated dune is a dune with an existing vegetative cover which has been growing on site for at least two growing seasons.

3. The extent of an erosion hazard area is calculated by multiplying the projected annual erosion rate at a site by 30 for the development of one to four unit dwelling structures and by 60 for all other developments.

(b) Development is prohibited in erosion hazard areas, except for:

1. Linear development which meets the Rule on Location of Linear Development (N.J.A.C. 7:7E-6.1);

2. Shore protection activities which meet the appropriate Coastal Engineering Use Rule (N.J.A.C. 7:7E-7.11);

3. Single story, beach/tourism oriented commercial development located within a commercial boardwalk area existing on July 19, 1993 is conditionally acceptable provided that it meets the following conditions:

i. The site is located within an area currently used and zoned for beach related commercial use, and is landward of and adjacent to the boardwalk;

ii. The height of the building does not exceed 15 feet measured from either the elevation of the existing ground or the boardwalk (depending on the specific site conditions) to the top of a flat roof or the mid-point of a sloped roof;

iii. The facility is open to the general public and supports beach/tourism related recreational activities, that is, retail, amusement and food services. Lodging facilities are excluded;

iv. The facility meets all the requirements of the Flood Hazard Areas rule (N.J.A.C. 7:7E-3.25); and

v. The development complies with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and 5B;

4. Single family and duplex developments that meet the standards of N.J.A.C. 7:7E-7.2(e) or (f);

5. The construction of dune walkover structures and at-grade walkover pathways, in accordance with Department standards found at N.J.A.C. 7:7E-3A;

6. Dune creation and beach maintenance activities in accordance with Department standards found at N.J.A.C. 7:7E-3A; and

7. The following development in Atlantic City provided it meets the standards of N.J.A.C. 7:7E-3.49:

i. Development on or over existing ocean piers;

ii. Pilings necessary to support development proposed on or over existing ocean piers; and

iii. Development on or over the Boardwalk.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.20 Barrier island corridor**

(a) Barrier island corridors are the interior portions of oceanfront barrier islands, spits and peninsulas. Along the New Jersey Coast, headlands are located between Monmouth Beach, Monmouth County and Pt. Pleasant Beach, Ocean County.

1. The oceanfront barrier island corridor encompasses that portion of barrier islands, spits and peninsulas (narrow land areas surrounded by both bay and ocean waters and connected to the mainland) that lies upland of wetlands, beach and dune systems, filled water's edges, and existing lagoon edges. Barrier island corridor does not include the headlands of northern Ocean County, Monmouth County, and the southern tip of Cape May County, which are part of the mainland.

(b) New or expanded development within the oceanfront barrier island corridor is conditionally acceptable provided that the development complies with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and 5B.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.21 Bay islands**

(a) Bay islands are islands or filled areas surrounded by tidal waters, wetlands, beaches or dunes, lying between the mainland and barrier island. Such islands may be connected to the mainland or barrier island by elevated or fill supported roads (see Appendix, Figure 3, incorporated herein by reference). Existing lagoon edges (N.J.A.C. 7:7E-3.24) are not bay islands.

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1. In cases where a bay island is also a Filled Water's Edge (N.J.A.C. 7:7E-3.23), the more restrictive provisions of the two rules shall apply.

2. For the purposes of this chapter, the areas listed below are not considered bay islands. The impervious cover limits for these areas are determined under the Special Area rules at N.J.A.C. 7:7E-3 where applicable, and/or under N.J.A.C. 7:7E-5B.

#### OCEAN COUNTY

Bonnett Island, Stafford Township  
Chadwick Island, Dover Township  
Channel Island, Mantoloking Borough  
Osborne Island, Little Egg Harbor Township  
Pelican Island, Dover/Berkeley Townships  
West Point Island, Lavallette Borough

#### ATLANTIC COUNTY

Chelsea Heights, Atlantic City  
Venice Heights, Atlantic City  
Ventnor Heights, Ventnor City

#### CAPE MAY COUNTY

Princeton Harbor, Avalon Borough  
West Wildwood, Wildwood City  
West 17th Street, Ocean City

(b) On bay islands which abut either a paved public road or a conveyance component of an offsite treatment, conveyance and disposal system with adequate capacity to convey, treat and dispose of the sewage generated from the proposed development, or which abut neither a paved public road nor such a conveyance, non-water dependent development is prohibited unless it meets the standards of (d) below and water dependent development is discouraged. Water dependent development is conditionally acceptable provided that:

1. Impervious cover does not exceed three percent of the bay island portion of the site (except pursuant to (d) below);

2. For a bay island portion of a site that is forested as determined at N.J.A.C. 7:7E-5.5, at least 30 percent of the existing forest shall be preserved in accordance with N.J.A.C. 7:7E-5.4(d), and the remainder shall be planted with herb/shrub vegetation that is adapted to the substrate and other environmental conditions of the site; and

3. For a bay island portion of a site that is unforested as determined at N.J.A.C. 7:7E-5.5, at least five percent of the bay island portion shall be planted with trees in accordance with N.J.A.C. 7:7E-5.4(d) and (e), and the remainder shall be planted with herb/shrub vegetation that is adapted to the substrate and other environmental conditions of the site.

(c) On bay islands which abut a paved public road and abut the conveyance component of an offsite treatment, conveyance and disposal system with adequate

capacity to convey, treat and dispose of the sewage generated from the proposed development, development is conditionally acceptable as follows:

1. Water dependent development is conditionally acceptable, provided that:

i. Impervious cover does not exceed 30 percent of the bay island portion of the site (except pursuant to (d) below);

ii. For a bay island portion of a site that is forested as determined at N.J.A.C. 7:7E-5.5, at least 30 percent of the existing forest shall be preserved in accordance with N.J.A.C. 7:7E-5.4(d), and the remainder shall be planted with herb/shrub vegetation that is adapted to the substrate and other environmental conditions of the site; and

iii. For a bay island portion of a site that is unforested as determined at N.J.A.C. 7:7E-5.5, at least five percent of the bay island portion shall be planted with trees in accordance with N.J.A.C. 7:7E-5.4(d) and (e), and the remainder shall be planted with herb/shrub vegetation that is adapted to the substrate and other environmental conditions of the site; and

2. Non-water dependent development is conditionally acceptable provided that:

i. Impervious cover does not exceed three percent of the bay island portion of the site (except pursuant to (d) below);

ii. For a bay island portion of a site that is forested as determined at N.J.A.C. 7:7E-5.5, at least 30 percent of the existing forest shall be preserved in accordance with N.J.A.C. 7:7E-5.4(d), and the remainder shall be planted with herb/shrub vegetation that is adapted to the substrate and other environmental conditions of the site; and

iii. For a bay island portion of a site that is unforested as determined at N.J.A.C. 7:7E-5.5, at least five percent of the bay island portion shall be planted with trees in accordance with N.J.A.C. 7:7E-5.4(d) and (e), and the remainder shall be planted with herb/shrub vegetation that is adapted to the substrate and other environmental conditions of the site.

3. Impervious cover shall not exceed three percent of the bay island portion of the site unless the development is entirely water dependent and meets (d)1 above, in which case the impervious cover limit shall not exceed 30 percent.

(d) Redevelopment or modification within an existing development on a bay island is conditionally acceptable provided that;

1. The construction of buildings and/or concrete asphalt pavement is located on the area covered by buildings and/or asphalt or concrete pavement legally existing on the site at the time the application is submitted to the Department and does not exceed the existing development as to any one of the following:

i. Number of units; or

ii. Square footage of interior floor space; and

2. Trees shall be planted and/or preserved on at least five percent of the bay island portion of the site in accordance with N.J.A.C. 7:7E-5.4(d) and (e).

### **7:7E-3.22 Beaches**

(a) Beaches are gently sloping areas of sand or other unconsolidated material, found on all tidal shorelines, including ocean, bay and river shorelines (see Appendix, Figure 1), that extend landward from the mean high water line to either:

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1. A man-made feature generally parallel to the ocean, inlet, or bay waters such as a retaining structure, seawall, bulkhead, road or boardwalk, except the sandy areas that extend fully under and landward of an elevated boardwalk are considered beach areas; or
2. The seaward or bayward foot of dunes, whichever is closest to the bay, inlet or ocean waters.

(b) Development is prohibited on beaches, except for development that has no prudent or feasible alternative in an area other than a beach, and that will not cause significant adverse long-term impacts to the natural functioning of the beach and dune system, either individually or in combination with other existing or proposed structures, land disturbances or activities. Examples of acceptable activities are:

1. Demolition and removal of paving and structures;
2. Dune creation and related sand fencing and planting of vegetation for dune stabilization, in accordance with N.J.A.C. 7:7E-3A;
3. The reconstruction of existing amusement and fishing piers and boardwalks;
4. Temporary recreation structures for public safety such as first aid and lifeguard stations;
5. Shore protection structures which meet the use conditions of N.J.A.C. 7:7E-7.11(e);
6. Linear development which meets the Rule on Location of Linear Development (N.J.A.C. 7:7E-6.1);
7. Beach maintenance activities which do not adversely affect the natural functioning of the beach and dune system, and which do not preclude the development of a stable dune along the back beach area. These activities include routine cleaning, debris removal, mechanical sifting, maintenance of access ways and Department approved dune creation and maintenance activities;
8. Post-storm beach restoration activities involving the placement of clean fill material on beaches, and the mechanical redistribution of sand along the beach profile from the lower to the upper beach. These post-storm activities, which are different than routine beach maintenance activities, must be carried out in accordance with the standards found at N.J.A.C. 7:7E-3A; and
9. The following development in Atlantic City provided it meets the standards of N.J.A.C. 7:7E-3.49:
  - i. Development on or over existing ocean piers;
  - ii. Pilings necessary to support development proposed on or over existing ocean piers; and
  - iii. Development on or over the Boardwalk.

(c) Public access shall be provided in accordance with the lands and waters subject to public trust rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11.

(d) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.23 Filled water's edge**

(a) Filled water's edge areas are existing filled areas lying between wetlands or water areas, and either the upland limit of fill, or the first paved public road or railroad

landward of the adjacent water area, whichever is closer to the water. Some existing or former dredged material disposal sites and excavation fill areas are filled water's edge (see Appendix, Figure 4, incorporated herein by reference).

(b) The "waterfront portion" is defined as a contiguous area at least equal in size to the area within 100 feet of navigable water, measured from the Mean High Water Line (MHWL). This contiguous area must be accessible to a public road and occupy at least 30 percent of its perimeter along the navigable water's edge.

(c) On filled water's edge sites with direct water access (that is, those sites without extensive inter-tidal shallows or wetlands between the upland and navigable water), development shall comply with the following:

1. The waterfront portion of the site shall be:

i. Developed with a water dependent use, as defined at N.J.A.C. 7:7E-1.8;

ii. Developed with an at-grade deck provided:

(1) The deck is open to the general public;

(2) The use of the deck is water oriented;

(3) The deck is not enclosed; and

(4) A public walkway is provided around the deck landward of the mean high water line at the water's edge; or

iii. Left undeveloped for future water dependent uses;

2. On the remaining non-waterfront portion of the site, provision of additional area devoted to water dependent or water-oriented uses may be required as a special case at locations which offer a particularly appropriate combination of natural features and opportunity for waterborne commerce and recreational boating; and

3. On large filled water's edge sites, of about 10 acres or more upland acres, where water-dependent and water-oriented uses can co-exist with other types of development, a greater mix of land uses may be acceptable or even desirable. In these cases, a reduced waterfront portion, that is, less than that provided by a 100 foot setback, may be acceptable provided that non-water related uses do not adversely affect either access to or use of the waterfront portion of the site.

(d) On filled water's edge sites without direct access to navigable water, the area to be devoted to water related uses will be determined on a case-by-case basis.

(e) On filled water's edge sites with an existing or pre-existing water dependent use, that is, one existing at any time since July of 1977, development must comply with the following additional conditions:

1. For sites with an existing or pre-existing marina, development that would reduce the area currently or recently devoted to the marina is acceptable if:

i. For every two housing units proposed on the filled water's edge the existing number of boat slips in the marina mooring area (N.J.A.C. 7:7E-3.10) is increased by one and at least 75 percent of the total number of slips (existing and new) remain open to the general public. Removal of upland to create slips is acceptable;

ii. Marina services are expanded in capacity and upgraded (that is, modernized) to the maximum extent practicable; and

iii. In-water or off site boat storage capability is demonstrated or upland storage is provided to accommodate at least 75 percent of the marina's boats, as determined by maximum slip capacity, 26 feet in length and longer, and 25 percent of the marina's boats less than 26 feet in length.

2. For sites with an existing or pre-existing water dependent use other than a marina, development that would reduce or adversely affect the area currently or recently devoted to the water dependent use is discouraged.

(f) In waterfront areas located outside of the CAFRA zone the water dependent use may be a public walkway, provided the upland walkway right-of-way is at least 30 feet wide, unless there are existing onsite physical constraints which cannot be removed or altered to meet this requirement.

(g) The development shall comply with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and either N.J.A.C. 7:7E-5A or 5B.

(h) Along the Hudson River and in other portions of the Northern Waterfront and Delaware River Region, where water dependent uses are deemed infeasible, some part of the waterfront portion of the site may be acceptable for non-water dependent development under the following conditions:

1. The development proposal addresses, as a minimum, past use of the site as well as potential for future water dependent, commercial, transportation, recreation, and compatible maritime support services uses;
2. The developed land uses closest to the water's edge are water oriented;
3. Currently active maritime port and industrial land uses are preserved;
4. Adverse impacts on local residents and neighborhoods are mitigated to the maximum extent practicable; and
5. All other coastal rules are met.

(i) On all filled water's edge sites, development must comply with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11.

(j) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.24 Existing lagoon edges**

(a) Existing lagoon edges are defined as existing man-made land areas resulting from the dredging and filling of wetlands, bay bottom and other estuarine water areas for the purpose of creating waterfront lots along lagoons for residential and commercial development.

1. Existing Lagoon Edges extend upland to the limit of fill, or the first paved public road or railroad generally parallel to the water area, whichever is less.

(b) Development of existing lagoon edges is acceptable provided:

1. The proposed development is compatible with existing adjacent land and water uses;
2. Existing retaining structures are adequate to protect the proposed development;
3. New or reconstructed retaining structures are consistent with the filling rule at N.J.A.C. 7:7E-4.10 and structural shore protection rule N.J.A.C. 7:7E-7.11(e); and
4. The development complies with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and either N.J.A.C. 7:7E-5A or 5B.

(c) See note at the beginning of this Chapter.

**7:7E-3.25 Flood hazard areas**

(a) Flood hazard areas are areas subject to flooding from the flood hazard area design flood, as defined by the Department under the Flood Hazard Area Control Act rules at N.J.A.C. 7:13. Flood hazard areas include those areas mapped as such by the Department, areas defined or delineated as an A or a V zone by the Federal Emergency Management Agency (FEMA), and any unmapped areas subject to flooding by the flood hazard area design flood. Flood hazard areas are subject to either tidal or fluvial flooding and the extent of flood hazard areas shall be determined or calculated in accordance with the procedures at N.J.A.C. 7:13-3. [Where flood hazard areas have been delineated by both the Department and FEMA, the Department delineations shall be used. Where flood hazard areas have not been delineated by the Department or FEMA, limits of the 100 year floodplain will be established by computation on a case-by-case basis. The seaward boundary shall be the mean high water line (see Appendix 1, Figures 6 and 7, incorporated herein by reference).

1. A complete list of streams for which the Department has delineated the flood hazard area can be found in N.J.A.C. 7:13 (Rules Governing Flood Hazard Areas).

2. The Federal Emergency Management Agency has delineated the tidal floodplain for all Coastal Zone municipalities.

3. Where portions of the flood hazard areas meet the definition of another Special Water's Edge type (Filled Water's Edge, Lagoon Edge, Beaches, Dunes, Overwash Areas, Erosion Hazard Areas, Coastal High Hazard Areas, Barrier Island Corridor, Bay Islands, Wetlands, Wetlands Buffer, Coastal Bluffs, and Intermittent Stream Corridors), the Special Water's Edge rules shall apply in terms of location acceptability and the flood hazard areas rule shall apply in terms of setback and flood proofing requirements.

(b) In a tidal flood hazard area below the mean high water line, this section shall apply only to the following activities:

1. Development of habitable buildings; and
2. Construction of railroads, roadways, bridges and/or culverts.

(c) Dedication of flood hazard areas for purposes of public open space is encouraged.

(d) In an undeveloped portion of a flood hazard area that is within 100 feet of a

navigable water body, development is prohibited unless the development is for water dependent use. "Navigable" and "water dependent" are defined at N.J.A.C. 7:7E- 1.8. For the purposes of this subsection and (d) below, an "undeveloped" area is an area that has no impervious cover.

(e) In a portion of an undeveloped flood hazard area that is 100 feet or farther from a navigable waterway, development is conditionally acceptable provided the development would not prevent potential water-dependent use in any portion of the flood hazard area within 100 feet of a navigable water body.

(f) Development in flood hazard areas shall conform with the applicable design and construction standards of the following:

1. The Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., and implementing rules at N.J.A.C. 7:13, except in lands regulated under the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq., pursuant to N.J.S.A. 58:16A-60;
2. The Uniform Construction Code, N.J.A.C. 5:23; and
3. The Federal flood reduction standards, 44 C.F.R. Part 60.

(g) Development in a flood hazard area shall comply with the requirements for impervious cover and vegetative cover under N.J.A.C. 7:7E-5 and either N.J.A.C. 7:7E-5A or 5B, as applicable.

(h) If endangered and/or threatened wildlife or species habitat is present in the flood hazard area such that the area is also an endangered or threatened wildlife or plant species habitat special area in accordance with N.J.A.C. 7:7E-3.38, then the requirements of N.J.A.C. 7:7E-3.38, Endangered or threatened wildlife or plant species habitats, shall apply.

(i) For the purposes of this section, if a term is defined in this chapter and in the Flood Hazard Area Control Act rules at N.J.A.C. 7:13, the definition in N.J.A.C. 7:13 shall govern. For any term used in this section that is not defined or otherwise described in this chapter but that is defined or described in the Flood Hazard Area Control Act rules at N.J.A.C. 7:13, the definition or description in N.J.A.C. 7:13 shall apply.

(j) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.26 Riparian Zones**

(a) A riparian zone exists along every regulated water, except there is no riparian zone along the Atlantic Ocean nor along any manmade lagoon, stormwater management basin, or oceanfront barrier island, spit or peninsula. Regulated waters are defined in the Flood Hazard Area Control Act rules at N.J.A.C. 7:13-2.2.

(b) The riparian zone includes the land and vegetation within each regulated water described in (a) above, as well as the land and vegetation within a certain distance of each regulated water as described in (c) below. The portion of the riparian zone that lies outside of a regulated water is measured landward from the top of bank. If a discernible bank is not present along a regulated water, the portion of the riparian zone outside the regulated water is measured landward as follows:

1. Along a linear fluvial or tidal water, such as a stream, the riparian zone is measured landward of the feature's centerline;
2. Along a non-linear fluvial water, such as a lake or pond, the riparian zone is measured landward of the normal water surface limit;
3. Along a non-linear tidal water, such as a bay or inlet, the riparian zone is measured landward of the mean high water; and
4. Along an amorphously-shaped feature, such as a wetland complex, through which a regulated water flows but which lacks a discernible channel, the riparian zone is measured landward of the feature's centerline.

(c) The width of the riparian zone along each regulated water described in (a) above is as follows:

1. The riparian zone is 300 feet wide along both sides of any Category One water, and all upstream tributaries situated within the same HUC-14 watershed;
2. The riparian zone is 150 feet wide along both sides of the following waters not identified in (c)1 above:
  - i. Any trout production water and all upstream waters (including tributaries);
  - ii. Any trout maintenance water and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water;
  - iii. Any segment of a water flowing through an area that contains documented habitat for a threatened or endangered species of plant or animal, which is critically dependent on the regulated water for survival, and all upstream waters (including tributaries) within one linear mile as measured along the length of the regulated water; and
  - iv. Any segment of a water flowing through an area that contains acid producing soils; and
3. The riparian zone is 50 feet wide along both sides of all waters not identified in (c)1 or (c)2 above.

(d) The riparian zones established by this chapter are separate from and in addition to any other similar zones or buffers established to protect surface waters. For example, the Stormwater Management rules at N.J.A.C. 7:8 establish 300-foot Special Water Resource Protection Areas along certain waters. Furthermore, the Freshwater Wetlands Protection Act rules at N.J.A.C. 7:7A establish 50-foot and 150-foot transition areas along freshwater wetlands and other features that are also regulated under this chapter. Compliance with the riparian zone requirements of this chapter does not constitute

compliance with the requirements imposed under any other Federal, State or local statute, regulation or ordinance.

(e) Development in riparian zones shall conform with the requirements for a flood hazard area individual permit under the Flood Hazard Area Control Act rules at N.J.A.C. 7:13-9, 10 and 11 or, in the alternative as applicable, a flood hazard area permit-by-rule at N.J.A.C. 7:13-7 or a flood hazard area general permit at N.J.A.C. 7:13-8.

(f) If endangered and/or threatened wildlife or species habitat is present in the riparian zone such that the area is also an endangered or threatened wildlife or plant species habitat special area in accordance with N.J.A.C. 7:7E-3.38, then the requirements of N.J.A.C. 7:7E-3.38, Endangered or threatened wildlife or plant species habitats, shall apply.

(g) For the purposes of this section, if a term is defined in this chapter and in the Flood Hazard Area Control Act rules at N.J.A.C. 7:13, the definition in N.J.A.C. 7:13 shall govern. For any term used in this section that is not defined or otherwise described in this chapter but that is defined or described in the Flood Hazard Area Control Act rules at N.J.A.C. 7:13, the definition or description in N.J.A.C. 7:13 shall apply.

(h) Rationale: Healthy riparian systems are essential to the natural environment. Loss of soil and plant life that occurs adjacent to regulated waters not only threatens public and private property, but directly impacts water quality and the health of fish and wildlife. The extreme importance of preserving and restoring adequate stream corridor buffers has been well documented in recent decades. Riparian zone functions include stream bank stabilization, removal of sediment, nutrients and contaminants, flood storage, wildlife habitat, aesthetics, and recreation and education.

### **7:7E-3.27 Wetlands**

(a) Wetlands or wetland means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation.

1. Wetlands areas are identified and mapped on the following:

i. National Wetlands Inventory Maps produced by the U.S. Fish and Wildlife Service at a scale of 1:24,000 (generalized locations only);

ii. Coastal wetland maps, pursuant to the Wetlands Act of 1970 (N.J.S.A. 13:9A-1 et seq.) prepared by the DEP at a scale of 1:2,400; and

iii. Freshwater wetland maps prepared by DEP at a scale of 1:12,000 (generalized locations only).

Note: Maps referenced in (a)1ii and iii above are available from the DEP Map and Publications sales office (609) 777-1038.

2. Generalized locations of some wetland types can be found in county soil surveys prepared by the U.S. Department of Agriculture, Soil Conservation Service.

3. The maps referenced under (a)1i, iii, and 2 above shall be useful as an indicator to assist in the preliminary determination of the presence or absence of wetlands only. They

have been determined to be unreliable for the purposes of locating the actual wetlands boundary on a specific site.

4. All tidal and inland wetlands, excluding the delineated tidal wetlands defined pursuant to N.J.A.C. 7:7-2.2, shall be identified and delineated in accordance with the USEPA three-parameter approach (that is, hydrology, soils and vegetation) specified under N.J.A.C. 7:7A-1.4 of the Freshwater Wetlands Protection Act Rules.

(b) Development in wetlands defined under the Freshwater Wetlands Protection Act of 1987 is prohibited unless the development is found to be acceptable under the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A).

(c) Development of all kinds in all other wetlands not defined in (b) above is prohibited unless the Department can find that the proposed development meets the following four conditions:

1. Requires water access or is water oriented as a central purpose of the basic function of the activity (this rule applies only to development proposed on or adjacent to waterways). This means that the use must be water dependent as defined in N.J.A.C. 7:7E-1.8;

1. Requires water access or is water oriented as a central purpose of the basic function of the activity (this rule applies only to development proposed on or adjacent to waterways). This means that the use must be water dependent as defined in N.J.A.C. 7:7E-1.5;

2. Has no prudent or feasible alternative on a non-wetland site;

3. Will result in minimum feasible alteration or impairment of natural tidal circulation (or natural circulation in the case of non-tidal wetlands); and

4. Will result in minimum feasible alteration or impairment of natural contour or the natural vegetation of the wetlands.

(d) In particular, dumping solid or liquid wastes and applying or storing certain pesticides on wetlands are prohibited.

(e) No action by the Commissioner shall prohibit, restrict or impair the exercise or performance of the powers and duties conferred or imposed by law on the Department of Environmental Protection, the Natural Resource Council and the State Mosquito Control Commission in said Department, the Department of Health, or any mosquito control or other project or activity operating under or authorized by the provisions of chapter 9 of Title 26 of Revised Statutes. This rule does not supersede the authority of the State Mosquito Commission to undertake mosquito control projects authorized by chapter 9 of Title 26 of the Revised Statutes.

(f) Development that adversely affects white cedar stands such as water table drawdown, surface and groundwater quality changes and the introduction of non-native plant species is prohibited.

(g) For projects which require a Waterfront Development permit, the reuse of former dredged material disposal sites for continued dredged material disposal is conditionally acceptable provided the following criteria are met:

1. The site has been used for dredged material disposal within the past 10 years;
2. The site has existing dikes or berms in sound condition, and/or has sufficient area of previously disposed material within the previously disturbed disposal area to allow the construction of structurally sound dikes and berms;
3. There are no anticipated adverse effects on threatened or endangered species;
4. There are no colonial nesting birds present on site which would be adversely affected (seasonal restrictions may be required);
5. No wetlands regulated pursuant to the Wetlands Act of 1970 would be adversely affected;
6. The former dredged material disposal area is not subject to daily tidal inundation, and the vegetation community is limited primarily to scrub/shrub or phragmites; and
7. The required Waterfront Development permit and Water Quality Certification are obtained.

(h) If an application to disturb or destroy wetlands meets the standards for permit approval, the Department will require the applicant to mitigate for the loss or degradation of the wetlands in accordance with the following:

1. Mitigation for the loss of wetlands subject to the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq., shall meet the standards of N.J.A.C. 7:7A.

2. When a permit allows the disturbance or loss of wetlands by filling or other means, this disturbance or loss shall be compensated for as specified under (h)9 below unless the applicant can prove through the use of productivity models or other similar studies, that by restoring or creating a lesser area, there will be replacement of wetlands of equal ecological value. In order to demonstrate equal ecological value, the applicant shall survey and provide written documentation regarding, at a minimum, existing soil, vegetation, water quality functions, flood storage capacity, soil erosion and sediment control functions, and wildlife habitat conditions and detail how the proposed mitigation plan will replace the ecological values of the wetland to be lost or disturbed.

3. Mitigation shall be performed prior to or concurrent with activities that will permanently disturb wetlands and immediately after activities that will temporarily disturb these habitats. A letter of credit or other financial assurance is required prior to approval of the mitigation proposal by the Department, except if the mitigator is a government agency or entity that is exempt from this requirement under Federal law. The financial assurance requirements are found at N.J.A.C. 7:7E-3B.3.

4. Where the Department permits a mitigation surface area of less than 2:1, monitoring by the permittee at a frequency determined by the Department to be appropriate on a case-by-case basis shall be required. In such cases, additional mitigation or further remedial action shall be required at a level and within the forms determined to be appropriate on a case-by-case basis by the Department when the Department determines that a net loss of equal ecological value occurs. Under no circumstances shall the mitigation area be smaller than the disturbed area. Creation of wetlands from existing natural resources protected under the applicable Special Area Rules (N.J.A.C. 7:7E-3) is

not an acceptable form of mitigation, nor is transfer of title of existing wetlands or intertidal or subtidal shallows to a government agency or conservation organization.

5. The Department will not consider a mitigation proposal in determining whether a project should be awarded a permit, but will require mitigation as a condition of any permit found to be acceptable under the criteria listed in N.J.A.C. 7:7A-3 and/or N.J.A.C. 7:7E-3.15 and 3.27.

6. As a condition of every creation or enhancement plan authorized under this subsection, an applicant shall sign a Department approved conservation restriction and register this restriction on the deed for the subject parcel. This conservation restriction will provide that no regulated activities will occur in the created or enhanced wetland area. This conservation restriction shall be approved by the Department and shall run with the land and be binding upon the applicant and the applicant's successors in interest in the premises or any part thereof. The permit will not become effective until the conservation restriction is recorded with the county clerk or Registrar of Deeds and Mortgages, if applicable. Any regulated activities undertaken on the site before a copy of the recorded conservation restriction is submitted to the Department will be considered in violation of these rules.

i. No future development will be permitted on the mitigation site unless the Department finds that the regulated activity has no practicable alternative which would:

(1) Not involve a wetland site;

(2) Involve a wetland but would have a less adverse impact on the aquatic ecosystem;

(3) Not have other significant adverse environmental consequences, that is, it shall not merely substitute other significant environmental consequences, for those attendant on the original proposal; and

(4) There is a compelling public need for the activity greater than the need to protect the mitigation site.

ii. To satisfy (h)6 above, the applicant shall provide a copy of the recorded document or a receipt showing that the conservation restriction has been recorded at the county clerk's office.

7. Except for publicly funded projects, as described at (h)7i below, any mitigation carried out off-site shall be on private property.

i. Mitigation for publicly funded projects may be carried out on public lands provided that these lands were private lands purchased by a public agency expressly for the purpose of performing mitigation.

8. Future development of the mitigation site is prohibited and as a condition of any permit which includes creation of the mitigation site, the owner shall be required to record a conservation restriction governing that site.

9. The Department distinguishes between four types of mitigation: restoration, creation, enhancement, and contribution. Depending on the circumstances under which wetlands are lost or disturbed, different types of mitigation may be required by the Department. The types of mitigation are explained below, in decreasing order of their desirability:

i. Restoration refers to actions performed on the site of a regulated activity, within six months of the commencement of the regulated activity, in order to reverse or remedy the effects of the activity on the wetland and to restore the site to preactivity condition.

(1) Restoration shall be required at a ratio of one acre created to one acre lost or disturbed. If restoration actions are performed more than six months after the commencement of the regulated activity which disturbed the wetland, these actions will no longer be considered restoration, but will be considered creation, and will be governed by the provisions of (h)9ii(3) below.

(2) If restoration actions are performed on degraded wetlands offsite, these actions will be considered enhancement and will be governed by the provisions of (h)9iii below.

ii. Creation refers to actions performed to establish wetland characteristics, habitat and functions on:

(1) A non-wetlands site; or

(2) A former wetlands site which has been filled or otherwise disturbed such that it no longer retains wetland characteristics. If the site retains wetland characteristics such that it meets the definition of a degraded wetland pursuant to N.J.A.C. 7:7A-1.4, it is not eligible for use in creation. Rather, it is only eligible for enhancement activities pursuant to (h)9iii below. If the disturbance to a formerly wetlands site is the result of a violation of the Freshwater Wetlands Protection Act and/or the Wetlands Act of 1970, the Department may, at its discretion, condition an approval of a mitigation proposal, or a permit, or both, on the resolution of the violation.

(3) Creation will be required at a ratio of two acres created to one acre lost or disturbed. Under no circumstances shall the mitigation area be smaller than the disturbed area.

(4) Creation shall not be permitted on a site that retains wetlands characteristics.

iii. Enhancement refers to actions performed to improve the characteristics, habitat and functions of an existing, degraded wetland such that the enhanced wetland will have resource values and functions similar to an undisturbed wetland. The enhancement requirement will be determined on a case-by-case basis.

iv. Contribution refers to the donation of money or land. The Department will permit the donation of land only after determining that all alternatives to the donation are not practicable or feasible, or that the permanent protection of the land will provide ecological benefits equal to or greater than those resulting from the creation of wetlands. This determination will be made in consultation with the United States Environmental Protection Agency (USEPA) for freshwater wetlands. Monies donated shall be used for the purchase of land to provide areas for wetland losses, to provide areas for restoration of degraded wetlands, and to provide areas to preserve wetlands and transition areas determined to be of critical importance, and the transfer of funds for research to enhance the practice of mitigation. If money is donated, the Department will require an amount equivalent to the lesser of the following costs:

(1) Purchasing and enhancing existing degraded wetlands, resulting in preservation of wetlands of equal ecological value to those which are being lost; or

(2) Purchase of property and the cost of creation of wetlands of equal ecological value to those which are being lost.

v. If the Department determines that land may be donated as part or all of a contribution to mitigate for the destruction of freshwater wetlands, the Wetlands Mitigation Council must first determine that the donated land has the potential to be a valuable component of the wetlands ecosystem.

10. All mitigation projects shall be carried out on-site to the maximum extent practicable. Mitigation of wetlands, on-site or off-site, from other existing climax habitats is not practicable and is discouraged.

i. If on-site mitigation is found to be impracticable, off-site mitigation shall be considered and implemented within the same watershed or estuary if feasible.

11. All mitigation proposals submitted to the Department shall be prepared in accordance with N.J.A.C. 7:7E-3B.

(i) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.28 Wetlands buffers**

(a) Wetlands buffer or transition area means an area of land adjacent to a wetland which minimizes adverse impacts on the wetlands or serves as an integral component of the wetlands ecosystem (see Appendix, Figure 7). Wider buffers than those noted below may be required to establish conformance with other Coastal Rules, including, but not limited to, 7:7E-3.38 and 3.39.

1. A wetlands buffer or transition area of up to 150 feet in width shall be established adjacent to all wetlands defined and regulated under the Freshwater Wetlands Protection Act. (Refer to the Freshwater Wetland Protection Act Rules, N.J.A.C. 7:7A, for further guidance).

2. For all other wetlands, including wetlands regulated under the Coastal Wetlands Act of 1970, a wetlands buffer of up to 300 feet shall be established.

(b) Subject to (a) above, all wetlands buffers (that is, transition area) associated with wetlands subject to the Freshwater Wetlands Protection Act shall be regulated in accordance with the Freshwater Wetlands Protection Act Rules, N.J.A.C. 7:7A.

(c) Development is prohibited in a wetlands buffer around all other wetlands, unless it can be demonstrated that the proposed development will not have a significant adverse impact and will cause minimum feasible adverse impact, through the use of mitigation where appropriate on the wetlands, and on the natural ecotone between the wetlands and surrounding upland. The precise geographic extent of the actual wetlands buffer required on a specific site shall be determined on a case-by-case basis using these standards.

(d) In areas of the coastal zone which are within the Hackensack Meadowlands District, the appropriate buffer width shall be determined in accordance with the requirements set forth in the Hackensack Meadowlands District Zoning Regulations.

### **7:7E-3.29(Reserved)**

### **7:7E-3.30(Reserved)**

### **7:7E-3.31 Coastal Bluffs**

(a) A coastal bluff is a steep slope (greater than 15 percent) of consolidated (rock) or unconsolidated (sand, gravel) sediment which is adjacent to the shoreline or which is demonstrably associated with shoreline processes.

1. The waterward limit of a coastal bluff is a point 25 feet waterward of the toe of the bluff face, or the mean high water line, whichever is nearest the toe of the bluff.

2. The landward limit of a coastal bluff is the landward limit of the area likely to be eroded within 50 years, or a point 25 feet landward of the crest of the bluff, whichever is farthest inland (see Appendix, Figures 7 and 8, incorporated herein by reference).

3. Steep slopes (N.J.A.C. 7:7E-3.34) are isolated inland areas with slopes greater than 15 percent. All steep slopes associated with shoreline processes or adjacent to the shoreline and associated wetlands, or contributing sediment to the system, will be considered coastal bluffs.

(b) Development is prohibited on coastal bluffs, except for linear development which meets the rule on the Location of Linear Development (N.J.A.C. 7:7E-6.1), shore protection activities which meet the appropriate Coastal Engineering Use rules (N.J.A.C. 7:7E-7.11), and single family homes and duplexes which are not located along the shorelines of the Atlantic Ocean, Delaware Bay, Raritan Bay or Sandy Hook Bay and comply with N.J.A.C. 7:7E-7.2(e) or (f).

(c) The stabilization of coastal bluffs with vegetation is encouraged.

(d) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.32 Intermittent stream corridors**

(a) Intermittent stream corridors are areas including and surrounding surface water drainage channels in which there is not a permanent flow of water and which contain an area or areas with a seasonal high water table equal to or less than one foot. The inland extent of these corridors is either the inland limit of soils with a seasonal high water table depth equal to, or less than one foot, or a disturbance of 25 feet measured from the top of the channel banks, whichever is greater (see Appendix, Figures 7 and 9, incorporated herein by reference).

1. Where an intermittent stream corridor is also a wetland, the Wetlands rule (N.J.A.C. 7:7E-3.27) shall apply.

(b) Uses that promote undisturbed growth of native vegetation and wildlife habitat value are encouraged.

(c) Cutting, filling, damming, detention basins for runoff recharge, paving, structures or any other activities that would directly degrade the function of intermittent stream corridors, except for linear infrastructure for which there is no feasible alternate route, is prohibited.

(d) Intermittent streams not subject to the ebb and flow of the tide shall also comply with the Freshwater Wetlands Protection Act Rules (N.J.A.C. 7:7A).

(e) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.33 Farmland conservation areas**

(a) Farmland conservation areas are defined as any contiguous area of 20 acres or more (in single or multiple tracts of single or multiple ownership) with soils in the Capability Classes I, II and III or special soils for blueberries and cranberries as mapped by the United States Department of Agriculture, Soil Conservation Service, in National Cooperative Soil Surveys, which are actively farmed, or suitable for farming, unless it can be demonstrated by the applicant that new or continued use of the site for farming or farm dependent purposes is not economically feasible. Farming or farm-dependent purposes include nurseries, orchards, vegetable and fruit farming, raising grains and seed crops, silviculture (such as Christmas tree farming), floriculture (including greenhouses), dairying, grazing, livestock raising, and wholesale and retail marketing of crops, plants, animals and other related commodities.

(b) Farmland conservation areas shall be maintained and protected for open space or farming purposes. Farming or farm-dependent uses are permitted uses in farmland conservation areas. Housing is permitted only if it is an accessory use to farming. Mining is permitted only in accordance with a reclamation plan which meets the requirements of the Mining Use rule (N.J.A.C. 7:7E-7.8).

(c) Continued, renewed, or new farming is encouraged in farmland conservation areas.

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.34 Steep slopes**

(a) Steep slopes are land areas with slopes greater than 15 percent, which are not adjacent to the shoreline and therefore not coastal bluffs (see N.J.A.C. 7:7E-3.31). Steep slopes include natural swales and ravines, as well as manmade areas, such as those created through mining for sand, gravel, or fill, or road grading. Slopes of less than 15 percent are not considered to be steep slopes.

(b) Development on steep slopes is discouraged where wetlands, wetland buffers, intermittent stream corridors, threatened and endangered species habitats, riparian zones or water areas are located adjacent to or at the base of the slope and on steep slopes which are forested as defined at N.J.A.C. 7:7E-5.5(c).

(c) Development on steep slopes other than those listed in (b) above, is conditionally acceptable provided:

1. The steep slope is vegetated with native woody vegetation to the maximum extent practicable; and
2. Stabilization measures are used, if necessary, such as terracing and paving, that are consistent with the natural or predevelopment character of the entire site, to the maximum extent practicable.

(d) Rationale: See note in the beginning of this chapter.

#### **7:7E-3.35 Dry borrow pits**

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(a) Dry borrow pits are excavations for the purpose of extracting coastal minerals which have not extended below the groundwater level. This includes, but is not limited to, dry sand, gravel and clay pits, and stone quarries.

(b) Surface mining is conditionally acceptable, provided the mining use rule at N.J.A.C. 7:7E-7.8 is satisfied.

(c) Channeling clean surface runoff into dry sand and gravel pits for the purposes of aquifer recharge is encouraged. Pavement runoff may be channeled into dry borrow pits provided that it is adequately filtered to remove pavement contaminants.

(d) Discharge of clean effluent from liquid waste treatment facilities for aquifer recharge is encouraged (e.g., tertiary sewage effluent), provided groundwater quality is monitored and maintained.

(e) Storing water in impermeable dry borrow pits is conditionally acceptable.

(f) Dredged material disposal is conditionally acceptable provided that:

1. The dredged material will not degrade groundwater quality;
2. The dredged material is of a particle size that will not disturb groundwater hydrology; and
3. Dredged material disposal is compatible with neighboring uses.

(g) Solid waste disposal is conditionally acceptable on a case-by-case basis provided that:

1. Waste disposal is compatible with neighboring uses;
2. Elevations of the landfill do not exceed original surface elevations before mining;

and

3. The waste disposal complies with the solid and hazardous waste rule at N.J.A.C. 7:7E-8.22.

(h) Filling or grading for construction is conditionally acceptable provided the fill is clean and of a texture that will not disturb local groundwater flow.

(i) All proposed uses must reduce all banks to a slope of less than one in three, stabilize them, and prepare them for planting, and initiate native successions.

(j) Rationale: See the note at the beginning of this Chapter.

### **7:7E-3.36 Historic and archaeological resources**

(a) Historic and archaeological resources include objects, structures, shipwrecks, buildings, neighborhoods, districts, and man-made or man-modified features of the landscape and seascape, including historic and prehistoric archaeological sites, which either are on or are eligible for inclusion on the New Jersey or National Register of Historic Places.

(b) Development that detracts from, encroaches upon, damages, or destroys the value of historic and archaeological resources is discouraged.

(c) Development that incorporates historic and archaeological resources in sensitive adaptive reuse is encouraged.

(d) Scientific recording and/or removal of the historic and archaeological resources or other mitigation measures must take place if the proposed development would irreversibly and/or adversely affect historic and archaeological resources. Surveys and reports to identify and evaluate historic and archaeological resources potentially eligible for the New Jersey or National Registers shall be performed by professionals who meet the National Park Service's Professional Qualifications Standards in the applicable discipline. Professional procedures and reports shall meet the applicable Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation and the New Jersey Historic Preservation Office's professional reporting and surveying guidelines, once these guidelines are promulgated as rules, in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq. A description of the qualifications and performance standards is available at the Historic Preservation Office.

(e) New development in undeveloped areas near historic and archaeological resources is conditionally acceptable, provided that the design of the proposed development is compatible with the appearance of the historic and archaeological resource. For archaeological resources within the area of the undertaking, avoidance and protection is appropriate. When this is not feasible and prudent, and these resources are of value solely for the information which they contain, archaeological data recovery to mitigate the project impact will be required.

(f) Recovery of shipwrecks consistent with the protection of historic values and environmental integrity of shipwrecks and their sites may be permitted subject to the conditions listed at (f) 1 through 7 below. The recovery of shipwrecks must also be consistent with the Shipwrecks and artificial reefs rule at N.J.A.C. 7:7E-3.13.

1. The proposed project is in the public interest;
2. The archaeological knowledge gained will outweigh the loss to future archaeological research and to the public of the preserved shipwreck;
3. The applicant has expertise in underwater archaeology as outlined by the Federal Requirements 36 CFR 66, pursuant to the Archaeological and Historic Preservation Act of 1974 (P.L. 93-291), and through the National Environmental Policy Act, the National Historic Preservation Act of 1966, (as amended), the Abandoned Shipwreck Act of 1987, and their respective implementing regulations and guidelines;
4. Artifacts will be recovered in an archaeologically appropriate manner;
5. Recovered artifacts will be analyzed and inventoried, and as appropriate, preserved, restored, and/or made accessible to future researchers;
6. Two copies of a professional archaeological report will be prepared for the Department giving the following information about the shipwreck and its excavation: Historic background, description of environment, salvage methodology, artifact analysis, description of techniques used in preservation of artifacts, base map, narrative and grid

map on artifacts recovered, bibliography, photographs, National Register documentation and conclusions; and

7. The entire exploration and salvage effort will be in accordance with the Secretary of the Interior's 1983 Standards and Guidelines for Archaeology and Historic Preservation, and the Department of the Interior's 1990 Abandoned Shipwreck Act Final Guidelines which are available from the Historic Preservation Office.

(g) The Department may require the submission of a cultural resource survey report if it is determined that there is a known historic or prehistoric resource in the project area, or a reasonable potential for the presence of such a resource, which may be affected by a proposed development. However, in general, such surveys will not be required for the developments and/or sites listed below:

1. Single family and duplex developments which are not part of a larger development;
2. Sites which can be documented as being previously disturbed to the extent that any archaeological resources present would have been completely destroyed;
3. Sites which are located on lands containing fill material, including Psammments soils (PN, PO, PW) or Urban Land Soils (UL, UP), as defined in the appropriate County Soil Survey; and
4. The replacement of structures and utilities, in-place and in-kind, provided that the area of previous disturbance does not increase.

(h) The ultimate decision on the requirement for a cultural resource survey will be made by the Department's Land Use Regulation Program, based on information received in response to public comments or information provided by the New Jersey Historic Preservation Office regarding the presence of known historic and prehistoric resources or the potential for their presence.

### **7:7E-3.37 Specimen trees**

(a) Specimen trees are the largest known individual trees of each species in New Jersey. The Department's Division of Parks and Forestry maintains a list of these trees (see "New Jersey's Biggest Trees", published by the Department's Division of Parks and Forestry, Summer 1991 for a listing of specimen trees). In addition, large trees approaching the diameter of the known largest tree shall be considered specimen trees. Individual trees with a circumference equal to or greater than 85 percent of the circumference of the record tree, as measured 4.5 feet above the ground surface, for a particular species shall be considered a specimen tree.

(b) Development is prohibited that would significantly reduce the amount of light reaching the crown, alter drainage patterns within the site, adversely affect the quality of water reaching the site, cause erosion or deposition of material in or directly adjacent to the site, or otherwise injure the tree. The site of the tree extends to the outer limit of the buffer area necessary to avoid adverse impacts, or 50 feet from the tree, whichever is greater.

(c) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.38 Endangered or threatened wildlife or plant species habitats**

(a) Endangered or threatened wildlife or plant species habitats are areas known to be inhabited on a seasonal or permanent basis by or to be critical at any stage in the life cycle of any wildlife or plant identified as "endangered" or "threatened" species on official Federal or State lists of endangered or threatened species, or under active consideration for State or Federal listing. The definition of endangered or threatened wildlife or plant species habitats include a sufficient buffer area to ensure continued survival of the population of the species. Absence of such a buffer area does not preclude an area from being endangered or threatened wildlife or plant species habitat.

1. Areas mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps of Habitat for Endangered, Threatened and Other Priority Wildlife (known hereafter as Landscape Maps) are subject to the requirements of this section unless excluded in accordance with (c)2 below. Buffer areas, which are part of the endangered or threatened wildlife species habitat, may extend beyond the mapped areas. The Department's Landscape Maps, with a listing of the endangered and threatened species within a specific area, are available from the Department's Division of Fish and Wildlife, Endangered and Nongame Species Program at the Division's web address, [www.state.nj.us/dep/fgw/ensphome](http://www.state.nj.us/dep/fgw/ensphome).

2. Information on the areas mapped as endangered or threatened plant species habitat on the Department's Landscape Maps and the occurrence of endangered or threatened plant species habitat is available from the Department's Office of Natural Lands Management, Natural Heritage Database at PO Box 404, Trenton, New Jersey 08625-0404.

3. The required endangered or threatened wildlife or plant species habitat buffer area shall be based upon the home range and habitat requirements of the species and the development's anticipated impacts on the species habitat.

(b) Development of endangered or threatened wildlife or plant species habitat is prohibited unless it can be demonstrated, through an Endangered or Threatened Wildlife or Plant Species Impact Assessment as described at N.J.A.C. 7:7E-3C.2, that endangered or threatened wildlife or plant species habitat would not directly or through secondary impacts on the relevant site or in the surrounding area be adversely affected.

(c) Applicants for development of sites that contain or abut areas mapped as endangered or threatened wildlife species habitat on the Landscape Maps shall either:

1. Demonstrate compliance with this rule by conducting an Endangered or Threatened Wildlife Species Impact Assessment in accordance with N.J.A.C. 7:7E-3C.2; or

2. Demonstrate that the proposed site is not endangered or threatened wildlife species habitat and this rule does not apply by conducting an Endangered or Threatened Wildlife Species Habitat Evaluation in accordance with N.J.A.C. 7:7E-3C.3.

(d) If the Department becomes aware of an occurrence of an endangered or threatened wildlife species on a site that is not mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps, and the Department determines that the habitat may be suitable for that species, the Department shall notify the applicant and the

applicant shall demonstrate compliance with or inapplicability of this rule in accordance with (c) above.

(e) If the Department becomes aware of an occurrence of an endangered or threatened plant species on a site that is not in the Natural Heritage Database, the Department will notify the applicant and the applicant shall demonstrate compliance with this rule in accordance with (b) above.

(f) The Department is responsible for the promulgation of the official Endangered and Threatened Wildlife lists pursuant to the Endangered and Non-Game Species Conservation Act, N.J.S.A. 23:2A et seq. These lists include wildlife species that are endangered and threatened in New Jersey as well as wildlife species officially listed as endangered or threatened pursuant to the Endangered Species Act of 1973, 16 U.S.C.1531 et seq. Because the lists are periodically revised by the Department in accordance with N.J.S.A. 23:2A-1 et seq., the lists are not published as part of this rule. The lists are found at N.J.A.C. 7:25-4.13 and 7:25-4.17, the rules adopted pursuant to the Endangered and Non-Game Species Conservation Act. To obtain a copy of the most current Endangered and Threatened Wildlife lists, please contact the Department, Division of Fish and Wildlife, Endangered and Nongame Species Program at the Division's web address, [www.state.nj.us/dep/fgw/ensphome](http://www.state.nj.us/dep/fgw/ensphome), or by writing to the Division at PO Box 400, Trenton, New Jersey 08625-0400.

(g) The Department is responsible for promulgation of the official Endangered Plant Species List pursuant to N.J.S.A. 13:1B-15. The Endangered Plant Species List, N.J.A.C. 7:5C-5.1, includes plant species determined by the Department to be endangered in the State as well as plant species officially listed as endangered or threatened or under active consideration for Federal listing as Endangered or Threatened. Because the Endangered Plant Species List is periodically revised based on new information documented by the the Department, it is not published as part of this rule. To obtain the most current Endangered Plant Species List, please contact the Department, Division of Parks and Forestry, Office of Natural Land Management, PO Box 404, Trenton, NJ 08625-0404.

(h) For sites located within the Pinelands National Reserve and the Pinelands Protection Area, the plant species listed in the Pinelands Comprehensive Management Plan (N.J.A.C. 7:50-6.24) are also considered endangered or threatened plant species.

(i) Rationale: See OAL Note at the beginning of this chapter.

### **7:7E-3.39 Critical wildlife habitats**

(a) Critical wildlife habitats are specific areas known to serve an essential role in maintaining wildlife, particularly in wintering, breeding, and migrating.

1. Rookeries for colonial nesting birds, such as herons, egrets, ibis, terns, gulls, and skimmers; stopovers for migratory birds, such as the Cape May Point region; and natural corridors for wildlife movement merit a special management approach through designation as a Special Area.

2. Ecotones, or edges between two types of habitats, are a particularly valuable critical wildlife habitat. Many critical wildlife habitats, such as salt marsh water fowl wintering areas, and muskrat habitats, are singled out as water or water's edge areas.

3. Definitions and maps of critical wildlife habitats are currently available only for colonial waterbird habitat in the 1979 Aerial Colony Nesting Waterbird Survey for New Jersey (NJDEP, Division of Fish and Wildlife). Until additional maps are available, sites will be considered on a case-by-case basis by the Division of Fish Wildlife.

(b) Development that would directly or through secondary impacts on the relevant site or in the surrounding region adversely affect critical wildlife habitats is discouraged, unless:

1. Minimal feasible interference with the habitat can be demonstrated;
2. There is no prudent or feasible alternative location for the development; and
3. The proposal includes appropriate mitigation measures.

(c) The Department will review proposals on a case-by-case basis.

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.40 Public open space**

(a) Public open space constitutes land areas owned or maintained by State, Federal, county and municipal agencies or private groups (such as conservation organizations and homeowner's associations) and used for or dedicated to conservation of natural resources, public recreation, visual or physical public access or, wildlife protection or management. Public open space also includes, but is not limited to, State Forests, State Parks, and State Fish and Wildlife Management Areas, lands held by the New Jersey Natural Lands Trust (N.J.S.A. 13:1B-15.119 et seq.), lands held by the New Jersey Water Supply Authority (N.J.S.A. 58:1B-1 et seq.) and designated Natural Areas (N.J.S.A. 13:1B-15.12a et seq.) within DEP-owned and managed lands.

(b) New or expanded public or private open space development is encouraged at locations compatible or supportive of adjacent and surrounding land uses.

(c) Development that adversely affects existing public open space is discouraged.

(d) Development within existing public open space is conditionally acceptable, provided that the development is consistent with the character and purpose of public open space, as described by the park master plan when such a plan exists.

(e) Development in Atlantic City is acceptable within existing public open space provided the public open space is a street right-of-way or the Boardwalk and the development meets the standards of N.J.A.C. 7:7E-3.49(e) through (j).

(f) Provision of barrier free access to public open space is encouraged.

(g) All new development adjacent to public open space will be required to provide an adequate buffer area and to comply with the Buffers and Compatibility of Uses rule (N.J.A.C. 7:7E-8.13). The buffer required will be dependent upon adjacent land uses and potential conflicts between users of public open space and the proposed adjacent land use.

(h) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.41 Special hazard areas**

(a) Special hazard areas include areas with a known actual or potential hazard to public health, safety, and welfare, or to public or private property, such as the navigable air space around airports and seaplane landing areas, potential evacuation zones and areas where hazardous substances as defined at N.J.S.A. 58:10-23.11b-k are used or disposed, including adjacent areas and areas of hazardous material contamination.

(b) Coastal development, especially residential and labor-intensive economic development, within special hazard areas is discouraged. All development within special hazard areas must include appropriate mitigating measures to protect the public health and safety.

(c) Approvals from the Department's Division of Solid and Hazardous Waste shall be obtained prior to the commencement of any hazardous substance investigations or clean-up activities at contaminated sites.

(d) Rationale: See the note at the beginning of this Chapter.

**7:7E-3.42 Excluded Federal lands**

(a) Excluded Federal lands are those lands, the use of which is, by law, subject solely to the discretion of or held in trust by the Federal Government, its officers or agents. These lands are excluded from the coastal zone as required by Section 304 of the Federal Coastal Zone Management Act.

1. The list of excluded Federal lands is found in the New Jersey Coastal Management Program, Final Environmental Impact Statement, August 1980, page 370.

(b) Federal actions on excluded Federal lands that affect any land or water use, or natural resource of the coastal zone shall be consistent with the Coastal Zone Management rules to the maximum extent practicable. The effects on the land or water use or natural resource maybe direct, indirect, cumulative, secondary or reasonably foreseeable effects.

(c) Rationale: See note at the beginning of this Chapter.

**7:7E-3.43 Special urban areas**

(a) Special urban areas are those municipalities defined in urban aid legislation (N.J.S.A. 52:27D-178) qualified to receive State aid to enable them to maintain and upgrade municipal services and offset local property taxes. Under N.J.S.A. 52:27D-178

et seq., the Department of Community Affairs (DCA) establishes a list of qualifying municipalities each fiscal year. DCA's list of qualifying municipalities may be obtained on request from the Department's Land Use Regulation Program, PO Box 439, Trenton, New Jersey 08625-0439, (609) 292-0060.

(b) Development that will help to restore the economic and social viability of special urban areas is encouraged. Development that would adversely affect the economic well being of these areas is discouraged, when an alternative which is more beneficial to the special urban areas is feasible. Development that would be of economic and social benefit and that serves the needs of local residents and neighborhoods is encouraged.

(c) Housing, hotels, motels and mixed use development, which is consistent with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, the public trust rights rule, N.J.A.C. 7:7E-8.11, and the Hudson River Waterfront Area rule, N.J.A.C. 7:7E-3.48, where applicable, are acceptable only over large rivers where water dependent uses are demonstrated to be infeasible. These uses are conditionally acceptable on structurally sound existing pilings, or where at least one of the following criteria is met:

1. Where piers have been removed as part of the harbor clean up program, the equivalent pier area may be replaced in either the same or other nearby location;

2. Where structurally sound existing pilings have been reconfigured, provided that the total area of water coverage is not increased and that fisheries resources are not adversely impacted; or

3. Where expansion of the existing total area water coverage has occurred, provided that it can be shown that extensions are functionally necessary for water dependent uses. For example, additional piers and pilings would be conditionally acceptable for a marina which is a water dependent use.

(d) Housing, hotels, motels and mixed use development are acceptable in filled water's edge areas, provided that development is consistent with the filled water's edge rule at N.J.A.C. 7:7E-3.23 and public access is provided in accordance with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11.

(e) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.44 Pinelands National Reserve and Pinelands Protection Area**

(a) The Pinelands National Reserve includes those lands and water areas defined in the National Parks and Recreation Act of 1978, Section 502 (P.L. 95-625), an approximately 1,000,000 acre area ranging from Monmouth County in the north, south to Cape May County and from Gloucester and Camden County on the west to the barrier islands of Island Beach State Park and Brigantine Island along the Atlantic Ocean on the east (see Appendix, Figure 10, incorporated herein by reference). The "Pinelands Area" is a slightly smaller area within the Pinelands National Reserve. It was designated for State regulation by the Pinelands Protection Act of 1979 (N.J.S.A. 13:18-1 et seq.). The Pinelands Commission adopted a Comprehensive Management Plan in November, 1980. Within the Pinelands Area, the law delineates a Preservation Area, where the plan shall

"preserve an extensive and contiguous area of land in its natural state, thereby insuring the continuation of a Pinelands environment ..." (Section 8c).

1. Under the authority of the Department's Surface Water Quality Standards (N.J.A.C. 7:9B), all surface waters within the boundaries of the Pinelands Area, except those waters designated as FWI, are designated "Pinelands Waters" which have special antidegradation policies, designated uses and water quality criteria (see N.J.A.C. 7:9B1-4, 1.5(d)6ii, 1.12(b), and 1.14(b)). The Department's present Groundwater Quality Standards (N.J.A.C. 7:9-6), which were adopted on March 3, 1981, and revised on February 1, 1993, identify the "Central Pine Barrens Area" as the only part of the Pinelands distinguished from the rest of the State (N.J.A.C. 7:9-6.7(c)).

2. The coastal municipalities wholly or partly within the Pinelands National Reserve Area include:

Atlantic County

Brigantine City  
Corbin City  
Egg Harbor City  
Egg Harbor Township  
Estell Manor Township  
Galloway Township  
Hamilton Township  
Mullica Township  
Port Republic  
Somers Point City  
Weymouth Township

Burlington County

Bass River Township  
Washington Township

Cape May County

Dennis Township  
Middle Township  
Upper Township  
Woodbine Borough

Cumberland County

Maurice River Township

Ocean County

Barnegat Township  
Beachwood Borough  
Berkeley Township  
Dover Township  
Eagleswood Township  
Lacey Township

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Lakehurst Borough  
Little Egg Harbor Township  
Manchester Township  
Ocean Township  
South Toms River Borough  
Stafford Township  
Tuckerton Borough

(b) Coastal development shall be consistent with the intent, policies and objectives of the National Parks and Recreation Act of 1978, P.L. 95-625, Section 502, creating the Pinelands National Reserve, and the State Pinelands Protection Act of 1979 (N.J.S.A. 13:18A-1 et seq.).

1. Within the Pinelands National Reserve, the Pinelands Commission will serve as a reviewing agency for coastal construction permit applications.

2. The Department's Land Use Regulation Program and the Pinelands Commission will coordinate the permit review process through the procedure outlined in the February 8, 1988 Memorandum of Agreement between the two agencies and any subsequent amendments to that agreement. Copies are available from the Department's Land Use Regulation Program, PO Box 439, Trenton, New Jersey 08625-0439, (609) 292-0060.

(c) Coastal activities in areas under the jurisdiction of the Pinelands Commission shall not require a freshwater wetlands permit, or be subject to transition area requirements of the Freshwater Wetlands Protection Act, except that discharge of dredged or fill materials in freshwater wetlands and/or State open waters shall require a State permit issued under the provisions of Section 404 of the Federal Water Pollution Control Act of 1972 as amended by the Clean Water Act of 1977, or under an individual or statewide general permit program administered by the State under the provisions of 33 USC 1344 and N.J.S.A. 13:9B-6(b).

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.45 Hackensack Meadowlands District**

(a) The "Hackensack Meadowlands District" is a 19,730 acre area of water, coastal wetlands and associated uplands designated for management by a State-level agency known as the New Jersey Meadowlands Commission, by the Hackensack Meadowlands Reclamation and Development Act of 1968 (N.J.S.A. 13:17-1 et seq.). See Figure 20.

(b) The New Jersey Meadowlands Commission will act as the lead coastal planning and management agency within this Special Area. The New Jersey Meadowlands Commission Master Plan Zoning Rules (N.J.A.C. 19:4) are adopted as part of the Coastal Management Program (see Appendix I) and the Hackensack Meadowlands District is designated a Geographic Area of Particular Concern (see the New Jersey Coastal Management Program, Final Environmental Impact Statement, August 1980, page 263). The Department will periodically review Commission actions and will consider incorporating any proposed changes in New Jersey Meadowlands Commission plans or policies into the Coastal Management Program with particular attention to continued

protection of wetlands and other environmental resources.

(c) Coastal activities under the jurisdiction of the New Jersey Meadowlands Commission shall not require a Freshwater Wetlands permit, or be subject to transition area requirements of the Freshwater Wetlands Protection Act, except that discharge of dredged or fill materials may require a permit issued under the provisions of Section 404 of the Federal Water Pollution Control Act of 1972 as amended by the Federal Clean Water Act of 1977, or under an individual or general permit program administered by the State under the provisions of the Federal Act and applicable State laws.

(d) Rationale: See note at the beginning of this Chapter.

### **7:7E-3.46 Wild and Scenic River Corridors**

(a) Wild and scenic river corridors are all rivers designated into the National Wild and Scenic Rivers System and any rivers or segments thereof being studied for possible designation into that system pursuant to the National Wild and Scenic Rivers Act (16 U.S.C. 1271-1278). For rivers designated into the national system, the wild and scenic river corridor shall include the river and adjacent areas located within one-quarter mile from the mean high water line on each side of the river until a Federal River Management Plan has been adopted, after which time the wild and scenic corridor shall be the area defined in the adopted plan. For rivers under study for possible designation into the national system, the wild and scenic river corridor shall include the river and adjacent areas extending one-quarter mile from the mean high water line on each side of the river.

(b) Development in wild and scenic river corridors shall comply with (b)1 and 2 below, and the standards for the specific type of development at (c), (d), (f), (g) and (h) below. The standards for linear development are found at (e) below.

1. Development that would have a direct and adverse effect on any "outstandingly remarkable resource value" for which the river was designated or is being studied for possible designation into the National Wild and Scenic Rivers System is prohibited. For the purposes of this rule, "outstandingly remarkable resource values" means any of those extraordinary scenic, recreational, cultural, historical, or fish and wildlife attributes of a river corridor which, under the National Wild and Scenic Rivers Act, are required to be preserved and protected for the benefit and enjoyment of future generations.

2. The development shall comply with the standards set forth in the Federal River Management Plan adopted pursuant to the National Wild and Scenic Rivers Act for the wild and scenic river corridor if a plan exists.

(c) Development of docks, piers, and moorings on the Great Egg Harbor River and Maurice River and their tributaries shall comply with the following:

1. A dock, pier or mooring shall not extend to a depth greater than two feet at mean high water or further than 20 percent of the river width, as measured from mean high water line on one side of the river to the mean high water line on the opposite side of the river, whichever is less.

2. On the Great Egg Harbor River and Maurice River, development of a dock, pier or mooring within 75 feet of the edge of a navigation channel, as defined at N.J.A.C. 7:7E-3.7, is prohibited.

3. On the tributaries to the Great Egg Harbor River and Maurice River, development of a dock, pier or mooring within 25 feet of the edge of a navigation channel, as defined at N.J.A.C. 7:7E-3.7, is prohibited.

(d) Where the need for shoreline stabilization has been demonstrated, biostabilization of eroding shorelines shall be used where feasible. These systems include live branch cuttings, live facings, live stakes, vegetative cuttings, vegetated earth buttresses, choir fiber products, fiber plugs, plants, fiber pallets, fiber carpet, and wood stake anchor systems. These materials shall be installed in accordance with the construction guidelines of Chapter 16 "Streambank and Shoreline Stabilization Protection," of the National Engineering Handbook (NEH), Part 650, 1996, published by the United States Department of Agriculture, herein incorporated by reference as amended and supplemented. This document is available on the web at [www.NTIS.gov](http://www.NTIS.gov) for a fee (order PB98114358). Standards for structural shore protection are found at N.J.A.C. 7:7E-7.11.

(e) Linear development shall be located within the right of way of an existing linear development route or outside of the wild and scenic river corridor where feasible. Where an analysis of alternatives demonstrates that proposed development which is in the public interest can not be so located, the linear development shall be located and designed to minimize adverse effect on outstandingly remarkable resource values and the width of the clearing for the linear development shall be minimized.

(f) Communication and cellular towers are prohibited in a wild and scenic river corridor.

(g) Development of bridges is conditionally acceptable provided it complies with the following:

1. The structure spans the entire width of the water body, and has no associated structures located below the mean high water line, unless it is demonstrated that such a structure is not feasible;

2. The bridge is non-obtrusive, including siting, design and materials, all of which are in character with the surrounding development;

3. A vertical clearance of five feet is maintained between the elevation of the water body at mean high water and the lowest structural member of the bridge where the water depth is greater than two feet at mean high water;

4. A single crossing is used where feasible;

5. There is no reduction of the total width and volume of the water body passing under the bridge;

6. The water body is crossed by a method which minimizes disruption to the bottom of the water body; and

7. The crossing is designed to minimize impacts to the fishery resources, and is generally at a 90 degree angle to the shoreline.

(h) Development of culverts is conditionally acceptable provided it complies with the following:

1. A natural streambed is provided through either the use of a bottomless structure or by recessing the culvert bottom a minimum of 12 inches below the bottom of the water body;
2. There is no reduction of the total pre-construction width and volume of the water body passing through the culvert; and
3. The crossing is designed to minimize impacts to the fishery resources, and is generally at a 90 degree angle to the shoreline.

(i) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.47 Geodetic control reference marks**

(a) Geodetic control reference marks are traverse stations and benchmarks established or used by the New Jersey Geodetic Control Survey pursuant to P.L. 1934, c.116. They include the following types:

1. Monument-(Mon), Disk-(DK): A standard United States Coast and Geodetic Survey or New Jersey Geodetic Control Survey disk set in a concrete post, pavement, curb, ledge rock, etc., stamped with a reference number, and used for both horizontal and vertical control.
2. Point (Pt.): A State highway, tidelands (riparian), city, etc. survey marker represented by a chiseled cross, punch hole, brass plug, etc. used for horizontal and vertical control. These stations are not marked, but if there should be an enclosing box, the rim is stamped with a number.
3. Rivet-(Rv.): A standard metal rivet set by the New Jersey Geodetic Control Survey, used for vertical control.
4. Mark-(Mk.): Same as point, but used only for vertical control. In the description of such marks there should appear a mark number followed by an equality sign and then the original name or elevation of the bench mark, and in parentheses the name of the organization which established the mark.

(b) The disturbance of a geodetic control reference mark is discouraged. When a geodetic control reference mark must be moved, raised or lowered to accommodate construction, the New Jersey Geodetic Control Survey shall be contacted at least 60 days prior to disturbance, and arrangements shall be made to protect the position. If the position can not be protected, it may be altered in position after approval by the New Jersey Geodetic Control Survey and under the supervision of a licensed professional engineer or land surveyor using standard methods. Copies of field notes and instruments, tape, and rod specifications including calibration data, shall be submitted to the New Jersey Geodetic Control Survey.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-3.48 Hudson River Waterfront Area**

(a) The following terms, when used in this section, shall have the following meanings:

1. "Average building height" is defined as the mean height of the roof line of a building on a pier measured from the pier deck level to the top of the parapet or the midpoint of a sloped roof above pier deck level.

2. "The Hudson River Waterfront Area" extends from the George Washington Bridge in Fort Lee, Bergen County to the Bayonne Bridge in Bayonne, Hudson County, inclusive of all land within the municipalities of Bayonne, Jersey City, Hoboken, Weehawken, West New York, Guttenberg, North Bergen, Edgewater and Fort Lee subject to the Waterfront Development Law.

3. "Landward end of pier" means the end of the pier at its point of attachment to the upland.

4. "Pier" means a pile supported, decked structure extending from upland over water. The longest axis of a pier is generally perpendicular to the shoreline. See "platform" below.

5. "Pier deck level" means the lowest deck surface that is at or above the flood hazard area design flood elevation as defined at and determined in accordance with N.J.A.C. 7:13.

6. "Platform" means a pile supported, decked structure extending from upland over water. The longest axis of a platform is generally parallel to the shoreline. See "pier" above.

7. "Walkway" means areas along the waterfront, including areas on piers, that are devoted to activities by the public such as but not limited to walking, jogging and bicycle riding.

8. "Waterward end of pier" means the end of a pier most distant from its point of attachment to the upland.

(b) Non-industrial development within the Hudson River Waterfront Area shall conform with the criteria as set forth in (d) below, which govern allowable building height, massing and public access. Industrial development, including water dependent transportation (passenger and vehicular) and cargo handling facilities, shall conform with the criteria to the extent practical consistent with public safety and the operational requirements of such facilities.

(c) Hudson River Waterfront Area development shall be consistent with all other applicable Coastal Zone Management rules with particular attention given to N.J.A.C. 7:7E- 3.40, Public open space, N.J.A.C. 7:7E-3.41 Special hazards areas, N.J.A.C. 7:7E-3.43 Special urban areas, N.J.A.C. 7:7E-3.50, Lands and waters subject to public trust rights, N.J.A.C. 7:7E-7.14 High rise structures, N.J.A.C. 7:7E-8.11 Public trust rights, N.J.A.C. 7:7E-8.12 Scenic Resources and Design, and N.J.A.C. 7:7E-8.4 Water Quality.

(d) The following standards apply to all developments proposed on piers and will be used by the Department as a guide for developments proposed on platforms. In some cases, a platform may, in effect, function as upland and, thus, be more appropriately reviewed under rules that regulate upland development.

1. Non-industrial development upon piers is conditionally acceptable provided that specific amounts of usable landscaped public open space are incorporated into the project, as provided below:

THIS IS A COURTESY COPY OF THIS RULE. ALL OF THE DEPARTMENT'S RULES ARE COMPILED IN TITLE 7 OF THE NEW JERSEY ADMINISTRATIVE CODE.

- i. The minimum length of public open space at the landward end of a pier required for any building less than or equal to 40 feet in average height shall be 20 feet;
- ii. The minimum length of public open space at the landward end of a pier required for any building above 40 feet in average height shall be computed as follows:

For example:

| Average Height | Minimum Landward Open Space Length |
|----------------|------------------------------------|
| 80 feet        | 60 feet                            |
| 70 feet        | 42.5 feet                          |
| 60 feet        | 30 feet                            |
| 50 feet        | 22.5 feet                          |
| 40 feet        | 20 feet                            |

- iii. The minimum length of distal public open space at the waterward end of a pier required for any building less than or equal to 40 feet in average height shall be 20 feet;
  - iv. The minimum length of public open space at the waterward end of a pier required for any building above 40 feet in average height shall be computed as follows:
- For example:

| Average Height | Minimum Waterward Open Space Length |
|----------------|-------------------------------------|
| 80 feet        | 120 feet                            |
| 70 feet        | 76 feet                             |
| 60 feet        | 45 feet                             |
| 50 feet        | 26 feet                             |
| 40 feet        | 20 feet                             |

v. The area of public open space at the ends of piers required by this section shall be the minimum length times the width of the pier. The public open space areas do not have to occupy the entire width of the pier for the full minimum length required, and do not have to be entirely at pier deck level, provided the following criteria are satisfied:

- (1) Public open space at each pier end, that covers the full width of the pier, shall be at least 20 feet in length or 70 percent of the minimum length, as determined above at (d)1i through iv above, whichever is greater;
- (2) The remaining area of public open space (up to 30 percent of the minimum length times the average width of the pier) must be contiguous with the public open space at the end of the pier; and
- (3) Up to 50 percent of the public open space at pier ends may be elevated up to 12 feet above pier deck level provided that easy access is provided between elevated and pier deck level public open space areas, for able bodied and disabled people;

vi. At least one public access walkway of at least 16 feet in width shall be provided along the entire length of a pier, from the waterward end to the landward end at the point at which it abuts the Hudson River Waterfront Walkway. All such walkways shall be at

pier deck level or ramped so that disabled access is provided between the public open space areas at both ends of a pier;

vii. Where piers are less than 400 feet apart, the heights, as allowed by this section, shall be further reduced by 20 percent for each pier. No reduction of open space will be allowed as a result of this height reduction; and

viii. Development that reuses existing structures on piers shall comply with the above criteria to the maximum practical extent; and

ix. All pier structures shall meet the requirements of the Flood hazard areas rule at N.J.A.C. 7:7E-3.25.

(e) All waterfront development along the Hudson River shall develop, maintain and manage a section of the Hudson Waterfront Walkway coincident with the shoreline of the development property. The developer shall, by appropriate instrument of conveyance, create a conservation restriction in favor of the Department. The conservation restriction shall define the physical parameters of the walkway and the allowable uses, address the maintenance and management duties and identify the responsible party. Development of each project's public access system shall conform to this special area policy and to the Hudson Waterfront Walkway Planning and Design Guidelines (1984) and the Hudson Waterfront Walkway Design Standards (1989), subject to the following clarification:

1. Public access to and along the main route of the Hudson Waterfront Walkway and on the adjacent piers shall be on a 24-hour basis, except as provided by N.J.A.C. 7:7E-8.11(f).

2. Within all public access corridors and public open space areas on piers, pedestrians shall have a declared right of way over vehicles. Public access corridors may be used for emergency vehicular access, but shall not serve as service or general vehicular roadways. All instances of vehicular/pedestrian crossing shall be designated to assure motorists are aware they are crossing a pedestrian right of way. Stop signs, speed bumps and similar design techniques shall be used as necessary.

(f) Applications which vary in detail from the standards of this rule are discouraged, but will be considered for approval if they would provide greater public access and/or protection of natural or scenic resources than would be afforded by strict compliance with this rule and the development, as proposed, would remain in compliance with the public trust rights rule, N.J.A.C. 7:7E-8.11. Applicants proposing a development which varies in detail from the standards of this rule are encouraged to contact the Department for guidance when conceptual plans have been prepared.

#### **7:7E-3.49 Atlantic City**

(a) Atlantic City is those lands within the municipal boundary of the City of Atlantic City.

(b) "Casino hotels" are hotels with casinos as provided for in the Casino Control Act (P.L. 1977, c.100, as amended).

1. Casino hotel development in Atlantic City shall be located in the city's traditional resort area (along the Boardwalk), and in the State Marina area to the maximum extent practicable. For the purpose of this section, the State Marina area is the area bounded by

Clam Creek, Absecon Inlet, Clam Thorofare, Penrose Canal, Absecon Boulevard, Huron Avenue, and Maryland Avenue to Magellan Avenue, across Delta Basin.

i. Casino hotel development is discouraged in existing residential areas and in areas where access by public transportation between the proposed hotel-casino and the Boardwalk is limited.

ii. Casino hotel development is discouraged along the access highways to Atlantic City that is, along the entire Atlantic City Expressway, Route 40 north and west of Beach Thorofare and Route 30 northwest of Penrose Canal.

iii. Casino development is encouraged in Atlantic City to ensure that the objectives of the 1976 constitutional referendum on casino gambling, including the stimulation of new construction and the revitalization of Atlantic City and its region, are achieved.

(c) The following standards apply to all development proposed on or over the existing ocean piers listed at (c)1 below.

1. Existing ocean piers (piers) are limited to the footprint of the following five piers, as depicted on the Department's 1995-1997 National Aerial Photographic Program imagery (GIS):

i. Garden Pier;

ii. Steel Pier;

iii. Steeplechase Pier, except that Steeplechase Pier may be connected to the Boardwalk provided the connecting portion of the pier does not exceed the width of the existing Steeplechase Pier;

iv. Central Pier; and

v. Million Dollar Pier (Ocean One).

2. Residential development is prohibited on the existing ocean piers except where a waiver of strict compliance with the municipal flood damage prevention ordinance has been granted by the Federal Emergency Management Agency for a hotel to be located over the water.

3. The development proposed on the pier must have an evacuation plan approved by the Atlantic City Office of Emergency Management.

4. A minimum of 50 percent of the total floor area of any building constructed on the pier shall be devoted to publicly accessible, non-casino entertainment and recreation.

5. The height of the structures on the pier shall not exceed 100 feet above the deck surface of the Boardwalk, except for decorative architectural elements and amusement rides which shall not exceed 200 feet. There shall be no occupancy above the 100 foot elevation.

6. The height of the structures on the pier shall not exceed 50 feet above the deck surface of the Boardwalk within 100 feet of the property line in common with the Boardwalk.

7. A building setback of 50 feet shall be maintained from the seaward end of the pier. If a building is 50 feet or more in height, an additional 20 feet setback from the seaward end of the pier is required.

8. Public access shall be provided in accordance with all of the following:

i. The development shall provide a means for pedestrians to walk along the dry beach under the pier from one side to the other, except where the beach is so narrow as to preclude such passage;

ii. A stairway shall be provided from the pier to the beach and from the Boardwalk to the beach on the southwesterly side of the pier, where the pier intersects the Boardwalk and, on the northeasterly side of the pier, either where the pier intersects the Boardwalk or on the Boardwalk within 50 feet of the point at which the pier intersects the Boardwalk;

iii. Publicly accessible open space, including lighted public seating and viewing and, where appropriate, fishing areas, shall be provided at the seaward end of the pier at the level of the deck surface of the Boardwalk. The publicly accessible open space shall occupy the entire width of the pier (parallel to the ocean shoreline in a northeast-southwest direction) for a distance of 50 feet landward from the end of the pier. The area between 30 and 50 feet inland from the end of the pier may be occupied by outdoor dining and food concessions and be partially enclosed, through the use of awnings, canopies, and windbreaks. No other structures shall be placed in this area;

iv. The public open space shall have unrestricted access, at no cost, and shall not be limited to patrons of the commercial or hotel facilities;

v. An open-air public access walkway of at least 18 feet in width shall be provided perpendicular to the Boardwalk, along the entire southwestern side of the pier at the level of the deck surface of the Boardwalk, with amenities such as seating and lighting. Servicing of buildings and storage of materials, refuse or any other obstructions are prohibited within this walkway;

vi. An open-air public access walkway of at least 12 feet in width shall be provided perpendicular to the Boardwalk, along the entire northeastern side of the pier at the level of the deck surface of the Boardwalk, with amenities such as seating and lighting. Servicing of buildings and storage of materials, refuse or any other obstructions are prohibited within this walkway;

vii. Public restrooms, showers and changing areas shall be provided on the pier, immediately adjacent to the Boardwalk and the stairs from the beach on either side of the pier. Alternatively, the public restrooms, showers and changing areas may be located immediately adjacent to the Boardwalk provided these facilities are:

- (1) Owned and maintained by the pier owner; and
- (2) Located no further than 200 linear feet from the pier; and

viii. Signage shall be provided along the Boardwalk at the entrance to the piers indicating the location and availability of the public access features listed in (c)8i through vii above.

9. Service corridors to the piers shall be located beneath the Boardwalk, or if service to the piers is to be provided over the Boardwalk, it shall be restricted to the period between 12 o'clock midnight and 8:00 A.M.

10. The size and spacing of the pilings necessary to support the proposed development on the piers shall comply with the following conditions:

i. The pilings shall not cause significant adverse long-term impact to natural functioning of the beach and dune system, either individually or in combination with other existing or proposed structures, land disturbances or activities;

ii. The pilings shall not cause significant adverse impacts to the local sediment supply;

iii. The pilings shall not create net adverse shoreline sand movement downdrift, including erosion or shoaling; and

iv. Pilings shall be spaced so as to provide linear access along the dry beach as required by (c)8i above.

11. Parking is prohibited on the piers.

(d) The construction of new commercial piers or expansion of existing commercial piers is prohibited, unless the pier is associated with a marina which meets the Resort Recreational Use rule, N.J.A.C. 7:7E-7.3, and the Marina Development Standards at N.J.A.C. 7:7E-7.3A or meets the standards at N.J.A.C. 7:7E-3.49(c).

(e) The following standards apply to all development proposed in the Boardwalk right-of-way as defined at (e)1 below:

1. For the purposes of this subsection, Boardwalk right-of-way means the shore-parallel promenade located immediately adjacent to the ocean and inlet beach occupying a 20 foot right-of-way from Jackson Avenue to Roosevelt Place, a 40 foot right-of-way from Roosevelt Place to Bellevue Avenue, a 60 foot right-of-way from Bellevue Avenue to Rhode Island Avenue, a 40 foot right-of-way from Rhode Island Avenue to Atlantic Avenue, and a 20 foot right-of-way from Atlantic Avenue to Caspian Avenue as shown on the 1999 Atlantic City tax duplicate.

2. Elevated pedestrian bridges are acceptable provided they meet the criteria of (e)2i through vi below:

i. The elevated pedestrian bridge shall be designed and used only for pedestrian movement and shall not provide for or be used for vehicular traffic, commercial space, storage or advertisement, either attached to or positioned within the elevated pedestrian bridge;

ii. The lowest portion of the elevated pedestrian bridge shall be elevated a minimum of 14 feet six inches above the deck surface of the Boardwalk;

iii. The elevated pedestrian bridge shall be a maximum of 20 feet wide and 15 feet high;

iv. The elevated pedestrian bridge shall be transparent with the exception of the support structure;

v. The elevated pedestrian bridge shall connect to an existing pier as defined at (c)1 above; and

vi. There shall be no more than one pedestrian bridge per existing pier.

3. Awnings, canopies, marquees, and other roof extensions are acceptable provided they meet the criteria of (e)3i through iii below:

i. The structure is not enclosed;

ii. The structure extends no more than 12 feet into the Boardwalk right-of-way; and

iii. There is an eight-foot clearance between the structure and the deck surface of the Boardwalk.

4. Signs which are not awnings, canopies, marquees or other roof extensions are acceptable provided they meet the criteria of (e)4i through iii below:

i. The structure is not enclosed;

ii. The structure extends no more than 12 feet into the Boardwalk right-of-way; and

iii. There is a 14 foot six inch clearance between the structure and the deck surface of the Boardwalk.

5. Any development that does not meet the standards in (e)2, 3 or 4 above is prohibited.

(f) Development is prohibited in the street rights-of-way listed in (f)1 and 2 below as shown on the 1999 Atlantic City tax duplicate, and in the street right-of-way listed in (f)3 below, with the exception of signage extending no more than four feet into the street right-of-way and located a minimum of 14 feet six inches above the surface of the sidewalk and of below-grade utilities, roads, sidewalks, public stairs and ramps providing access to the Boardwalk and mitigation pursuant to (j) below.

1. That portion of the following streets located southeast of Pacific Avenue:

- i. Sovereign Avenue (50 foot right-of-way);
- ii. Montpelier Avenue (60 foot right-of-way);
- iii. Iowa Avenue (72 foot right-of-way);
- iv. Missouri Avenue (50 foot right-of-way);
- v. Kentucky Avenue (50 foot right-of-way);
- vi. Tennessee Avenue (60 foot right-of-way); and
- vii. Rhode Island Avenue (50 foot right-of-way);

2. That portion of the following streets located northeast of Rhode Island Avenue:

- i. Atlantic Avenue (100 foot right-of-way);
- ii. Pacific Avenue (60 foot right-of-way); and
- iii. Grammercy Place (60 foot right-of-way);

3. That portion of Albany Avenue (60 foot right-of-way) located southeast of Pacific Avenue as shown on the 1999 Atlantic City tax duplicate or an alternative alignment with a minimum 60 foot right-of-way approved by the Department which provides a comparable view corridor to the ocean and horizon.

(g) Development is acceptable southeast of Pacific Avenue in or over the right-of-way of a street listed in (g)1 through 6 below as shown on the 1999 Atlantic City tax duplicate provided that it either meets the standards of (g)7 and 8 below or of (i) below.

1. Chelsea Avenue (60 foot right-of-way);
2. Texas Avenue(50 foot right-of-way);
3. Florida Avenue(50 foot right-of-way);
4. Martin Luther King, Jr. Boulevard (50 foot right-of-way);
5. South Carolina Avenue (50 foot right-of-way);
6. New Hampshire Avenue(50 foot right-of-way);

7. A corridor 50 feet in height and 50 feet in width, except 60 feet in width for Chelsea Avenue, shall be maintained at street level within the street right of way between Pacific Avenue and the Boardwalk. The entire corridor shall be unenclosed, entirely devoid of structures, maintain views to the Boardwalk and allow unrestricted physical access to the public.

8. Mitigation is provided in accordance with (j) below.

(h) Development is acceptable in or over the right-of-way of any street located perpendicular to the Atlantic Ocean and southeast of Pacific Avenue and not listed in (f) or (g) above provided that it meets the standards of (i) below or mitigation is provided in accordance with (j) below.

(i) The following may be constructed without mitigation in or over the right-of-way of an existing street located perpendicular to the Atlantic Ocean and southeast of Pacific Avenue and not listed in (f) above:

1. Elevated pedestrian bridges are acceptable provided they meet the criteria of (i)1i and ii below:

- i. The elevated pedestrian bridge meets the standards at (e)2i through iv above; and
- ii. The elevated pedestrian bridges shall be no closer to one another than 1,000 feet, as measured along the street right-of-way;

2. Awnings, canopies, marquees, and other roof extensions are acceptable provided they meet the criteria of (i)2i through iii below:

- i. The structure is not enclosed;
- ii. The structure extends no more than 8 feet into the street right-of-way; and
- iii. There is an eight-foot clearance between the structure and the surface of the sidewalk;

3. Signs which are not awnings, canopies, marquees, or other roof extensions are acceptable provided they meet the criteria of (i)3i through iii below:

- i. The structure is not enclosed;
- ii. The structure extends no more than eight feet into the street right-of-way; and
- iii. There is a 14 foot six inch clearance between the structure and surface of the sidewalk; and

4. Below-grade utilities, roads, sidewalks, and public stairs and ramps providing access to the Boardwalk approved as mitigation under (j) below.

(j) Mitigation shall be provided for development within the right-of-way of a street located perpendicular to the Atlantic Ocean and southeast of Pacific Avenue, except for those developments listed in (i) above, in accordance with the following:

1. The amount to be paid in mitigation shall be calculated as follows:

i. For development within a street right-of-way at grade, or below a height of 14 feet six inches above grade, the amount of mitigation is five times the property tax on the assessed value of the right-of-way area to be developed. The assessed value is an average of the value of the land on both sides of the area to be developed; and

ii. For development within a street right-of-way at a height of 14 feet six inches or greater above grade, the amount of mitigation is three times the Atlantic City tax on the assessed value of the right-of-way area to be covered by development. The assessed value is an average of the value of the land on both sides of the right-of-way area to be covered by development;

2. Mitigation monies shall be paid in full to the Casino Reinvestment and Development Authority prior to the commencement of construction; and

3. Mitigation monies paid to the Casino Reinvestment and Development Authority in accordance with (j)1 and 2 above, shall be designated only for acquisition and/or improvement of lands for public access and public parks along the oceanfront and inlet. If the money is used for these improvements within a street-end, the money shall be used only in a street-end listed in (f) above.

(k) Standards relevant to intercept parking are as follows:

1. Each hotel-casino facility located in Atlantic City shall provide one of every five non-Absecon Island and non-Brigantine Island resident hotel-casino employees commuting during the daily peak hour with an intercept space. Absecon Island residents are residents of Atlantic City, Margate, Ventnor and Longport. Brigantine Island residents are residents of the City of Brigantine. Nobsecon Island and non-Brigantine Island resident employees commuting during the daily peak hour is the sum of the number of non-Absecon Island and non-Brigantine Island resident employees of the shift with the largest number of employees plus the number of non-Absecon Island and non-Brigantine Island resident employees of the next largest adjoining shift. This intercept parking space shall be located off Absecon and Brigantine Islands, specifically outside of the municipal boundary of the five municipalities identified above. If off-island sites are not available, temporary use of other sites is conditionally acceptable if an applicant can demonstrate that it will be moved to an off-island site within one year.

2. Alternatives that would reduce vehicle miles traveled and peak hour employee travel demand may be substituted for the employee intercept parking space requirements for casino facilities. The Department will review proposed alternatives in consultation with the Department of Transportation. The Department will approve alternatives, which it determines will reduce vehicle miles traveled and peak-hour employee travel by at least as much as would result from furnishing intercept parking as described above. Acceptable alternatives include, but are not limited to, employee subsidies for bus, rail transit, van pools, and/or bicycle programs.

3. Alternative scheme proposals must include documentation indicating the existing travel pattern and mode of travel characteristics of non-Absecon and non-Brigantine Island resident employees. This information shall be provided to the Department along with the necessary data used to establish the vehicle miles traveled and peak hour employee travel demand with and without the proposed peak hour traffic reduction program. All proposals shall include a monitoring program to be submitted to the Department to verify the success of the proposed traffic reduction program, update the employee travel characteristics pattern, and serve as a basis for future adjustments if necessary.

(l) Development in Atlantic City shall be constructed in conformance with this section and with all other applicable provisions in this chapter.

#### **7:7E-3.50 Lands and waters subject to public trust rights**

(a) Lands and waters subject to public trust rights are tidal waterways and their shores, including both lands now or formerly below the mean high water line, and shores above the mean high water line. Tidal waterways and their shores are subject to the Public Trust Doctrine and are held in trust by the State for the benefit of all the people, allowing the public to fully enjoy these lands and waters for a variety of public uses.

(b) Development that adversely affects lands and waters subject to public trust rights is discouraged.

(c) (Reserved)

(d) Public access to lands and waters subject to public trust rights shall be provided in accordance with the public trust rights rule, N.J.A.C. 7:7E-8.11.

(e) Rationale: See the note at the beginning of this Chapter.

## **SUBCHAPTER 3A. STANDARDS FOR BEACH AND DUNE ACTIVITIES**

### **7:7E-3A.1 Purpose and scope**

(a) This subchapter sets forth the standards applicable to routine beach maintenance, emergency post-storm restoration, dune creation and maintenance, and construction of boardwalks. These standards are reference at N.J.A.C. 7:7E-3.16, Dunes; N.J.A.C. 7:7E-3.17, Overwash areas; N.J.A.C. 7:7E-3.19, Erosion hazard areas; N.J.A.C. 7:7E-3.22, Beaches; and N.J.A.C. 7:7E-7.11, Coastal engineering. In addition, N.J.A.C. 7:7E-3A.2, 3A.3 and 3A.4 are the standards for the coastal general permit for beach and dune maintenance activities, N.J.A.C. 7:7-7.6.

1. The standards applicable to routine beach maintenance, including debris removal and clean-up; mechanical sifting and raking; maintenance of access ways; removal of sand from street ends; boardwalk promenades and residential properties; repairs or reconstruction of existing gazebos and dune walkover structures, and limited sand transfers from the lower beach to the upper beach or alongshore are found at N.J.A.C. 7:7E-3A.2;

2. The standards that apply to the restoration of all beaches that are impacted by coastal storms with a recurrence interval to or exceeding a five-year storm event are found at N.J.A.C. 7:7E-3A.3;

3. The standards for dune creation and maintenance including the placement and/or repair of sand fencing, the planting and fertilization of appropriate dune vegetation, the maintenance and clearing of beach access pathways less than 8 feet in width; and the construction or repair of approved dune walkover structures are found at N.J.A.C. 7:7E-3A.4; and

4. The standards for construction of boardwalks along tidal shorelines are found at N.J.A.C. 7:7E-3A.5.

### **7:7E-3A.2 Standards applicable to routine beach maintenance**

(a) Routine beach maintenance includes debris removal and clean-up; mechanical sifting and raking; maintenance of accessways; removal of sand from street ends, boardwalks/promenades and residential properties; the repair or reconstruction of existing boardwalks, gazebos and dune walkover structures; and limited sand transfers from the lower beach to the upper beach or alongshore (shore parallel). Sand transfers from the lower beach profile to the upper beach profile are specifically designed to restore berm width and elevation, to establish/enhance dunes and to repair dune scarps. Activities which preclude the development of a stable dune along the back beach are not considered to be routine beach maintenance activities, pursuant to this section. Specifically, the bulldozing of sand from the upper beach (berm) to the lower beach (beach face), for the purpose of increasing the berm width or flattening the beach profile, is not considered to be routine maintenance.

1. If the activities in (a) above are proposed to be conducted by a municipal or county agency on property owned by that governing body, then the municipal or county engineer must certify that the activities will be conducted in accordance with these standards. The appropriate municipal or county engineer is responsible for ensuring compliance with these requirements. If these activities are proposed to be conducted on privately owned property, then the property owner is responsible for ensuring that the activities will be conducted in accordance with these standards. If these activities are proposed to be conducted on State owned properties, then the DEP, Bureau of Construction and Engineering must certify that the activities will be conducted in accordance with these standards.

2. All guidelines and specifications of this section must be incorporated into any contract documents or work orders related to proposed beach and dune activities, as described in this section. The Land Use Regulation Program is available to assist in the development of specific maintenance plans for oceanfront locations, upon request.

3. In areas documented by the Department as habitat for threatened or endangered beach nesting shorebirds such as Piping Plovers (*Charadrius melodus*) and Least Terns (*Sterna albifrons*), no beach raking or other mechanical manipulation of the beach shall take place between April 1 and August 15.

i. The Department's Division of Fish and Wildlife shall develop a list of specific areas where this restriction shall apply, based on documented habitat during the most recent nesting season. The list of restricted areas shall be updated annually by the Division of Fish and Wildlife, at the end of each nesting season and be available upon request from the Department's Land Use Regulation Program at PO Box 439, Trenton, New Jersey 08625-0439 (609) 292-0060. The updated list shall be provided by the Department to each permittee prior to April 1 of each year.

ii. If a particular beach area is identified on the updated list as described in (a)3i above as habitat for threatened or endangered beach nesting shorebirds, regardless of the habitat classification of the previous nesting season, no beach raking or other mechanical manipulation of the beach shall take place between April 1 and August 15 in those areas.

iii. If a particular beach area is not identified on the updated list as described in (a)3i above, but is subsequently found to contain a nest of a threatened or endangered beach nesting shorebird, the Department shall notify the permittee and no beach raking or mechanical manipulation of the beach shall take place between April 1 and August 15 in those areas.

iv. The restrictions contained in (a)3 above may be waived if the Department's Division of Fish and Wildlife determines that the identified areas do not represent suitable threatened or endangered beach nesting shorebird habitat, due to beach erosion or other causes. Requests for such a waiver shall be made in writing to the Land Use Regulation Program, PO Box 439, Trenton, New Jersey, 08625-0439; and

4. Mechanical sifting and beach raking shall be limited to recreational beach areas only. For the purposes of this subsection, "recreational beach area" means all areas within 100 yards of a staffed lifeguard stand.

(b) Projects involving the mechanical redistribution of sand from the lower beach profile to the upper beach profile, or alongshore, are acceptable, in accordance with the following standards:

1. The amount of sand transferred at any one time shall be limited to one foot scraping depth at the borrow zone. This borrow zone may not be rescraped until the sand volume from the previous scraping activities has been fully restored.

2. The borrow zone shall be limited to the area between the low water line and the inland limit of the berm. It is strongly recommended that a program of beach profiling be utilized to monitor the condition of the beaches and to ensure compliance with the standards of this section.

3. If the purpose of the sand transfers is to repair eroded dunes (dune scarps), all filled areas shall be stabilized with sand fencing and planted with beach grass in accordance with DEP and/or SCS standards. Fencing shall be in place within 30 days of the transfer operation, while the vegetative plantings may be installed during the appropriate seasonal planting period (October 15 through March 31, anytime the sand is not frozen).

4. There shall be no disturbance to existing dune areas.

5. In areas of documented habitat for threatened or endangered beach nesting shorebirds such as Piping Plovers (*Charadrius melodus*) and Least Terns (*Sterna albifrons*), no sand transfers shall take place between April 1 and August 15.

i. The Department's Division of Fish and Wildlife shall develop a list of specific areas where this restriction shall apply, based on documented habitat during the most recent nesting season. The list of restricted areas shall be updated annually by the Division of Fish and Wildlife, at the end of each nesting season and be available upon request from the Department's Land Use Regulation Program at PO Box 439, Trenton, New Jersey 08625-0439 (609) 292-0060. The updated list shall be provided by the Department to each permittee prior to April 1 of each year.

ii. If a particular beach area is identified on the updated list as described in (b)5i above as habitat for threatened or endangered beach nesting shorebirds, regardless of the habitat classification of the previous nesting season, no sand transfers shall take place between April 1 and August 15 in those areas.

iii. If a particular beach area is not identified on the updated list as described in (b)5i above, but is subsequently found to contain a nest of a threatened or endangered beach nesting shorebird, the Department shall notify the permittee and no sand transfers shall take place between April 1 and August 15 in those areas.

iv. The restrictions contained in (b)5 above may be waived if the Department's Division of Fish and Wildlife determines that the identified areas do not represent suitable threatened or endangered beach nesting shorebird habitat, due to beach erosion or other causes. Requests for such a waiver shall be made in writing to the Land Use Regulation Program, PO Box 439, Trenton, New Jersey, 08625-0439; and

6. Sand transfers to or from wetland areas that may exist on a beach are not authorized by this permit.

7. Records of all sand transfer activities shall be maintained by the property owner, beach association, governmental agency or other authority conducting the activities, and shall be available for inspection by the Department, upon request. These records shall include, but not be limited to, dates of transfer, borrow area limits, fill area limits, estimates of the amount of sand transferred, the name of the person(s) supervising the transfer activities, and the engineering certification required (if appropriate) for all sand transfer activities.

**7:7E-3A.3 Standards applicable to emergency post-storm beach restoration**

(a) This section on emergency post-storm beach restoration will apply to all beaches which are impacted by coastal storms with a recurrence interval equal to or exceeding a five-year storm event. Emergency post-storm beach restoration projects not specifically identified in this section may be authorized by the Department through an Emergency Permit authorization pursuant to N.J.A.C. 7:7-1.7 if the Department determines that there is an imminent threat to lives or property.

(b) Beach restoration activities, as part of an emergency post-storm recovery, include: the placement of clean fill material with grain size compatible with (or larger than) the existing beach material; the bulldozing of sand from the lower beach profile to the upper beach profile; the alongshore transfer of sand on a beach; the placement of concrete or rubble; and the placement of sand filled geotextile bags or tubes. The placement of sand filled geotextile bags or tubes is preferred to the placement of concrete, rubble or other material.

(c) The emergency post-storm beach restoration activities in (b) above should be designed and implemented as a means to restore the beaches to the pre-storm condition, or to restore the beaches to a level sufficient to provide protection from a storm event with a minimum recurrence interval of five years (five-year storm protection). For the purpose of this section, five-year storm protection equates to a minimum 30-foot wide berm at elevation +8 Mean Sea Level (NAD, 1983). Restoration beyond the pre-storm beach condition is encouraged by the Department, but will not be considered "emergency post-storm beach restoration," pursuant to this section.

(d) The bulldozing of sand from the lower beach profile to the upper beach profile, as part of an emergency post-storm beach restoration plan, is acceptable, in accordance with the following standards:

1. Bulldozing is limited to the beach area landward of the low water line. Removal of material from below the low water line is considered dredging, and is not authorized pursuant to this section; and
2. The beach face cannot be graded to a slope steeper than 1:3.

(e) The longshore transfer of sand from one beach area to another, as part of an emergency post-storm beach restoration plan, is acceptable, in accordance with the following standards:

1. No disturbance to existing dune areas is permitted;
2. Sand borrow areas shall not be bulldozed to a depth which exceeds one foot;
3. The borrow areas may not be rescarped until full sand volume recovery has occurred; and
4. An adequate supply of sand is available at the borrow area site, so that the relocation of this material will not decrease the level of protection adjacent to the borrow area.

(f) The placement of sand filled geotextile bags or geotubes, as part of an emergency post-storm beach restoration plan, is acceptable, in accordance with the following standards:

1. In areas where dunes are present, the geotextile bags or geotubes shall be placed along the toe of any scarped dune, or seaward of the dune toe, and not on the dune itself;
2. In areas where dunes are not present, the geotextile bags or geotubes shall be placed at the landward limit of the beach and in no case be placed below the mean high water line;
3. The geotextile bags or geotubes shall be tapered at the end of the project area, to minimize the impact to adjacent areas which are not protected by the geotextile bags or geotubes;
4. The crest and seaward side of the geotubes shall be buried to achieve a gradual, uniform slope from the upper beach to the crest of the geotextile bag or geotube;
5. The length of shoreline along which the geotextile bags or geotubes are installed shall not exceed a cumulative length of 500 feet;
6. Fill material for the geotextile bags or geotubes shall be from an upland source, excluding the beach and dune; and
7. The geotextile bag or geotube shall be installed parallel to the shoreline.

(g) The placement of sand, gravel, rubble, concrete, or other inert material, as part of an emergency post-storm beach restoration plan, is acceptable, in accordance with the following standards:

1. All material shall be non-toxic sand, gravel, concrete, rubble, or other inert material;
2. The placement of concrete or rubble shall be temporary in nature, and is not to be used as permanent protection, unless it is part of a DEP approved, engineered design for permanent shore protection;
3. All concrete and rubble placed on the beach shall be removed within 90 days, unless the placement is part of a Department approved, engineered design for permanent shore protection; and
4. The use of automobiles, tires, wood debris, asphalt, appliances or other solid waste is prohibited.

#### **7:7E-3A.4 Standards applicable to dune creation and maintenance**

(a) Dune creation and maintenance includes the placement and/or repair of sand fencing (including wooden support posts), the planting and fertilization of appropriate dune vegetation, the maintenance and clearing of beach access pathways less than eight feet in width, and the construction or repair of approved dune walkover structures. Bulldozing, excavation, grading, vegetation removal or clearing, and relocation of existing dunes are not authorized pursuant to this section.

(b) All dune creation and maintenance activities should be conducted in accordance with the specifications found in Guidelines and Recommendations for Coastal Dune Restoration and Creation Projects (DEP, 1985), and/or Restoration of Sand Dunes Along the Mid-Atlantic Coast (Soil Conservation Service, 1992). The Department will provide

site specific technical assistance for dune creation and maintenance projects, upon request.

(c) All proposed dune vegetation should be limited to the following coastal species: American Beachgrass (*Ammophila breviligulata*), Coastal Panicgrass (*Panicum amarulum*), Bayberry (*Myrica pennsylvanica*), Beach Plum (*Prunus maritima*), and Shore Juniper (*Juniperus conferta*). Although they may not be currently available from commercial nurseries at this time, the following plant species are also well suited to the dune environment: Seaside Goldenrod (*Solidago sempervirens*), Beach Pea (*Lathyrus japonicus*), Sea Oats (*Uniola paniculata*), Bitter Panicgrass (*Panicum amarum*), and even Saltmeadow Cordgrass (*Spartina patens*).

1. American beachgrass is the preferred species for the stabilization of newly established dunes, and for stabilization of the primary frontal dune. Woody plant species are suitable for back dune and secondary dune environments. Herbaceous plant species are preferred as supplemental plantings for all dune areas.

2. Dune vegetation should be diversified as much as possible, in an effort to provide continuous stabilization in the event that pathogens reduce or eliminate the effectiveness of one species. A complex of associated grasses, herbaceous species and woody species is preferred to the planting of one species.

(d) The construction of elevated timber dune walkover structures shall be in accordance with the standards and specifications (or similar specifications) described in Beach Dune Walkover Structures (Florida Sea Grant, 1981). The construction of elevated dune walkover structures, particularly at municipal street-ends and other heavily used beach access points, is preferred to the construction of pathways or walkways through the dunes.

1. Copies of the DEP and Florida Sea Grant reports are available from the DEP, Land Use Regulation Program, PO Box 439, Trenton, NJ 08625-0439. Copies of the Soil Conservation Service report are available directly from the Soil Conservation Service, Plant Materials Center, 1536 Route 9 North, Cape May Court House, NJ 08210.

(e) The construction of at-grade dune walkovers is acceptable only at single family and duplex residential dwellings, subject to the following conditions:

1. Only one walkover per residential building is allowed;
2. The width of the walkover must not exceed four feet;
3. The walkover shall be fenced on both sides through the use of sand fencing;
4. The use of unrolled sand fencing as a base for the walkover is preferred to the use of planks and boards. Sand fence based walkovers allow for easier seasonal removal and placement, and allow for greater growth of beachgrass, while still providing an adequate base for pedestrian traffic; and
5. Solid boardwalk type walkovers shall be elevated at least one foot above the dune, to allow for movement of sand and vegetative growth under the boardwalk structure.

(f) The controlled use of discarded natural Christmas trees for the purpose of dune stabilization is generally discouraged, but may be acceptable, in accordance with the standards set forth below. Discarded Christmas trees serve the same function as sand

fencing, by trapping wind blown sand and facilitating sand deposition and dune formation. However, uncontrolled or inappropriate placement of trees will hinder the development of dunes and may present a fire hazard.

1. Only natural, coniferous trees are suitable for use in dune stabilization. The use of tree limbs, clippings, artificial trees, and other dead vegetation is prohibited;

2. Trees should be placed at least 100 feet landward of the high water line, in areas which are generally not subject to spring tidal inundation and wave swash action;

3. The placement of trees should be oriented against the prevailing winds, in either a straight line or zig-zag formation;

4. The trees should be installed by overlapping the stump end of one tree with the pointed end of another, and then anchoring the connection point with a sufficient amount of sand to hold the trees in place;

5. Newly placed trees should be monitored to ensure that the trees remain anchored and do not become dislodged. Additional quantities of sand or wooden anchor stakes may be used to hold the trees in place until they become stabilized; and

6. All newly deposited sand should be stabilized through the planting of beachgrass, during the appropriate planting season.

#### **7:7E-3A.5 Standards applicable to the construction of boardwalks**

(a) The construction of oceanfront or bayfront boardwalks should address a number of engineering concerns related to structural support, resistance to vertical and horizontal water and wind loads, and scouring. The construction of boardwalks along tidal shoreline is acceptable, in accordance with the following standards:

1. All timber support piles shall be a minimum of eight inches in diameter;

2. Support piles should be driven to a depth of at least -10 feet (mean sea level), for all V-zone locations. In A-zones, the depth of penetration should be at least -five feet (mean sea level);

3. The method for insertion of piles should be a pile driver or drop hammer;

4. All support joists and timber connections should be anchored through the use of hurricane clips or metal plates; and

5. All metal fasteners, including but not limited to bolts, screws, plates, clips, anchors and connectors, shall be hot dipped galvanized.

### **SUBCHAPTER 3B. INFORMATION REQUIRED IN TIDAL WETLAND AND INTERTIDAL AND SUBTIDAL SHALLOWS MITIGATION PROPOSALS**

#### **7:7E-3B.1 Purpose and scope**

(a) This subchapter sets forth the standards for mitigation proposals pursuant to N.J.A.C. 7:7E-3.15 and 7:7E-3.27.

1. Mitigation for the loss of tidal wetlands and intertidal and subtidal shallows shall comply with the Coastal Permit Program rules, N.J.A.C. 7:7, and the Coastal Zone Management rules, N.J.A.C. 7:7E, and include an appropriate buffer area; and

2. Mitigation for the loss of freshwater wetlands shall comply with the Freshwater Wetlands Protection Act rules, N.J.A.C. 7:7A, Coastal Permit Program rules, N.J.A.C. 7:7, and the Coastal Zone Management rules, N.J.A.C. 7:7E.

**7:7E-3B.2 Tidal wetland and intertidal and subtidal shallows mitigation proposal requirements**

- (a). All tidal wetland and intertidal and subtidal shallows mitigation proposals submitted to the Land Use Regulation Program shall include, but not be limited to:
1. An introduction describing the wetland or intertidal and subtidal shallows mitigation proposal. The introduction shall include the following:
    - i. The amount, in acres, of:
      - (1) Wetlands to be created, enhanced, or restored, in accordance with N.J.A.C. 7:7E-3.27 and the associated wetlands buffer area required by N.J.A.C. 7:7E-3.28; or
      - (2) The amount of intertidal and subtidal shallows to be created as required by N.J.A.C. 7:7E-3.15;
    - ii. The goals of the mitigation project in terms of either (a)1ii(1) or (2) below:
      - (1) For creation, restoration or enhancement of wetlands, the wetlands types, values, and functions, and a discussion of how the mitigation proposal will satisfy those goals. For example, the goal of the wetlands mitigation project is to establish a low marsh wetland complex dominated by *Spartina alterniflora* that is flowed twice daily by the tide; or
      - (2) For intertidal and subtidal shallows creation, the area, depth, and duration of tidal inundation;
    - iii. The reasons why the mitigation site is an appropriate site for meeting the goals in (a)1ii above, and the aspects of the site that will ensure the success of the mitigation project;
    - iv. A copy of the USGS quad map(s) showing the location of the permitted activity and showing the mitigation site with the state plane coordinates of the mitigation site. The accuracy of these coordinates shall be within 50 feet of the actual center point of the site. For linear mitigation projects 2,000 feet in length and longer, additional coordinates shall be provided at each 1,000 foot interval; and
    - v. The New Jersey Wetlands/Tidelands Map number(s) for the development and for the mitigation site, if the mitigation site is at a different location;
  2. A description (such as size, type, vegetation, hydrology, and wildlife use) of the wetlands or intertidal and subtidal shallows that are being destroyed or disturbed by the permitted activity;
  3. Photographs of the proposed mitigation site showing topography, vegetation, tidal streams and wetland features;
  4. The names and addresses of all current and proposed owner(s) of the mitigation site;
  5. The lot, block, municipality and county of the proposed mitigation site. This information shall also be visible on the front page of the proposal and on the site plan;
  6. A discussion relative to the proposed hydrology of the mitigation site. The discussion should focus on the sources of water for the mitigation project, provide seasonal high water table information as well as the projected elevation of final grade of the mitigation project in relation to mean sea level (MSL), along with slope percent;
  7. A projected water budget for the proposed mitigation site. The water budget should detail the sources of water for the mitigation project as well as the water losses. The projected water budget should document that an ample supply of water is available to create, enhance, or restore wetland conditions, as applicable. The water budget must

contain sufficient data to show that the mitigation project will indefinitely in the future have sustained wetland hydrology, or for intertidal and subtidal shallows, that the mitigation project will have sustained tidal inundation. The water budget shall include the following regional information for the proposed and existing site conditions:

- i. The seasonal high water table;
  - ii. The tidal range (low, high and spring high tide) over the course of a month;
  - iii. For wetland creation, restoration or enhancement, the elevation of the existing reference wetland system in the vicinity of the project site, if applicable; and
  - iv. For wetland creation, restoration or enhancement, the salinity range of adjacent waters;
8. For wetland creation, restoration and enhancement, a detailed discussion relating to the created substrate of the proposed mitigation site, including a description of how the substrate of the site will be prepared, as well as a demonstration that the soil texture and pH are appropriate for the proposed wetland community;
9. For wetland creation, restoration and enhancement, a landscape plan showing the proposed vegetative community on the proposed mitigation site, including the buffer area defined at N.J.A.C. 7:7E-3.28. The landscape plan shall include the following:
- i. The species;
  - ii. The quantity and location of each species;
  - iii. The stock type (for example, plugs, potted, seed);
  - iv. The source of the plant material;
  - v. The proper time to plant; and
  - vi. Any appropriate substitutions as approved by the Department;
10. For wetland creation, restoration and enhancement, a preventative maintenance plan detailing how invasive or noxious vegetation will be controlled, and how predation of the mitigation plantings will be prevented. The plan shall describe the measures to be taken if a problem with invasive or noxious plants or predation occurs during the construction or monitoring period. The installation of goose fences to control problems resulting from the presence of geese in the State is encouraged;
11. A draft conservation restriction that meets the requirements of N.J.A.C. 7:7E-3.27(h)6. A model conservation restriction is available from the Land Use Regulation Program, PO Box 439, Trenton, New Jersey 08625-0439, (609) 777-0454;
12. A metes and bounds description of the proposed mitigation site. For wetland creation, restoration or enhancement, the metes and bounds description shall include the buffer area as defined at N.J.A.C. 7:7E-3.28;
13. An estimate of the actual cost of carrying out the construction of the mitigation project. The cost estimate shall include the value of the land, site preparation costs, engineering costs, plantings costs, environmental consultant fees, attorney fees, construction costs, supervising construction fees and monitoring costs. The cost estimate of the project will be used when determining the amount of the financial assurance required;
14. A site plan for the mitigation project which includes:
- i. The lot, block, municipality and county of the proposed mitigation site; and
  - ii. Existing and proposed elevations and grades of the mitigation site, and off-site elevations and grades when the proposed elevations on the mitigation project site will create potentially unstable conditions on the adjoining parcel or create slopes greater than

15 percent. All existing and proposed elevations and grades must be shown in at least one foot intervals. For wetland creation, restoration or enhancement, only, the slope of the proposed mitigation site shall have a run to rise ratio no greater than 10 feet vertical to one foot horizontal (10:1) along a created buffer area as well as along any berms that are intended to function as water control structures or berms created along a stream;

iii. Pre- and post- construction plan views and cross sectional views of the mitigation site;

iv. For wetland creation, restoration or enhancement only, the buffer area required under N.J.A.C. 7:7E-3.28;

v. For wetland creation, restoration or enhancement only, a detail that shows, or a statement indicating the soil amendments and the seed stabilization mix, if any, to be used on the mitigation site;

15. A construction schedule including projected dates of excavation, planting, fertilizing, as appropriate;

16. Certification demonstrating that the proposed mitigation will not adversely affect districts, buildings, structures, or archaeological sites that are listed in, or eligible for listing in, the National Register of Historic Places. If during construction of the mitigation site the mitigator encounters National Register of Historic Places listed or eligible historic districts, buildings, structures, or archaeological sites, the mitigator shall notify the Department immediately and proceed as directed by the Department;

17. A financial assurance that meets the requirements at N.J.A.C. 7:7E-3B.3; and

18. Any additional information the Department determines necessary to review an individual mitigation project.

### **7:7E-3B.3 Financial assurance requirements**

(a) A letter of credit or other financial assurance is required prior to approval of the mitigation proposal by the Department, except if the mitigator is a government agency or an entity that is exempt from this requirement under Federal Law. The letter of credit or other financial assurance shall be obtained from a firm licensed to do business in New Jersey.

(b) The letter of credit or other financial assurance shall be in the amount sufficient for the Department to hire an independent contractor to complete and maintain the mitigation project should the mitigator default. The financial assurance shall be in the following amounts:

1. For wetland creation, restoration or enhancement, and for intertidal and subtidal shallows creation, a construction assurance, equal to 115 percent of the estimated cost of completing the mitigation; and

2. For wetland creation, restoration or enhancement, a maintenance assurance to ensure success of the mitigation through the completion of the monitoring period, equal to 115 percent of the estimated cost of maintaining and monitoring the mitigation project.

(c) The financial assurance will be reviewed annually by the Department and shall be adjusted to reflect current economic factors.

(d) The portion of the financial assurance required under (b)1 above, shall be released

upon the Department's determination that the construction phase and planting phase, if any, of the mitigation project have been successfully completed in accordance with the mitigation proposal; and

(e) The portion of the financial assurance required under (b)2 above, shall be released upon the Department's finding that the mitigation project is successful in accordance with N.J.A.C. 7:7E-3B.5.

**7:7E-3B.4 Department review of mitigation proposal**

(a) The Department shall, within 60 days after receiving a mitigation proposal, review the proposal for completeness and:

1. Request any addition information; or
2. Declare the mitigation proposal complete.

(b) The Department shall approve a mitigation proposal only if it meets all of the applicable requirements of this subchapter.

(c) Prior to the commencement of mitigation, the mitigator shall submit proof that the conservation restriction required at N.J.A.C. 7:7E-3B.2(a)11 was recorded with the County Clerk (or the Registrar of Deeds and Mortgages, if applicable).

**7:7E-3B.5 Post-construction monitoring of the mitigation site**

(a) All mitigation projects subject to this subchapter shall perform post-construction monitoring in accordance with (a)1 or 2 below.

1. All tidal wetland mitigation sites shall demonstrate compliance with each post-construction monitoring season specified in (b) 1, 2 and 3 below. Post-construction monitoring shall begin the first full growing season after the construction/planting of the mitigation project is completed. A full growing post-construction monitoring season, in general, is the period from the beginning of April through the beginning of October, depending upon the location of the site in the State.

2. All intertidal and subtidal shallows mitigation sites shall demonstrate compliance with the post-construction monitoring standards at (c)1 and 2 below for a lunar month after construction of the mitigation site is completed. A lunar month is the period between two successive full moons.

(b) For wetland mitigation projects, the post-construction monitoring required at (a)1 above shall meet the standards listed below for each full growing post-construction monitoring season. Failure to meet the standards for a given post-construction monitoring season described at (b)1, 2 or 3 below shall result in a remedial action by the mitigator. The Department, after consultation with the mitigator, shall determine the remedial actions necessary to correct the unsatisfactory condition. Remedial action may include, but not be limited to, regrading, replanting, or relocation of the mitigation site.

1. For the first post-construction monitoring season to be considered successful, the post-construction monitoring report described at (d) below shall provide documentation demonstrating that the standards listed at 1i through iv below are satisfied. If one or more of the standards listed below are not satisfied, then a remedial action as described in

(b) above will be required, and this full growing post-construction monitoring season shall be repeated.

i. Documentation through soil borings, demonstrating that the appropriate soil was used on the site as indicated in the mitigation approval;

ii. As-built plans, demonstrating that the site was graded and planted in accordance with the approved mitigation plans;

iii. Based on the approved water budget prepared in accordance with N.J.A.C. 7:7E-3B.2(a)7, documentation demonstrating the mitigation site is a wetland;

iv. Documentation demonstrating that the percent coverage of the planted vegetation or targeted hydrophytes as detailed in the approved mitigation plan has been achieved.

2. For the second post-construction monitoring season to be considered successful, the post-construction monitoring report described at (d) below shall provide documentation demonstrating that the standards listed at (b)2i and ii below are satisfied. If the standards at (b)2i and ii listed below are not satisfied, then a remedial action as described at (b) above will be required, and this full growing post-construction monitoring season shall be repeated.

i. Based on the approved water budget prepared in accordance with N.J.A.C. 7:7E-3B.2(a)7, documentation demonstrating that the mitigation site continues to be a wetland;

ii. Documentation demonstrating that the percent coverage of the planted vegetation or targeted hydrophytes as detailed in the approved mitigation plan has been achieved.

3. For the final post-construction monitoring season to be considered successful, the post-construction monitoring report described at (d) below shall provide documentation demonstrating that the standards listed at (b)3i through iv below are satisfied. If one or more of the standards listed below are not satisfied, then a remedial action as described at (b) above will be required, and this full growing post-construction monitoring season shall be repeated.

i. Documentation demonstrating that the approved goals of the wetland mitigation project (including the required buffer area) prepared pursuant to N.J.A.C. 7:7E-3B.2(a) and the permit are satisfied. This documentation shall include information concerning invasive/noxious plant species and the percent coverage of these species on the site;

ii. Based on the approved water budget prepared in accordance with N.J.A.C. 7:7E-3B.2(a)7, documentation demonstrating that the mitigation site is a wetland. The documentation shall include, when appropriate, monitoring well data, stream gauge data, photographs and field observation notes collected throughout the monitoring period;

iii. Documentation demonstrating that the percent coverage of the planted vegetation or targeted hydrophytes as detailed in the approved mitigation plan has been achieved;

iv. A field delineation of the wetlands at the wetland mitigation project site, based on techniques specified in the Federal Manual for Identifying and Delineation Jurisdictional Wetlands (1989) herein incorporated by reference. This manual is available from the Department's Office of Maps and Publications at (609) 777-1038 for a fee; and

v. A plan showing the flagged wetland delineation required at (b)3iv above. The wetland line shall include global positioning system data points.

(c) For intertidal and subtidal shallows mitigation projects, the post-construction monitoring required at (a)2 above shall comply with (c)1 and 2 below. If one or more of the standards listed below are not satisfied, then the post-construction monitoring shall be

repeated the following lunar month(s) until all of the standards listed below are satisfied. Failure to meet the standards for a given post-construction monitoring season described at (c)1 or 2 below shall result in a remedial action. The Department, after consultation with the mitigator, shall determine the remedial actions necessary to correct the unsatisfactory condition. Remediation may include, but not be limited to, regrading of the mitigation site. The mitigator shall submit:

1. As-built plans with soundings demonstrating that the site was graded according to the approved mitigation plans; and

2. Documentation demonstrating that the mitigation site meets the definition of an intertidal subtidal shallow, that is it is permanently or twice daily submerged from the spring high tide to a depth of four feet below mean low water.

(d) The post-construction monitoring reports required at (b) and (c) above shall be submitted to the Department by November 15 of each year and shall include five copies of the following:

1. A USGS quad map showing the location of the mitigation site; a county road map showing the location (including the lot and block) of the mitigation site, of the mitigation site; and a copy of an aerial photograph of the mitigation site. The point(s) of access to the mitigation site must be clearly indicated on all maps;

2. A copy of the permit that required the mitigation;

3. A brief description of the mitigation project;

4. Photographs of the mitigation site with a location map indicating the location and direction of each photograph;

5. For mitigation projects requiring the establishment of a vegetative community, an assessment of the planted vegetation and the species that are naturally colonizing the site. This assessment shall include data sheets from the sampling points which describe the vegetation present, the percent coverage of the vegetation, the results of the analysis of the soil borings and the location of the water table;

6. Based on the approved water budget prepared in accordance with N.J.A.C. 7:7E-3B.2(a)7, documentation demonstrating that the mitigation site is a wetland or intertidal or subtidal shallows. The documentation shall include, as appropriate, monitoring well data, stream gauge data, photographs and/or field observation notes collected throughout the post-construction monitoring period;

7. Documentation, based on field data, that the approved goals of the mitigation project (including the buffer area, for wetland creation, restoration or enhancement only) prepared pursuant to N.J.A.C. 7:7E-3B.2(a), are satisfied;

8. A narrative evaluating the success/failure of the project in accordance with (b) and/or (c) above; and

9. In the event the mitigation monitoring period is a failure in accordance with (b) and/or (c) above, a narrative description of proposed actions that will permanently rectify the problems.

### **SUBCHAPTER 3C. STANDARDS FOR CONDUCTING AND REPORTING THE RESULTS OF AN ENDANGERED OR THREATENED WILDLIFE OR PLANT SPECIES HABITAT**

## **IMPACT ASSESSMENT AND/OR ENDANGERED OR THREATENED WILDLIFE SPECIES HABITAT EVALUATION**

### **7:7E-3C.1 Purpose and Scope**

(a) This subchapter sets forth the standards for conducting an Endangered or Threatened Wildlife or Plant Species Habitat Impact Assessment and for conducting an Endangered or Threatened Wildlife Species Habitat Evaluation. One or both must be employed by an applicant seeking to demonstrate compliance with or inapplicability of N.J.A.C. 7:7E-3.38 when the site contains or abuts areas mapped as endangered or threatened wildlife species habitat on the Landscape Maps. This subchapter also sets forth the standards for reporting the results of an Endangered or Threatened Wildlife or Plant Species Habitat Impact Assessment and an Endangered or Threatened Wildlife Species Habitat Evaluation.

(b) An Endangered or Threatened Wildlife or Plant Species Habitat Impact Assessment is required to demonstrate that endangered or threatened wildlife or plant species habitat as defined at N.J.A.C. 7:7E-3.38(a) would not, directly or through secondary impacts on the relevant site or in the surrounding area, be adversely affected by the proposed development. The standards for conducting an impact assessment pursuant to N.J.A.C. 7:7E-3.38(b), (d) and (e) are found at N.J.A.C. 7:7E-3C.2.

(c) An Endangered or Threatened Wildlife Species Habitat Evaluation is required to demonstrate that a site does not contain suitable habitat, as defined at N.J.A.C. 7:7E-3.38(a), including sufficient buffer to ensure continued survival of the population of the species, pursuant to N.J.A.C. 7:7E-3.38(c). The standards for conducting an evaluation are found at N.J.A.C. 7:7E-3C.3.

(d) The reporting requirements for habitat evaluations and impact assessments are found at N.J.A.C. 7:7E-3C.4.

### **7:7E-3C.2 Standards for conducting Endangered or Threatened Wildlife or Plant Species Habitat Impact Assessments**

(a) These standards shall be used by applicants who choose not to dispute the Department designation of the site as endangered or threatened wildlife species habitat. Applicants shall demonstrate compliance with N.J.A.C. 7:7E-3.38(b) by providing information required at this section and N.J.A.C. 7:7E-3C.4. The required information shall demonstrate that the proposed development will not negatively affect the population(s) or habitat of endangered or threatened wildlife species that resulted in identification of the site, or an area abutting the site, as endangered or threatened wildlife species habitat in accordance with N.J.A.C. 7:7E-3.38(a) and/or (d).

(b) These standards shall be used by applicants if an endangered or threatened plant species has been documented to be on the site or a portion of the site or an area abutting the site. Applicants shall demonstrate compliance with N.J.A.C. 7:7E-3.38(b) by providing information required at this section and N.J.A.C. 7:7E-3C.4. The required information shall demonstrate that the proposed development will not negatively affect

the population(s) or habitat of endangered or threatened plant species documented to be on the site or a portion of the site or on an area abutting the site.

(c) Impact assessments shall be conducted for each endangered or threatened wildlife or plant species described in (a) and/or (b) above. The impact assessment shall consider the likely affects of the proposed development on the local populations of the particular species on or abutting the site. The impacts shall be assessed using accepted ecological principles and scientific literature on each species and both direct and indirect impacts of the proposed development shall be considered. This assessment shall be based on habitat requirements and life history of each species, and the manner in which the proposed development may alter habitat, including, but not limited to, vegetation, soils, hydrology, human disturbance, and effects on competitor, parasite, or predator species.

### **7:7E-3C.3 Standards for conducting Endangered or Threatened Wildlife Species Habitat Evaluations**

(a) These standards shall be used by applicants who dispute the Department designation of the site as endangered or threatened wildlife species habitat, or dispute the boundary of that habitat. Applicants who dispute the Department's determination shall provide information that demonstrates that the habitat is not suitable for each of the endangered or threatened wildlife species that resulted in that resulted in identification of the site, a portion of the site, or an area abutting the site, as endangered or threatened wildlife species habitat in accordance with N.J.A.C. 7:7E-3.38(a) and/or (d).

(b) Habitat evaluations for endangered or threatened wildlife species pursuant to N.J.A.C. 7:7E-3.38(c) shall be conducted for each wildlife species described in (a) above. This habitat evaluation shall:

1. Use scientific methodology appropriate for each species or species group;
2. Examine specific attributes and characteristics of the site that limit or eliminate its suitability as habitat, including, but not limited to, an examination of vegetative cover, soils, hydrology, existing land use and any other factors that are used to determine suitability of a site for the species. The site's vegetative analysis shall include an on-site investigation and evaluation; and
3. Include an examination of the area surrounding the site using aerial photographs and/or appropriate cover maps.

(c) A survey for the endangered or threatened wildlife species that resulted in identification of the site, a portion of the site, or an area abutting the site, as endangered or threatened wildlife species habitat in accordance with N.J.A.C. 7:7E-3.38(a) and/or (d), will only be considered in the context of supplementing information on habitat suitability. If such a survey is conducted, it shall be conducted consistent with techniques established in the scientific literature.

### **7:7E-3C.4 Standards for reporting the results of impact assessments and habitat evaluations**

(a) All habitat evaluations and impact assessments submitted to the Department shall include:

1. An introduction describing the goals of the habitat evaluation and/or impact assessment;
2. A copy of the USGS quad map(s) showing the location of the site, with the State plane coordinates of the site. The accuracy of these coordinates shall be within 50 feet of the actual center point of the site. For linear sites, 2,000 feet in length and longer, additional coordinates shall be provided at each 1,000 foot interval;
3. The lot, block, municipality and county in which the site is located;
4. For wildlife habitat evaluations and impacts assessments only, a map identifying the site, and the areas mapped as endangered or threatened wildlife species habitat on the Landscape Maps onsite and abutting the site, along with a list of the endangered or threatened species that resulted in the mapping of endangered or threatened species habitat;
5. For impact assessments for plant species only, a map identifying the location of the species habitat on the site or abutting the site along with a list of the potential plant species from the Department's Natural Heritage Database;
6. A description of the habitat requirements for each of these species identified at (a)4 and/or 5 above, including appropriate literature citations; and
7. The names and qualifications of all investigators who performed habitat evaluations, species surveys, and/or impact assessments.

(b) For wildlife habitat evaluations only, a narrative, including supporting documentation, including maps, photographs and field logs, which contains the following:

1. A description, for each species, of the findings of the habitat evaluation performed in accordance with N.J.A.C. 7:7E-3C.3;
2. If a survey was conducted in accordance with N.J.A.C. 7:7E-3C. 3(b), literature citations for the methodology used and a description of how the methodology was applied to the survey, giving the following information: surveyor's name(s), dates and times surveys were performed, number of samples, and number of replications. This information shall be provided for each species surveyed.
3. A comparison of the findings of the habitat evaluation with the known habitat requirements for each species, as provided at (a)6 above, and a description of the specific attributes and characteristics of the site that limit or eliminate the site's suitability as habitat;

(c) For impact assessments only, a narrative, including supporting documentation, such as maps and photographs, which contains the following:

1. A description for each species, of how the proposed development will alter habitat, including vegetation, soils, hydrology, human disturbance, and effects on competitor, parasite, or predator species. The impact assessment shall describe the likely affects of the proposed development on the local populations of the particular species on or abutting the site and why the development would not directly or through secondary impacts adversely affect each endangered or threatened species habitat; and
2. Literature citations used to reach the conclusions in (c)1 above.

#### **SUBCHAPTER 4. GENERAL WATER AREAS**

### **7:7E-4.1 Purpose and Scope**

(a) General Water Areas are all water areas which are located below either the spring high water line or the normal water level of non-tidal water that are subject to this subchapter and to Special Area rules.

(b) General Water Areas are divided by volume and flushing rate into eight categories as described below:

1. "Atlantic Ocean" includes the area of the Atlantic Ocean that extends out to the three geographical mile limit of the New Jersey territorial sea and is bounded by the boundaries of New York and Delaware (see Appendix, Figure 13c).

2. "Lakes, ponds and reservoirs" are relatively small water bodies with no tidal influence or salinity. Many are groundwater fed, while others serve as surface aquifer recharge areas. Lakes that are the result of former mining operations are not included in this definition, but are defined at N.J.A.C. 7:7E-3.14, Wet Borrow Pits.

3. "Large rivers" are waterways with watersheds greater than 1,000 square miles. Large Rivers are limited to the Delaware, Hudson and Raritan Rivers.

i. The Delaware River is a tidal river from the Bridge Street Bridge in Trenton to its mouth at Delaware Bay, defined as a line between Alder Cover, Lower Alloways Creek Township and the Delaware River Basin Commission-River and Bay Memorial at Liston Point, Delaware.

ii. The Hudson River is a tidal river from the New York State Line to its mouth at Upper New York Bay at the Morris Canal, Jersey City.

iii. The Raritan River is a tidal river from a point approximately 1.1 miles upstream from the Landing Lane Bridge between Piscataway and Franklin Townships to its mouth at Raritan Bay and the Arthur Kill.

4. "Man-made harbors" are semi-enclosed or protected water areas which have been developed for boat mooring or docking.

5. "Medium rivers, creeks and streams" are rivers, streams and creeks with a watershed of less than 1,000 square miles. This definition includes waterways such as the Hackensack, Passaic, Oldmans, Big Timber, Pennsauken, Navesink, Manasquan, Toms, Wading, Mullica, Great Egg, Maurice, Cohansey, Salem, and Rancocas (see Appendix, Figures 13c-e, incorporated herein by reference).

6. "Open bays" are large, semi-confined estuaries with a wide unrestricted inlet to the ocean and with a major river mouth discharging directly into the upper portion. Open bays are limited to the Delaware Bay, Raritan Bay, Sandy Hook Bay and Upper New York Bay (see Appendix, Figure 13b, incorporated herein by reference).

7. "Semi-enclosed and back bays" are a partially confined estuary with direct inlet connection and some inflow of freshwater. Semi-enclosed bays differ from back bays in depth, degree of restriction of inlet and level of freshwater flow.

8. "Tidal guts" are the waterway connections between two estuarine bodies of water. Also known as thorofares or canals, tidal guts control the mix of salt and freshwater. Examples include the Arthur Kill and Kill Van Kull (see Appendix, Figures 13a-e, incorporated herein by reference).

(c) N.J.A.C. 7:7E-4.2 through 4.20 set forth the requirements for specific types of development within General Water Areas as defined at (a) above. In many cases an area

already identified as a Special Area will also fall within the definition of a General Area. In these cases, both General and Special Area rules apply. In case of conflict between General and Special Area rules, the more specific Special Area rules shall apply.

#### **7:7E-4.2 Aquaculture**

(a) Aquaculture is the use of permanently inundated water areas, whether saline or fresh, for the purposes of growing and harvesting plants or animals in a way to promote more rapid growth, reduce predation, and increase harvest rate. Oyster farming in Delaware Bay is a form of aquaculture.

(b) Aquaculture is encouraged in all General Water Areas as defined at N.J.A.C. 7:7E-4.1, provided:

1. It does not unreasonably conflict with resort or recreation uses;
2. It does not cause significant adverse off-site environmental impacts; and
3. It does not present a hazard to navigation. A hazard to navigation includes all potential impediments to navigation, including access to adjacent moorings, water areas and docks and piers.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.3 Boat ramps**

(a) Boat ramps are inclined planes, extending from the land into a water body for the purpose of launching a boat into the water until the water depth is sufficient to allow the boat to float. Boat ramps are most frequently constructed of asphalt, concrete or crushed shell.

- (b) Boat ramps are conditionally acceptable provided:
1. There is a demonstrated need that cannot be met by existing facilities;
  2. They cause minimal practicable disturbance to intertidal flats or subaqueous vegetation;
  3. Boat ramps shall be constructed of environmentally acceptable material, such as concrete or oyster shells; and
  4. Garbage cans are provided near the boat ramp.

(c) Public use ramps shall have priority over restricted use and private ramps.

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.4 Docks and piers for cargo and commercial fisheries**

(a) Docks and piers for cargo and passenger movement and commercial fisheries are structures supported on pilings driven into the bottom substrate or floating on the water surface, used for loading and unloading passengers or cargo, including fluids, connected to or associated with, a single industrial or manufacturing facility or to commercial fishing facilities.

(b) Docks and piers for cargo and passenger movement and commercial fisheries are

conditionally acceptable provided:

1. The width and length of the dock or pier is limited to only what is necessary for the proposed use;
2. The dock or pier will not pose a hazard to navigation. A hazard to navigation includes all potential impediments to navigation, including access to adjacent moorings, water areas and docks and piers; and
3. The associated use of the adjacent land meets all applicable Coastal Zone Management rules.

(c) The standards for port uses are found at N.J.A.C. 7:7E-7.9. The standards for the construction of a dock or pier composed of fill and retaining structures are found at N.J.A.C. 7:7E-4.10.

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.5 Recreational docks and piers**

(a) Recreational and fishing docks and piers are structures supported on pilings driven into the bottom substrate, or floating on the water surface or cantilevered over the water, which are used for recreational fishing or for the mooring of boats or jet skis used for recreation or fishing, except for commercial fishing, and house boats.

(b) Recreational docks and piers, including jet ski ramps, and mooring piles, are conditionally acceptable provided:

1. There is a demonstrated need that cannot be satisfied by existing facilities;
2. The construction minimizes adverse environmental impact to the maximum extent feasible;
3. The docks and piers and their associated mooring piles are located so as to not conflict with overhead transmission lines;
4. There is minimum feasible interruption of natural water flow patterns;
5. Space between horizontal planking is maximized and width of horizontal planking is minimized to the maximum extent practicable. Under normal circumstances, a minimum of 3/8 inch, 1/2 inch, 3/4 inch, or one inch space is to be provided for four inch, six inch, eight to 10 inch, or 12 inch plus wide planks, respectively.
6. The width of the structure shall not exceed twice the clearance between the structure and the surface of the ground below or the water surface at mean high tide (measured from the bottom of the stringers), except for floating docks whose width shall not exceed eight feet. Under typical circumstances the maximum width of the structure shall be eight feet over water and six feet over wetlands and intertidal flats, except as noted at (b)6iii below. For the purposes of this section, an intertidal flat is a low lying strip of land along a shoreline located between spring high and spring low tides. The height of the structure over wetlands shall be a minimum of four feet regardless of width;
  - i. A minimum of eight feet of open water shall be provided between any docks if the combined width of the docks over the water exceeds eight feet;
  - ii. Construction and placement of the dock shall be a minimum of four feet from all property lines, for docks which are perpendicular to the adjacent bulkhead or shoreline; and

iii. In man-made lagoons only, the maximum width of the structure shall be eight feet over water and six feet over wetlands; The height of the structure over wetlands shall be a minimum of four feet;

7. In man-made lagoons only, the structure extends no more than 20 percent of the width of the lagoon from bank to bank; and

8. The proposed structure and associated mooring piles do not hinder navigation or access to adjacent water areas. A hazard to navigation will apply to all potential impediments to navigation, including access to adjacent moorings, water areas and docks and piers.

(c) The construction of recreational docks and piers within areas designated by the Department as shellfish habitat must comply with the standards specified under the shellfish habitat rule, N.J.A.C. 7:7E-3.2.

(d) The construction of recreational docks and piers within submerged vegetation areas must comply the standards specified under the Submerged Vegetation rule, N.J.A.C. 7:7E-3.6.

(e) For sites which have existing dock or pier structures exceeding eight feet in width over water areas and/or wetlands, which were constructed prior to September 1978 and for which the applicant proposes to increase the coverage over the water area or wetland by relocating or increasing the number or size of docks or piers, the existing oversized structures must be reduced to a maximum of eight feet in width over water areas and six feet in width over wetlands and intertidal flats. All structures proposed as part of an expansion must comply with all of the applicable Coastal Zone Management rules.

(f) The construction of covered or enclosed structures such as gazebos or sheds located on or above the decking of recreational docks and piers is prohibited except on public piers owned and controlled by a public agency.

(g) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.6 Maintenance dredging**

(a) Maintenance dredging is the removal of accumulated sediment from previously authorized and legally dredged navigation and access channels, marinas, lagoons, canals or boat moorings for the purpose of maintaining a previously authorized water depth and width for safe navigation.

1. To be considered maintenance dredging:

i. The proposed dredge area must be limited to the same depth, length and width as the previous dredging operation; and

ii. For natural water areas, the area must have been either:

(1) Currently used for navigation or mooring of vessels requiring the proposed water depth; or

(2) Dredged within the last 10 years.

(b) Maintenance dredging is conditionally acceptable to the authorized depth, length

and width within all General Water Areas to ensure that adequate water depth is available for safe navigation, provided:

1. An acceptable dredged material placement site, with sufficient capacity will be used. (see N.J.A.C. 7:7E-4.8 Dredged material disposal in water areas and N.J.A.C. 7:7E-7.12 Dredged material placement on land);

2. Pre-dredging chemical and physical analysis of the dredged material and/or its elutriate may be required where the Department suspects contamination of sediments. Additional testing, such as bioaccumulation and bioassay testing of sediments, may also be required as needed to determine the acceptability of the proposed placement site for the dredged material. The results of these tests will be used to determine if contaminants may be resuspended at the dredging site and what methods may be needed to control their escape. The results will also be used to determine acceptability of the proposed dredged material placement method and site;

3. Turbidity concentrations (that is, suspended sediments) and other water quality parameters at, downstream, and upstream of the dredging site, and slurry or decant water overflows shall meet applicable State Surface Water Quality Standards at N.J.A.C. 7:9B. The Department may require the permittee to conduct biological, physical and chemical water quality monitoring before, during, and after dredging and disposal operations to ensure that water quality standards are not exceeded;

4. If predicted water quality parameters are likely to exceed State Surface Water Quality Standards, or if pre-dredging chemical analysis of dredged material or elutriate reveals significant contamination, the Department will work cooperatively with the applicant to fashion acceptable control measures and will impose seasonal restrictions under specific circumstances identified at (b)7 below;

5. For mechanical dredges such as clamshell bucket, dragline, grab, or ladders, deploying silt curtains at the dredging site may be required, if feasible based on site conditions. Where the use of silt curtains is infeasible, dredging using closed watertight buckets or lateral digging buckets may be required. The Department may decide not to allow mechanical dredging of highly contaminated sites even if turbidity control measures were planned;

6. For hydraulic dredges specific operational procedures designed to minimize water quality impacts, such as removal of cutter head, flushing of pipeline sections prior to disconnection, or limitations on depth of successive cuts may be required;

7. The Department may authorize dredging on a seasonally restricted basis only, in waterways characterized by the following:

i. Known spawning, wintering or nursery areas of shortnose sturgeon, winter flounder Atlantic sturgeon, alewife, blueback herring, striped bass, white perch or blue crab;

ii. Water bodies downstream of known anadromous fish spawning sites under N.J.A.C. 7:7E-3.5 Finfish migratory pathways, where the predicted turbidity plume will encompass the entire cross-sectional area of the water body, thus forming a potential blockage to upstream migration;

iii. Areas of contaminated sediments with high levels of fecal coliform and/or streptococcus bacteria, and/or hazardous substances adjacent to (upstream or downstream) State approved shellfishing waters and public or private bathing beaches; or

iv. Areas within 1,000 meters or less of oyster beds as defined in N.J.A.C. 7:7E-3.2;

and

8. Maintenance dredging side slopes shall not be steeper than 3:1 adjacent to wetlands to prevent undermining and/or sloughing of the wetlands.

(c) Reprofiling, which is the movement of material from one area of a berth or channel to an adjacent, deeper location, is discouraged in all water areas except the New York-New Jersey Harbor Area as provided at (c)1 below.

1. Reprofiling is conditionally acceptable in the New York-New Jersey Harbor Area north of Sandy Hook, excluding the Raritan Bay and its tributaries east of the Cheesequake Creek provided:

- i. The applicant has demonstrated that there is no other available dredged material management alternative;
- ii. The project involves the movement of less than 5,000 cubic yards of material;
- iii. The depth of the material to be removed is limited to three feet;
- iv. There exists a suitable adjacent deep water area with sufficient capacity to accommodate the relocated material within which the material will be stable and located so as not to interfere with adjacent navigation channels or berths; and
- v. The reprofiling is performed by dragging a steel beam or pipe across the berth and/or channel bottom, thereby leveling accumulated sediment to a uniform, specified depth. Alternative procedures will be considered only under special instances where the use of a drag bar is impractical due to limited space in the project area.

(d) Propwash dredging, which is the movement of sediment by resuspending accumulated material by scouring the bottom with boat propellers or specially designed equipment with propellers, is prohibited.

(e) The Department has prepared a dredging technical manual, titled "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters," October 1997, which provides guidance on dredged material sampling, testing, transporting, processing, management, and placement. The manual is available from the Department's Office of Maps and Publications, PO Box 420, Trenton, New Jersey, 08625-0420, (609) 777-1038.

(f) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.7 New dredging**

(a) New dredging is the removal of sediment that does not meet the definition of maintenance dredging at N.J.A.C. 7:7E-4.6.

(b) New dredging is conditionally acceptable in all General Water Areas for boat moorings, navigation channels or anchorages provided:

1. There is a demonstrated need that cannot be satisfied by existing facilities;
2. The facilities served by the new dredging satisfy the location requirements for Special Water's Edge Areas;
3. The adjacent water areas are currently used for recreational boating, commercial fishing or marine commerce;

4. The dredge area causes no significant disturbance to Special Water or Water's Edge Areas;
5. The adverse environmental impacts are minimized to the maximum extent feasible;
6. The dredge area is reduced to the minimum practical;
7. The maximum depth of the newly dredged area shall not exceed that of the connecting access or navigation channel necessary for vessel passage to the bay or ocean;
8. Dredging will have no adverse impacts on groundwater resources;
9. No dredging shall occur within 10 feet of any wetlands. The proposed slope from this 10 foot buffer to the nearest edge of the dredged area shall not exceed three vertical to one horizontal; and
10. Dredging shall be accomplished consistent with all of the following conditions, as appropriate to the dredging method:
  - i. An acceptable dredged material placement site with sufficient capacity will be used. (See N.J.A.C. 7:7E-4.8 Dredged material disposal in water areas, and N.J.A.C. 7:7E-7.12 Dredged material placement on land);
  - ii. Pre-dredging chemical and physical analysis of the dredged material and/or its elutriate may be required where the Department suspects contamination of sediments. Additional testing, such as bioaccumulation and bioassay testing of sediments, may also be required as needed to determine the acceptability of the proposed placement site for the dredged material. The results of these tests will be used to determine if contaminants may be resuspended at the dredging site and what methods may be needed to control their escape. The results will also be used to determine acceptability of the proposed dredged material placement method and site;
  - iii. Turbidity concentrations (that is, suspended sediments) and other water quality parameters at, downstream, and upstream of the dredging site, and slurry water overflows shall meet applicable State Surface Water Quality Standards at N.J.A.C. 7:9B. The Department may require the permittee to conduct biological, physical and chemical water quality monitoring before, during, and after dredging and disposal operations to ensure that water quality standards are not exceeded;
  - iv. If predicted water quality parameters are likely to exceed State Surface Water Quality Standards, or if pre-dredging chemical analysis of dredged material or elutriate reveals significant contamination, then the Department will work cooperatively with the applicant to fashion acceptable control measures and will impose seasonal restrictions under the specific circumstances identified at (b)11vii below;
  - v. For new dredging using mechanical dredges such as clamshell bucket, dragline, grab, or ladders, deploying silt curtains at the dredging site may be required, if feasible based on site conditions. Where the use of silt curtains is infeasible, dredging using closed watertight buckets or lateral digging buckets may be required. The Department may decide not to allow mechanical dredging of highly contaminated sites even if turbidity control measures were planned;
  - vi. For hydraulic dredges, specific operational procedures designed to minimize water quality impacts, such as removal of cutter head, flushing of pipeline sections prior to disconnection, or limitations on depth of successive cuts, may be required;
  - vii. The Department may authorize dredging on a seasonally restricted basis only, in waterways characterized by the following:

- (1) Known spawning, wintering or nursery areas of shortnose sturgeon, winter flounder, Atlantic sturgeon, alewife, blueback herring, striped bass or blue crab;
  - (2) Water bodies downstream of known anadromous fish spawning sites under N.J.A.C. 7:7E-3.5 Finfish migratory pathways, where the predicted turbidity plume will encompass the entire cross-sectional area of the water body, thus forming a potential blockage to upstream migration;
  - (3) Areas of contaminated sediments with high levels of fecal coliform and/or streptococcus bacteria, and/or hazardous substances adjacent to (upstream or downstream) State approved shellfishing waters and public or private bathing beaches; or
  - (4) Areas within 1,000 meters or less of oyster beds as defined in N.J.A.C. 7:7E-3.2; and
- viii. Side slopes shall not be steeper than 3:1 adjacent to wetlands to prevent undermining and/or sloughing of the wetlands.

(c) Propwash dredging, which is the movement of sediment by resuspending accumulated material by scouring the bottom with boat propellers or specially designed equipment with propellers is prohibited.

(d) New dredging or excavation to create new lagoons for residential development is prohibited in wetlands, N.J.A.C. 7:7E-3.27, wetlands buffer, N.J.A.C. 7:7E-3.28, endangered or threatened wildlife or vegetation species habitats, N.J.A.C. 7:7E-3.38, and discouraged elsewhere.

(e) New dredging is conditionally acceptable to control siltation in lakes, ponds and reservoirs, provided that an acceptable sedimentation control plan is developed to address re-sedimentation of these water bodies.

(f) The Department has prepared a dredging technical manual, titled "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters," October 1997, which provides guidance on dredged material sampling, testing, transporting, processing, management, and placement. The manual is available from the Department's Office of Maps and Publications, PO Box 420, Trenton, New Jersey, 08625-0420, (609) 777-1038.

(g) With the exception of N.J.A.C. 7:7E-4.7(b), (c), (d) and (e) above, new dredging is discouraged.

(h) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.8 Dredged material disposal**

(a) Dredged material disposal is the discharge of sediments removed during dredging operations.

(b) The standards relevant to dredged material disposal in water areas are as follows:  
1. Dredged material disposal is prohibited in tidal guts, man-made harbors, medium rivers, creeks and streams, and lakes, ponds and reservoirs. Dredged material disposal is

discouraged in open bays, semi-enclosed and backbays where the water depth is less than six feet;

2. Disposal of dredged materials in the ocean and bays deeper than six feet is conditionally acceptable provided that there is no feasible beneficial use or upland placement site available and it is in conformance with the USEPA and US Army Corps of Engineers Guidelines (40 C.F.R. parts 220-228 and 230-232 and 33 CFR, parts 320-330 and 335-338) established under Section 404(b) of the Clean Water Act and the Evaluation of Dredged Material Proposed for Ocean Disposal Testing Manual, EPA-503/8-91/001, February 1991, and Evaluation of Dredged Material Proposed for Discharge in Inland and Near Coastal Waters Testing Manual, EPA-000/0-93/000, May 1993, as appropriate to the proposed disposal site;

3. Dredged material disposal in water areas shall conform with applicable State Surface Water Quality Standards at N.J.A.C. 7:9B;

4. Overboard disposal (also known as aquatic, open water, side casting, subaqueous, or wet) of uncontaminated sediments into unconfined disposal sites in existing anoxic dredge holes, shall comply with the following:

i. Data on water quality, benthic productivity and seasonal finfish use demonstrate that the unconfined disposal site has limited biological value;

ii All subaqueous dredged material disposal shall utilize best management techniques such as submerged elbows or underwater diffusers and may be limited to a particular tidal cycle to further minimize impacts; and

iii. The hole shall not be filled higher than the depth of the surrounding waters.

5. Overboard disposal of sediments consisting of less than 90 percent sand shall be conditionally acceptable in unconfined disposal sites when shallow waters preclude removal to an upland or confined site. Such disposal shall comply with the following:

i. Shellfish habitats (as defined in N.J.A.C. 7:7E-3.2) are not within 1,000 meters;

ii. Disposal will not smother or cause condemnation or contamination of harvestable shellfish resources (as in N.J.A.C. 7:7E-3.2);

iii. Sediment characteristics of the dredged material and disposal site are similar; and

6. Uncontaminated dredged sediments with 75 percent sand or greater are generally encouraged for beach nourishment.

(c) The standards for dredged material placement on land are found at N.J.A.C. 7:7E-7.12.

(d) The Department has prepared a dredging technical manual, titled "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters," October 1997, which provides guidance on dredged material sampling, testing, transporting, processing, management, and placement. The manual is available from the Department's Office of Maps and Publications, PO Box 420, Trenton, New Jersey, 08625-0420, (609) 777-1038.

(e) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.9 Solid waste or sludge dumping**

(a) The dumping of solid waste or sludge is the discharge of solid or semi-solid waste

material from industrial or domestic sources or sewage treatment operations into a water area.

(b) The dumping of solid or semi-solid waste of any type in any General Water Area is prohibited.

(c) Rationale: See the note at the beginning of this Chapter.

**7:7E-4.10 Filling**

(a) Filling is the deposition of material including, but not limited to, sand, soil, earth, and dredged material, into water areas for the purpose of raising water bottom elevations to create land areas.

(b) Filling is prohibited in lakes, ponds, reservoirs and open bay areas at greater than 18 feet as defined at N.J.A.C. 7:7E-4.1, unless the filling is consistent with the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) and Freshwater Wetlands Protection Act rules, N.J.A.C. 7:7A.

(c) Filling in a man-made lagoon as defined at N.J.A.C. 7:7E-1.8, is discouraged unless:

1. The filling complies with (d) below; or
2. In those areas where two existing lawful bulkheads are not more than 75 feet apart and no limit of fill line has been promulgated by the Department, the connecting bulkhead may not extend seaward of a straight line connecting the ends of the existing bulkheads. Compliance with the mitigation rule at N.J.A.C. 7:7E-1.6 shall not be required in such cases.

(d) Except as provided in (b) and (c) above, filling is discouraged in all other water areas. In cases where there is no alternative to filling, filling is conditionally acceptable provided:

1. The use that requires the fill is water dependent;
2. There is a demonstrated need that cannot be satisfied by existing facilities;
3. There is no feasible or practical alternative site on an existing Water's Edge;
4. The minimum practicable area is filled;
5. The adverse environmental impacts are minimized, for example, by compensating for the loss of aquatic habitat by creation of an area of equivalent or greater environmental value elsewhere in the same estuary;
6. Minimal feasible interference is caused to Special Areas; and
7. Pilings and columnar support or floating structures are unsuitable for engineering or environmental reasons.

(e) Mitigation shall be required for the filling of tidal water areas at a ratio of one acre created to one acre lost in the same estuary. The mitigation standards for the filling of intertidal and subtidal shallows are found at N.J.A.C. 7:7E-3.15(g) and (h). Mitigation shall not be required for the following:

1. Filling in accordance with N.J.A.C. 7:7E-4.10(c);

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2. Beach nourishment in accordance with N.J.A.C. 7:7E-7.11(d); and
3. Construction of a replacement bulkhead in accordance with N.J.A.C. 7:7E-7.11(e)2i or ii.

(f) Filling of wetlands must comply with the Wetlands rule, N.J.A.C. 7:7E-3.27.

(g) Filling using clean sediment of suitable particle size and composition is acceptable for beach nourishment projects provided it meets the standards of the Coastal Engineering rule, N.J.A.C. 7:7E-7.11(d)

(h) Standards for the removal of unauthorized fill are as follows:

1. For filling which took place prior to September 26, 1980 (the effective date of the Coastal Zone Management rules Statewide, or prior to September 28, 1978 for areas within the coastal area as defined by CAFRA (N.J.S.A. 13:19-4), removal shall be required only if the fill has resulted in ongoing significant adverse environmental impacts, such as the blocking of an otherwise viable tidal wetland or water body, and its removal will alleviate the adverse impacts.

2. For filling which took place subsequent to September 26, 1980 (or subsequent to September 28, 1978 for areas within the coastal area defined as defined by CAFRA (N.J.S.A. 13:19-4)) removal shall be required if the fill does not comply with the standards of (b), (c) or (d) above.

(i) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.11 Mooring**

(a) A boat mooring is a temporary or permanently fixed or floating anchored facility in a water body for the purpose of attaching a boat.

(b) Temporary or permanent boat mooring areas are conditionally acceptable provided:

1. There is a demonstrated need that cannot be satisfied by existing facilities;
2. Adverse environmental impacts are minimized to the maximum extent practicable;
3. The mooring area is adequately marked and is located so as not to hinder navigation. A hazard to navigation will apply to all potential impediments to navigation, including access to adjacent moorings, water areas, docks and piers.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.12 Sand and gravel mining**

(a) Sand and gravel mining is the removal of sand or gravel from the water bottom substrate, usually by suction dredge, for the purpose of using the sand or gravel at another location.

(b) Sand and gravel mining is discouraged in all water body types except as provided at (b)1 below.

1. Sand and gravel mining is prohibited in lakes, ponds and reservoirs, man-made

harbors and tidal guts as defined at N.J.A.C. 7:7E-4.1, unless the water body was created by the mining process, in which case the use is conditionally acceptable provided:

- i. Direct and indirect impacts to Special areas are minimized;
- ii. Turbidity and resuspension of toxic materials is controlled throughout the mining operation consistent with the State's Surface Water Quality Standards (N.J.A.C. 7:9B-4);
- iii. There is an acceptable disposal site for the waste from washing operations;
- iv. In rivers, creeks, and streams, the depth of water at the mining site is at least six feet below mean low water;
- v. The mining will not increase shoreline erosion; and
- vi. The mining will not create anoxic water conditions.

(c) Sand and gravel mining for the purposes of beach nourishment is conditionally acceptable provided:

1. Direct and indirect impacts to special areas and marine fish and fisheries are minimized;
2. In rivers, creeks, and streams, the depth of water at the mining site is at least six feet below mean low water;
3. The mining will not increase shoreline erosion;
4. The mining will not create anoxic water conditions; and
5. The beach nourishment project complies with the coastal engineering rule, N.J.A.C. 7:7E-7.11(d).

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.13 Bridges**

(a) A bridge is any continuous structure spanning a water body, except for an overhead transmission line.

(b) Bridges are conditionally acceptable provided:

1. There is a demonstrated need that cannot be satisfied by existing facilities;
  2. Pedestrian and bicycle use is provided for unless it is demonstrated to be inappropriate; and
  3. Fishing catwalks and platforms are provided to the maximum extent practicable.
- This shall be taken into consideration during the design phase of all proposed bridge projects.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.14 Submerged pipelines**

(a) Submerged pipelines (pipelines) are underwater pipelines which transmit liquids or gas, including crude oil, natural gas, water petroleum products or sewerage.

(b) Submerged pipelines are conditionally acceptable provided:

1. The pipelines are not sited within Special Areas, unless no prudent and feasible alternate route exists;
2. Directional drilling is used unless it is demonstrated that the use of directional

drilling is not feasible;

3. The pipeline is buried to a sufficient depth to avoid exposure or hazard;
4. All trenches are backfilled to preconstruction depth with naturally occurring sediment; and
5. The proposed development has been designed to minimize impacts to the water area.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.15 Overhead transmission lines**

(a) Overhead transmission lines are wires hung between supporting pylons for transmission from the site of origin to the site of consumption. Overhead transmission lines include electrical, telecommunication and cable television lines.

(b) Overhead transmission lines are prohibited over open bays, semi-enclosed and back bays, lakes, ponds and reservoirs as defined at N.J.A.C. 7:7E-4.1. Overhead transmission lines are discouraged over large rivers as defined at N.J.A.C. 7:7E-4.1.

(c) Overhead transmission lines are conditionally acceptable over rivers, streams, creeks, and tidal guts as defined at N.J.A.C. 7:7E-4.1, provided:

1. There is a demonstrated need that cannot be satisfied by existing facilities;
2. There is no feasible alternative route that avoids crossing water bodies;
3. The transmission line provides adequate vertical clearance for masts; and
4. Visual impacts are minimized to the maximum extent practicable.

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.16 Dams and impoundments**

(a) Dams and impoundments are structures that obstruct natural water flow patterns for the purpose of forming a contained volume of water. Impoundments include dikes with sluice gates and other structures to control the flow of water.

(b) Except for medium rivers, creeks and stream as defined at N.J.A.C. 7:7E-4.1, the construction of dams and impoundments is prohibited. The construction of these structures is conditionally acceptable in medium rivers, creeks and streams as defined at N.J.A.C. 7:7E-4.1, provided:

1. The structures are essential for water supply purposes or for the creation of special wildlife habitats;
2. Adverse impacts are minimized; and
3. The structures will not adversely affect navigation routes.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.17 Outfalls and intakes**

(a) Outfalls and intakes are pipe openings that are located in water areas for the purpose of intake of water or discharge of effluent including sewage, stormwater and

industrial effluents.

(b) Outfalls and intakes are conditionally acceptable provided that the use associated with the intake or outfall meets applicable Coastal Zone Management rules.

(c) Rationale: See the note at the beginning of this Chapter.

**7:7E-4.18 Realignment of water areas**

(a) Realignment of water areas means the physical alteration or relocation of the surface configuration of any water area. This does not include the rebulkheading of a previously bulkheaded water area or the bulkheading at or above the spring high water line.

(b) Realignment of naturally occurring water areas is discouraged. Discouraged uses can only be approved if it can be demonstrated that the proposed development is in the public interest and mitigation for the impact is provided.

(c) Realignment of previously realigned water areas is conditionally acceptable, provided:

1. It is demonstrated that no adverse environmental impacts (that is, water quality, flood hazard, species diversity reduction/alteration) will result; and
2. A net recreational/ecological benefit will demonstrably accrue.

(d) Rationale: See the note at the beginning of this Chapter.

**7:7E-4.19 Breakwaters**

(a) Breakwaters, including, but not limited to, those constructed of concrete, rubble mound and timber, are structures designed to protect shoreline areas or boat moorings by intercepting waves and reducing the wave energy which would normally impact the adjacent shoreline areas or boat mooring areas. Typically, timber breakwaters are designed and utilized to protect boat moorings. In most cases concrete or rubble mound breakwaters are designed and utilized to protect shoreline areas which are subject to storm waves and associated erosion.

(b) Construction of breakwaters is conditionally acceptable provided:

1. Timber, vinyl or plastic breakwaters shall be at least 18 inches above the bottom of the waterway and shall provide a minimum of three inch spacing between planks except as provided at (b)3 below. The individual plank width shall not exceed six inches; and
2. For detached breakwaters which are not fixed directly to a dock or pier structure, marking with photocell lights and/or reflectors is required; and
3. The construction of breakwater structures other than those which comply with (b)1 above shall be consistent with the acceptability conditions for Filling, N.J.A.C. 7:7E-4.10 and Structural Shore Protection N.J.A.C. 7:7E-7.11.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.20 Submerged cables**

(a) Submerged cables (cables) are underwater telecommunication cables, and shall include all associated structures in the water such as repeaters.

(b) Submerged cables, or portions thereof, which are not located in the Atlantic Ocean shall meet the following conditions:

1. The cable shall not be sited within Special Areas, unless no prudent and feasible alternate route exists;
2. Directional drilling for the installation of cables is encouraged over the use of trenching;
3. The cable route minimizes areas where anchors are likely to foul the cable; and
4. The alignment of the cable route is marked at the landfall. This provision does not apply to cables that are directionally drilled.

(c) Submerged cables, or portions thereof, which are sited in the Atlantic Ocean shall meet the following conditions:

1. Siting a cable in the Atlantic Ocean is discouraged unless the cable complies with the following:
  - i. If the cable is either sited within Surf clam areas, N.J.A.C. 7:7E-3.3, or sited within areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom-tending gear, no prudent and feasible land-based alternate route exists and the cable follows the shortest route to waters beyond the Surf clam areas and areas where Marine fish are commercially harvested using mobile bottom-tending gear; and
  - ii. If the cable is sited within Prime fishing areas, N.J.A.C. 7:7E-3.4, Shipwreck and artificial reef habitats, N.J.A.C. 7:7E-3.13, or Historic and archaeological resources, N.J.A.C. 7:7E-3.36, no prudent and feasible alternate route exists outside of these special areas and the cable follows the route with the least disturbance to these special areas;
2. The submerged cable, shall be buried to a depth of at least 1.2 meters both in Surf clam areas, N.J.A.C. 7:7E-3.3, and in areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom-tending gear except where it is demonstrated that it is not practicable to bury the cable to 1.2 meters due to geologic or topographic features or crossing of existing in-service cables. Where it is demonstrated that achieving the depth of 1.2 meters is not practicable, the cable shall be buried as close as practicable to the above standard;
3. Where a submerged cable will cross an existing in-service cable either within Surf clam areas, N.J.A.C. 7:7E-3.3, or within areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom-tending gear, the cable company shall minimize the impact of cable crossings on commercial fishing and minimize the risks to the proposed and existing cables, as follows:
  - i. The cable shall be buried to the depth of the existing cable or as close thereto as practicable at the crossing;
  - ii. The number of cable crossings shall be minimized;
  - iii. The location of the cable route shall be adjusted after consultation with the fishing interest groups identified in N.J.A.C. 7:7-4.2(a)3 in order to reduce the impact of cable crossings on commercial fishing, to the maximum extent practicable; and

iv. The permittee shall, to the maximum extent practicable, share information and otherwise cooperate with those responsible for any cables being crossed and with installers of subsequent cables crossing the subject cable so as to reduce the impacts of cable crossings on commercial fishing.

4. Where a submerged cable will cross an existing out-of service cable either within Surf clam areas, N.J.A.C. 7:7E-3.3, or within areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom-tending gear, the cable company shall minimize the impact of cable crossings on commercial fishing and minimize the risks to the proposed and existing cables, as follows:

i. Where the out-of-service cable is buried less than 0.6 meter, the out-of-service cable shall be cut, and recovered for proper disposal for a distance of at least 500 meters on each side of the selected cable crossing. For surface laid out-of-service cables, the ends of the remaining out-of-service cable shall be re-laid flat on the seabed to minimize problems for other seabed users. For buried out-of-service cables, the ends of the remaining out-of-service cable shall be re-buried to the original depth;

ii. Where the out-of-service cable is buried between 0.6 and 1.2 meters, the out-of-service cable shall, if practicable, be cut and recovered for proper disposal for a distance of at least 500 meters on each side of the selected cable crossing. The ends of the remaining out-of-service cable shall be re-buried as close as practicable to the original depth, and in no case to a depth of less than 0.6 meters. If the out-of-service cable can not be cut and recovered, the cable crossing shall comply with (c)3 above; and

iii. Where the out-of-service cable is buried more than 1.2 meters, the cable shall be laid over the out-of-service cable at the depth prescribed in (c)2 above.

5. Directional drilling for the submerged cable landing is encouraged over the use of trenching to minimize impacts to beaches, dunes, and shallow water areas .

6. The submerged cable route minimizes areas where anchors are likely to foul the submerged cable.

7. Prior to installation of the cable, the permittee shall obtain a financial assurance from a lender or insurer regulated and authorized by the New Jersey Department of Banking and Insurance to transact business in New Jersey. The financial assurance shall be in an amount sufficient for the Department to hire an independent contractor to remove the inactive cable should the permittee fail to do so. Letters of credit, surety bonds and insurance assuring that the Department could hire an independent contractor to remove an inactive cable shall be acceptable to satisfy the financial assurance requirement. The financial assurance shall be released upon the permittee's removal of the cable or upon the Department's determination that the cable may remain in place in accordance with (c)11 below.

8. After the submerged cable has been installed, a long-term inspection and maintenance plan, approved by the Department, shall be implemented both within Surf clam areas, N.J.A.C. 7:7E-3.3, and within areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom tending gear, to insure that the cable remains at the authorized depth and location. The plan shall provide for the following:

- i. An inspection immediately following cable installation;
- ii. An inspection 2 years after cable installation;
- iii. An inspection every 5 years after the inspection required at 8ii above;

iv. An investigation within six months after the Department reports to the permittee that it has received information suggesting that the cable has been uncovered. If appropriate, such investigation shall include an inspection of the cable. The Department may require an inspection after reviewing the report submitted pursuant to (c)9 below; and

v. Reburial of the cable within 90 days, if practicable, and in no case later than 6 months after the permittee discovers that the cable has been uncovered. Reburial shall be to the depth prescribed in (c)2 above to the maximum extent practicable.

9. A report containing the results of the initial inspection required in 8i above shall be submitted by the permittee to the Department within six months following the inspection. The report shall identify all areas where inactive cable has been cut and all areas where the cable is not buried to a depth of 1.2 meters, and indicate the actual depth in those areas. The report shall also provide the installed route of the cable. All locations shall be reported using latitude and longitude coordinate pairs, in the WGS 84 (World Geodetic System 1984) datum, that were arrived at using the global positioning system (GPS). To reduce the impacts of fishing on cables by notifying the commercial fishing industry of the locations of areas where the cable is buried less than 1.2 meters deep, a copy of the report shall be submitted to the fishing interest groups identified in N.J.A.C. 7:7-4.2(a)3.

10. A report containing the results of inspection and maintenance of the submerged cable required in 8 above, if applicable in the reporting year, a discussion of storm events which could have affected the cable, and reported hits of the cable for the previous year shall be submitted by the permittee to the Department in January of each year. The report shall also indicate if and when the cable becomes out-of-service.

11. Within two years of taking the cable out of service pursuant to Federal Communications Commission regulations, the submerged cable shall be removed both from Surf clam areas, N.J.A.C. 7:7E-3.3, and from areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom-tending gear. The Department may allow all or portions of the cable to remain in place if leaving the cable in place would not result in a long term adverse impact to the ocean and/or ocean resources, and the cable would not unreasonably interfere with fishing or other uses of the seabed. A permittee who seeks to leave an inactive cable in place shall submit a request, including the reasons and justification for leaving the cable in place. The Department shall solicit public input on the request, including input from the fishing interest groups identified in N.J.A.C. 7:7-4.2(a)3.

12. If portions of the cable located either within Surf clam areas, N.J.A.C. 7:7E-3.3, or within areas where Marine fish, as defined at N.J.A.C. 7:7E-8.2, are commercially harvested using mobile bottom-tending gear, are not buried to a depth of 0.6 meters, the permittee shall provide a one-time monetary contribution to the Department's dedicated account for shellfish habitat mitigation. The amount of each mitigation contribution provided under this section shall be based on the length of cable that is not buried to a depth of 0.6 meters, based on the inspection required in (c)8i above. The contribution will be calculated at the rate of \$100 per meter of cable which is buried to a depth of less than 0.6 meters. Moneys in the Shellfish Habitat Mitigation account are to be administered by the Department's Bureau of Shellfisheries and utilized for shellfish habitat restoration, enhancement and related research projects.

(d) Rationale: See the note at the beginning of this Chapter.

**7:7E-4.21 Artificial reefs**

(a) Artificial Reefs are man-made structures intended to simulate the characteristics and functions of natural reefs created by placing hard structures on the sea-floor for the purpose of enhancing fish habitat and/or fisheries. In time, an artificial reef will attain many of the biological and ecological attributes of a natural reef. Artificial reefs do not include shore protection structures, pipelines, fish aggregating devices, and other structures not constructed for the sole purpose of fish habitat.

(b) New reefs shall be sited in accordance with the following:

1. The reef site shall not be located in the following special areas: surf clam areas (N.J.A.C. 7:7E 3.3), prime fishing areas (N.J.A.C. 7:7E-3.4), navigation channels (N.J.A.C. 7:7E-3.7), inlets (N.J.A.C. 7:7E-3.9), and Submerged infrastructure routes (N.J.A.C. 7:7E-3.12) and historic and archaeological resources (N.J.A.C. 7:7E-3.36);
2. The reef site shall be located in the Atlantic Ocean;
3. The reef site shall be located in a manner that minimizes impacts on commercial fishing operations;
4. The reef site shall not be located within shipping lanes, and/or anchorages;
5. The natural seafloor at the reef site shall have a firm substrate to minimize sinking of reef materials;
6. The reef site shall not be located within an area environmentally influenced by dredge disposal sites, sewage outfalls, or other areas known to experience hypoxic events, contaminated waters or sediment that may impair the quality of fish habitat; and
7. The reef site shall not be located in an area with currents that have the potential to cause material instability, scouring, or sanding over.

(c) Construction of new or expanded artificial reefs is conditionally acceptable provided that at the time of deployment, and at all times after creation, the following conditions are met:

1. The reef materials are of sufficient density so that it will not move outside of the approved reef boundary;
2. The reef materials shall not float;
3. The reef materials shall not pose a hazard to navigation;
4. The reef materials shall not pose a threat to the marine environment;
5. The reef materials shall not be toxic;
6. The reef materials shall not be hazardous;
7. The reef materials shall not be explosive;
8. The reef materials shall not be radioactive;
9. The following reef materials are acceptable for deployment, provided that (c)1 through 8 above are met:
  - i. Ships;
  - ii. Armored military vehicles;
  - iii. Manufactured reef habitats;
  - iv. Dredge rock;
  - v. Concrete and steel rubble;
  - vi. Demolition material free of floating debris;

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- vii. Obsolete submarine telephone cable; and
  - viii. Miscellaneous reef materials that meet the conditions in (c)1 through 8 above;
10. The reef material shall be deployed in the following manner:
- i. No materials shall be deposited until notification has been provided to the Department at least 72 hours in advance;
  - ii. Inspection by the Department prior to deployment, to ensure materials are not harmful to the marine environment, and will not pose a threat to human safety, and comply with the reef material conditions (c)1 through 8 above;
  - iii. Department personnel shall directly observe and oversee the deployment of any reef materials;
  - iv. To the extent practicable, deployment of reef materials shall not adversely impact the marine environment; and
  - v. The locations of artificial reef sites shall be recorded using a Global Positioning Satellite (GPS) system.

(d) An Artificial Reef Management Plan shall be submitted for each individual reef permit application and shall include the following:

- 1. A description of the proposed site;
- 2. A mechanism for recording materials used in constructing the reef; and
- 3. A monitoring schedule to measure the stability, durability and biological attributes of reef materials and impacts to the marine environment. The schedule shall include submission of monitoring reports, including a listing of materials deployed in the previous year, to the Department every year during reef construction, and every five years thereafter.

(e) It shall be the responsibility of the reef-builder to provide the location of the artificial reef to the US Department of Commerce, NOAA, National Ocean Survey, 1315 East-West Highway, Silver Spring, MD 20910-3282, for inclusion on nautical charts.

(f) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-4.22 Miscellaneous uses**

(a) Miscellaneous uses are uses of Water Areas not specifically defined in this section or addressed in the Use rules (N.J.A.C. 7:7E-7).

(b) Water dependent uses of Water Areas not identified in the Use rules will be analyzed on a case-by-case basis to ensure that adverse impacts are minimized. Non-water dependent uses are discouraged in all Water Areas.

(c) Rationale See the note at the beginning of this Chapter.

## **SUBCHAPTER 5. REQUIREMENTS FOR IMPERVIOUS COVER AND VEGETATIVE COVER FOR GENERAL LAND AREAS AND CERTAIN SPECIAL AREAS**

### **7:7E-5.1 Purpose and scope**

(a) This subchapter sets forth requirements for impervious cover and vegetative cover on sites in the upland waterfront development area, as defined at N.J.A.C. 7:7E-5.2, and in the CAFRA area, as defined at N.J.A.C. 7:7E-5.2. In addition:

1. For a site in the upland waterfront development area, the applicable impervious cover limits and vegetative cover percentages are determined under N.J.A.C. 7:7E-5A, based on the site's growth rating, development potential, and environmental sensitivity; and

2. For a site in the CAFRA area, the applicable impervious cover limits and vegetative cover percentages are determined under N.J.A.C. 7:7E-5B, based on the site's location in a coastal center; in a Coastal Planning Area; in a CAFRA center, CAFRA core, or CAFRA node; or on a military installation.

(b) General Land Areas are all land areas, as defined at N.J.A.C. 7:7E-1.8, that are subject to this chapter and that are located outside of Special Water's Edge Areas. Special Water's Edge Areas are identified at N.J.A.C. 7:7E-3.16 through 3.32.

(c) This subchapter and N.J.A.C. 7:7E-5A and/or 5B apply to development in General Land Areas, Special Land Areas, and the following seven Special Water's Edge Areas:

1. N.J.A.C. 7:7E-3.17, Overwash areas;
2. N.J.A.C. 7:7E-3.18, Coastal high hazard areas;
3. N.J.A.C. 7:7E-3.19, Erosion hazard areas;
4. N.J.A.C. 7:7E-3.20, Barrier island corridor;
5. N.J.A.C. 7:7E-3.23, Filled water's edges;
6. N.J.A.C. 7:7E-3.24, Existing lagoon edges; and
7. N.J.A.C. 7:7E-3.25, Flood hazard areas.

(d) This subchapter and N.J.A.C. 7:7E-5A and 5B do not apply to:

1. The development of a single family home or duplex dwelling unless such development results in development of more than one single family home or duplex dwelling either solely or in conjunction with a previous development as defined at N.J.A.C. 7:7-2.1(b)8;

2. A linear development, as defined in N.J.A.C. 7:7E-1.8, except that this subchapter and N.J.A.C. 7:7E-5A and 5B shall apply if the linear development is wholly within a development and/or serves the development;

3. A mining operation, under N.J.A.C. 7:7E-7.8;

4. A public park which is publicly owned, or publicly controlled for the purposes of public access;

5. Aquaculture, as defined at N.J.S.A. 58:1A-3;

6. Sanitary landfills;

7. Wastewater treatment plants; or

8. Water treatment plants.

(e) If a site is located in the Hackensack Meadowlands District, as defined under N.J.S.A. 13:17-1 et seq., the Department shall not apply the requirements in N.J.A.C. 7:7E-5 and 5A, but shall apply the requirements for that area set forth at N.J.A.C. 7:7E-3.45.

(f) A site may include land both within the upland waterfront development area and within the CAFRA area. Where this occurs each portion of the site is treated separately and the impervious cover limits and vegetative cover percentages for the different portions of the site are determined under N.J.A.C. 7:7E-5A or 5B as appropriate.

(g) The rules in this subchapter and N.J.A.C. 7:7E-5A and 5B do not preempt the application of any municipal ordinance that would result in more restrictive impervious cover requirements or more extensive vegetative cover requirements than would otherwise be applicable to a development site under this subchapter and N.J.A.C. 7:7E-5A and 5B.

### **7:7E-5.2 Definitions**

In addition to the terms defined at N.J.A.C. 7:7E-1.8, the following words and terms are defined for purposes of this subchapter and N.J.A.C. 7:7E-5A and 5B:

“100 percent affordable housing development” means a development which all dwelling units are available at a sales price or rent within the means of a low or moderate income household as defined by the Council on Affordable Housing pursuant to N.J.A.C. 5:94.

"CAFRA center" means a center with a boundary incorporated by reference or revised in accordance with N.J.A.C. 7:7E-5B.3.

"CAFRA core" means a core with a boundary incorporated by reference or revised in accordance with N.J.A.C. 7:7E-5B.3.

"CAFRA node" means a node with a boundary incorporated by reference or revised in accordance with N.J.A.C. 7:7E-5B.3.

"CAFRA Planning Map" means the map used by the Department to identify the location of Coastal Planning Areas, CAFRA centers, CAFRA cores and CAFRA nodes. The CAFRA Planning Map is available on the Department's Geographic Information System (GIS).

"Center" means a compact form of development which may have one or more cores and residential neighborhoods. A center may be an urban center, regional center, town, village, or hamlet, based on factors such as comparative size, population density, total population, transportation access, infrastructure, and employment base.

"Coastal center" means a center in the CAFRA area with a boundary delineated by the Department for the purpose of applying the requirements for impervious cover and vegetative cover at N.J.A.C. 7:7E-5 and 5B until such time as, in accordance with N.J.A.C. 7:7E-5B.3, the coastal center expires or is superseded by the CAFRA center. There are two categories of coastal centers, mainland coastal centers and non-mainland coastal centers. Each of these centers may be further categorized as a coastal regional center, coastal town, coastal village or coastal hamlet.

“Coastal Critical Environmental Site” means a Critical Environmental Site in the CAFRA area with a boundary incorporated by reference in accordance with N.J.A.C. 7:7E-5B.6(h).

"Coastal Planning Area" means a planning area in the CAFRA area with a boundary incorporated by reference in accordance with N.J.A.C. 7:7E-5B.3.

"Community development boundary" means the line delineating a center from the environs of the center. The boundary is defined by physical features such as rivers, roads, or changes in the pattern of development, or by open space or farmland.

"Core" means a pedestrian-oriented area of commercial and civic uses serving the surrounding municipality or center, generally including some housing and access to public transportation.

“Critical Environmental Site” means an area generally less than a square mile which includes one or more environmentally sensitive features located either outside of a planning area classified as environmentally sensitive or within centers located within such planning areas.

"95-97 imagery" means the 1995-1997 National Aerial Photographic Program, New Jersey color infra-red imagery.

"Node" means a concentration of facilities and activities which are not organized in a compact form.

"Planning area" means an area of greater than one square mile that shares a common set of conditions such as population density, infrastructure systems, level of development, or environmental sensitivity. The five types of planning areas are Metropolitan Planning Area, Suburban Planning Area, Fringe Planning Area, Rural Planning Area, and Environmentally Sensitive Planning Area.

"Stormwater management facility" means a facility which receives, stores, conveys, or discharges stormwater runoff and is designed in accordance with all applicable local, county, and State regulations. A stormwater management facility may be a retention or detention basin; infiltration structure; grassed swale; filter fabric; rip-rap channel; and/or stormwater outfall.

"Tidelands Map" means the Tidelands Base Photo Map, adopted by the Department's Tidelands Resource Council under N.J.S.A. 13:1B-13.1 et seq.

"Upland waterfront development area" means all lands outside of the CAFRA area extending from the mean high water line of a tidal water body to the first paved public road, railroad or surveyable property line existing on September 26, 1980 generally

parallel to the waterway, provided that the landward boundary of the upland area shall be no less than 100 feet and no more than 500 feet from the mean high water line.

**7:7E-5.3 Impervious cover requirements that apply to sites in the upland waterfront development and CAFRA areas**

(a) This section sets forth impervious cover requirements that apply to sites in the upland waterfront development and CAFRA areas. Impervious cover limits, specific to each of these areas, are found at N.J.A.C. 7:7E-5A and 5B.

(b) A stormwater management facility is not counted toward the impervious cover limit for a site.

(c) The impervious cover allowed on a site shall be placed on the net land area on the site, as determined at (d) below, and in addition, for an unforested site under N.J.A.C. 7:7E-5A.9(b)3 or N.J.A.C. 7:7E-5B.3(e) 2, the impervious cover shall be placed on the area covered by buildings and/or asphalt or pavement legally existing on the site at the time the application is submitted to the Department. If the amount of impervious cover calculated under this subchapter, N.J.A.C. 7:7E-5A, and/or N.J.A.C. 7:7E-5B is greater than the net land area of the site, the acreage of the impervious cover allowed on the site shall be the acreage of the net land area. The placement of impervious cover may be further restricted by other provisions in this chapter. For example, placement of impervious cover would be discouraged in critical wildlife habitat under N.J.A.C. 7:7E-3.39.

(d) To determine the acreage of the net land area on a site:

1. Determine the acreage of the total land area on the site;
2. Identify all areas on the site that are classified as one of the following Special

Water's Edge Areas:

- i. Dunes (N.J.A.C. 7:7E-3.16);
- ii. Bay islands (N.J.A.C. 7:7E-3.21);
- iii. Beaches (N.J.A.C. 7:7E-3.22);
- iv. Wetlands (N.J.A.C. 7:7E-3.27);
- v. Wetland buffers (N.J.A.C. 7:7E-3.28);
- vi. Coastal bluffs (N.J.A.C. 7:7E-3.31); and
- vii. Intermittent stream corridors (N.J.A.C. 7:7E-3.32);
3. Sum the acreage of the land areas identified in (d)2 above;
4. Subtract (d)3 above from (d)1 above; and
5. The result is the net land area to be used in calculating the impervious cover limits

in N.J.A.C. 7:7E-5A and 5B.

(e) If a site or a portion of a site is a contaminated site, as defined at N.J.A.C. 7:26E-1.8 in the Department's Technical Requirements for the Remediation of Contaminated Sites, the impervious cover limit for the site may be increased if required under the Technical Requirements for the Remediation of Contaminated Sites at N.J.A.C. 7:26E in order to properly remediate the contaminated portion of the site.

**7:7E-5.4 Vegetative cover requirements that apply to sites in the upland waterfront development and CAFRA areas**

(a) This section sets forth vegetative cover requirements that apply to sites in the upland waterfront development and CAFRA areas. Vegetative cover percentages, specific to each of these areas, are found at N.J.A.C. 7:7E-5A and 5B. More trees may be planted or preserved than required, and if so, the herb/shrub area shall be reduced proportionately.

(b) If a site is located in the northern waterfront region or urban area region in the upland waterfront development area; or if a site is located in a CAFRA center, CAFRA core, or CAFRA node; or if the area of trees on a site required to be planted and/or preserved as calculated under (b)1 below is smaller than one acre, the vegetative requirements with respect to trees are as follows:

1. The area (in acres) of the site that shall be planted in trees and/or preserved in trees is calculated under N.J.A.C. 7:7E-5A.10 or 5B.4; and
2. The area (in acres) of the site that would have been required under N.J.A.C. 7:7E-5A.10 or 5B.4 to be planted and/or preserved in trees is not subject to (d) or (e) below but shall instead be planted and/or preserved in a mix of trees and herb/shrub vegetation adapted to the substrate and other environmental conditions of the site.

(c) If a residential development of 24 units or fewer that is not part of a larger development is proposed on a site in the upland waterfront development area or in the CAFRA area and does not meet the criteria at (b) above, the vegetative requirements with respect to trees are as follows:

1. The area (in acres) of the site that shall be planted in trees and/or preserved in trees is calculated under N.J.A.C. 7:7E-5A.10 or 5B.4.

2. The area (in acres) of a forested site or portion to be preserved in trees is not subject to (d) below. However, the trees preserved shall be protected from any future development by a recorded conservation restriction enforceable by the Department which:

- i. Requires that the area of trees be preserved in its natural state;
  - ii. Prohibits removal or clearing of dead trees greater than five inches in diameter at four and one-half feet above ground except to prevent a safety hazard; and
  - iii. Prohibits removal, clearing or mowing of live vegetation, including trees, unless it is demonstrated to the Department that such removal will result in habitat enhancement;
- and

3. The area of an unforested site or portion to be planted in trees is not subject to (d) or (e) below but shall instead be planted and/or preserved in a mix of trees and/or herb/shrub vegetation adapted to the substrate and other environmental conditions of the site.

(d) For sites other than those that meet (b) or (c) above, when trees are required to be planted or preserved under N.J.A.C. 7:7E-5A or 5B, the trees shall be planted and/or preserved in a tree cluster as follows:

1. Trees preserved and/or planted shall be located in a cluster within the boundaries of

one lot that shall not be further subdivided. However, on a site with existing non-contiguous forested areas larger than five acres each, the Department may require that a tree cluster be preserved on a lot located in each of the forested areas. The tree cluster should, to the maximum extent practicable, be adjacent to existing on-site or off-site forests or other natural resources, such as critical wildlife habitat areas as defined at N.J.A.C. 7:7E-3.39, or water bodies;

2. The boundaries of the tree cluster shall be clearly marked with permanent, visible markers such as concrete blocks or posts, metal stakes, or other easily seen, permanent, immovable markers;

3. The tree cluster shall be protected from any future development by a recorded conservation restriction, which requires that the tree cluster be preserved in its natural state, and prohibits removal or clearing of dead trees greater than five inches in diameter at four and one-half feet above ground except to prevent a safety hazard; and which prohibits removal, clearing or mowing of live vegetation, including trees, unless it is demonstrated to the Department that such removal will result in habitat enhancement;

4. For a residential development of 25 units or more, the recorded conservation restriction required under (d)3 above, shall be enforceable by the Department and:

i. A local public entity;

ii. A private nonprofit organization whose trustees have no other interest in the land;

or

iii. A homeowner's association; and

5. For a non-residential development, the recorded conservation restriction required under (d)3 above shall be enforceable by the Department and a local public entity or a private nonprofit organization whose trustees have no other interest in the land, unless no such entity or organization will agree to enforce the conservation restriction.

(e) Trees planted to meet the tree cluster requirement of (d) above shall be planted in accordance with the following:

1. The trees shall be spaced approximately 10 feet apart, and shall be planted in a staggered, non-linear, pattern;

2. If a tree has lost more than 50 percent of its canopy within a full growing season after it is planted, it shall be immediately replaced with another tree as large as the first tree was when planted;

3. All trees shall be native or adapted to the substrate and other environmental conditions of the site. For example, many species common in inland areas are not well adapted to the acid sandy soils common along the coast;

4. The entire area of tree plantings shall be covered with a mulch of hardwood chips at least three inches deep;

5. Two-thirds of the trees planted shall be:

i. Canopy or dominant tree species which typically grow taller than 50 feet at maturity;

ii. A minimum of one and one half inches in diameter at the base; and

iii. Balled, burlapped and supported by staking with guy wires, which shall be removed after one year; and

6. The remaining one-third of the trees planted shall be:

i. Understory or subcanopy tree species which typically grow to a height of less than

50 feet at maturity;

- ii. A minimum of four to five feet in height; and
- iii. Balled and burlapped, or container-grown.

(f) Herb/shrub vegetation required under N.J.A.C. 7:7E-5A or 5B shall be adapted to the substrate and other environmental conditions of the site. For example, many species common in inland areas are not well adapted to the acid sandy soils common along the coast.

(g) The vegetative cover required on a site shall be planted or preserved only on the net land area determined under N.J.A.C. 7:7E-5.3(d).

**7:7E-5.5 Determining if a site is forested or unforested**

(a) The vegetative cover percentage that applies to a site under N.J.A.C. 7:7E-5A or 5B varies depending on whether the site is forested. If only a portion of a site is forested, separate vegetative cover percentages shall be calculated for the forested and unforested portions of the site.

(b) The following will be considered to be unforested for the purposes of determining vegetative cover percentages:

- 1. A site, as defined at N.J.A.C. 7:7E-1.8, which is smaller than one acre; and
- 2. An area of trees, smaller than one acre, that is surrounded on all sides by areas with fewer than one tree per 100 square feet.

(c) To determine if a site or portion of a site is forested:

- 1. Select two 25-foot by 25-foot plots in each acre of the site as follows:
  - i. The plots shall be located in the portion of each acre with the highest density of trees, as defined at N.J.A.C. 7:7E-1.8, based on a visual inspection;
  - ii. If any half-acre of the site has fewer than one tree per 100 square feet, no plots need be selected on that half-acre;
  - iii. If the tree size and density are very uniform over some or all of the site, fewer plots may be selected in the area of uniformity;
- 2. In each plot, measure the diameter of each tree at four and one-half feet above ground;
- 3. Score each tree as follows:

| Diameter of tree | Points |
|------------------|--------|
| 2 to 4 inches    | 1      |
| >4 to 12 inches  | 2      |
| > 12 inches      | 4      |

- 4. Add together the scores for all of the trees in the plot;
- 5. If the total score for a plot is equal to or greater than 16, the plot is forested. For example, if a 25-foot by 25-foot plot contains three trees which are three inches in diameter, three trees which are six inches in diameter, and three trees which are 15 inches

in diameter, the score for the plot would be:  $(3 \times 1) + (3 \times 2) + (3 \times 4) = 21$ , and the plot is considered forested;

6. If a plot is forested, the Department shall assume that the half-acre of the site surrounding the plot is also forested, unless additional plots are sampled in that half-acre and the scores demonstrate that the half-acre is not entirely forested. In that case, a sufficient number of plots shall be sampled to delineate the forested portion of the half-acre; and

7. If a plot is unforested, the Department shall assume that the half-acre of the site surrounding the plot is also unforested, unless a site visit, photographs, or other information indicates that it contains forested areas.

## **IMPERVIOUS COVER LIMITS AND VEGETATIVE COVER PERCENTAGES IN THE UPLAND WATERFRONT DEVELOPMENT AREA**

### **7:7E-5A.1 Purpose and scope**

This subchapter sets the impervious cover limits and vegetative cover percentages for sites in the upland waterfront development area, as defined at N.J.A.C. 7:7E-5.2. For a site in the upland waterfront development area, impervious cover limits and vegetative cover percentages are based on the growth rating, environmental sensitivity, and development potential, and on whether the site is forested or unforested.

### **7:7E-5A.2 Upland waterfront development area regions and growth ratings**

(a) The growth rating for a site in the upland waterfront development area is determined by the region in which it is located, and the growth rating assigned to that region.

(b) The growth ratings are as follows:

1. A development growth rating is assigned to regions of the upland waterfront development area that are already largely developed. Development in regions with this growth rating is preferred over development in regions with limited growth and extension growth ratings;

2. An extension growth rating is assigned to regions of the upland waterfront development area that qualify for neither a development growth rating nor a limited growth rating; and

3. A limited growth rating is assigned to regions of the upland waterfront development area that contain large environmentally sensitive areas.

(c) The eight different regions and their growth ratings are based on their respective patterns of development and cultural and natural resources.

(d) The regions are as follows:

1. The urban area region, which is the land within the upland waterfront development area that is within a special urban area, as described at N.J.A.C. 7:7E-3.43;

2. The northern waterfront region, which is the land within the upland waterfront development area within Monmouth County, and extending north from Monmouth County to the New York State boundary;

3. The western ocean region, which is the land within the upland waterfront development area that is within Ocean County, west of the Garden State Parkway and south of State Route 37;

4. The southern region, which is the land within the upland waterfront development area that is in Cape May County (but not located in the Great Egg Harbor River region);

5. The Mullica-southern ocean region, which is:

i. The land in Ocean County within the upland waterfront development area that is south of Cedar Run Creek and west of U.S. Route 9;

ii. The land within the upland waterfront development area in Bass River Township, Burlington County; and

iii. The land within the upland waterfront development area in Atlantic County that is north of County Route 561 (Jimmy Leeds Road);

6. The Great Egg Harbor River region, which is:

i. The land within the upland waterfront development area in Atlantic County that is southwest of County Alternate Route 559; and

ii. The land within the upland waterfront development area in Cape May County that is east of State Highway 50, north of County Route 585, and west of U.S. Route 9;

7. The Delaware River region, which is:

i. The land within the upland waterfront development area in the municipalities of Bridgeton and Millville in Cumberland County and Salem in Salem County; and

ii. The land within the upland waterfront development area in Salem County (but not located in the Delaware estuary region), and extending north from Salem County through Gloucester County, Camden County, Burlington County (but not located in Bass River Township), and Mercer County; and

8. The Delaware estuary region, which is:

i. The land within the upland waterfront development area in Cumberland County (but not located in the municipalities of Bridgeton and Millville); and

ii. The land within the upland waterfront development area in Salem County that is south and east of a boundary formed by Interstate 295 from its intersection with the New Jersey Turnpike to County Route 641; County Route 641 from its intersection with the New Jersey Turnpike to U.S. Route 130; U.S. Route 130 from its intersection with County Route 641 to its intersection with Oldmans Creek (but not located within the municipality of Salem).

(e) The growth ratings assigned to the regions described in (d) above are as follows:

1. The following regions are assigned a development growth rating:

i. Urban area region;

ii. Northern waterfront region; and

iii. Delaware River region;

2. The following regions are assigned an extension growth rating:

i. Western ocean region; and

ii. Southern region; and

3. The following regions are assigned a limited growth rating:

i. Mullica-southern ocean region;

ii. Great Egg Harbor River region; and

iii. Delaware estuary region.

**7:7E-5A.3 Environmental sensitivity**

(a) The environmental sensitivity of a site is based on the soil type and the depth to seasonal high water table or the presence of paving or structures. Different portions of a site may have different environmental sensitivities.

(b) A site or portion of a site has a high environmental sensitivity if it has wet or high permeability moist soils.

1. Wet or high permeability moist soils are soils with a depth to seasonal high water table of three feet or less, unless the soils are loamy sand or coarser as defined by the United States Department of Agriculture's Soil Texture Triangle, in which case they are soils with a depth to seasonal high water table of four feet or less.

(c) A site or portion of a site has a medium environmental sensitivity if it has neither a high environmental sensitivity nor a low environmental sensitivity.

(d) A site or portion of a site has a low environmental sensitivity if the depth to seasonal high water table is greater than five feet, or the site or portion of the site has paving or structures at the time the application is submitted.

**7:7E-5A.4 Development potential**

(a) Development potential is determined by the type of development proposed and the presence or absence of certain development-oriented elements at or near the site of the proposed development, including roads; wastewater conveyance, treatment and disposal system; and existing development. Development potential may be high, medium or low, as determined under N.J.A.C. 7:7E-5A.5 through 5A.7. A single development potential applies to an entire site.

(b) If a development proposed on a site is inconsistent with the applicable Areawide Water Quality Management Plan adopted under N.J.A.C. 7:15, the development potential cannot be determined for the site. Any development that is inconsistent with the applicable Areawide Water Quality Management Plan is prohibited under N.J.A.C. 7:7E-8.4(b).

(c) The types of development are:

1. Residential or minor commercial development, which includes housing, hotels, motels, minor commercial facilities of a neighborhood or community scale with 700 or fewer parking spaces and less than 100,000 square feet of enclosed building area, and mixed use developments that are predominantly residential. For the purposes of this section and N.J.A.C. 7:7E-5A.5, residential or minor commercial development also includes libraries, daycare centers, municipal or other government administrative, public works or emergency service buildings, and churches, synagogues or other houses of worship;

2. Major commercial or industrial development, which includes all industrial development, warehouses, offices, manufacturing plants, energy facilities, wholesale and major shopping centers with more than 100,000 square feet of enclosed building area,

and major parking facilities with more than 700 parking spaces. For the purposes of this section and N.J.A.C. 7:7E-5A.6, major commercial or industrial development also includes solid waste facilities and wastewater treatment plants; and

3. Campground development, which provides facilities for visitors to enjoy the natural resources of the State. Typically, this type of development is suited to sites somewhat isolated from other development and with access to water, beach, forest and other natural amenities.

(d) The development potential for a site shall be determined as follows:

1. If a proposed development is a residential or minor commercial development as described at (b)1 above, the development potential for the site is determined under N.J.A.C. 7:7E-5A.5;

2. If a proposed development is a major commercial or industrial development as described at (b)2 above, the development potential for the site is determined under N.J.A.C. 7:7E-5A.6; and

3. If a proposed development is a campground development as described at (b)3 above, the development potential for the site is determined under N.J.A.C. 7:7E-5A.7.

(e) If a proposed development is not a residential development, a minor commercial development, a major commercial development, an industrial development, or a campground development, the development potential for the site shall be that for the most similar type of development described at (b) above.

#### **7:7E-5A.5 Development potential for a residential or minor commercial development site**

(a) Subject to the limitation at N.J.A.C. 7:7E-5A.4(b), the development potential for a residential development site or a minor commercial development site is determined using (b) through (d) below.

(b) A site upon which a residential or minor commercial development is proposed is a high development potential site if it meets all of the requirements at (b)1 through 4 below:

1. An existing paved public road abuts the site;

2. If an offsite wastewater conveyance, treatment and disposal system is to be used:

3. A majority of the perimeter of the site, excluding wetlands or surface water areas or land areas abutting limited access transportation corridors, is adjacent to or across a public road or railroad from land that is developed, or a majority of the area, excluding wetlands or surface water areas, within 1,000 feet of the site is developed. For the purposes of this paragraph, developed land consists of that part of a property where one of the developments listed below is located and does not include any undeveloped portions of the property that surround the developed portion:

i. Residential development at densities of at least one dwelling unit per acre;

ii. Commercial development;

iii. Industrial development, including warehouses;

iv. Schools and other public institutions;

v. Ball fields;

vi. Those areas of public parks developed for active recreational use; or

vii. Transportation facilities including train stations and airfields; and

4. If the site is located in a region with a limited growth or extension growth rating, the site shall, in addition to meeting the requirements at (b)1 through 3 above, be located one-half mile or less from the nearest existing commercial or industrial development that has more than 20,000 square feet of enclosed building area within a single facility.

(c) A site upon which a residential development or a minor commercial development is proposed is a medium development potential site if it is not a high development potential site under (b) above but does meet the requirements of either (c)1 or 2 below:

1. The site is located in a region with a development growth rating and the site is located:

i. One thousand feet or less from the nearest existing paved public road, or 1,000 feet or less from the nearest public road that is approved and will be constructed before or concurrently with the development; and

ii. If an offsite wastewater conveyance, treatment and disposal system is to be used, 1,000 feet or less from the conveyance component of that system, or 1,000 feet or less from the conveyance component of a system that is approved and shall be constructed before or concurrently with the development, provided:

(1) The wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity; or

2. The site is located in a region with a limited growth or extension growth rating and the site is located:

i. One thousand feet or less from the nearest existing paved public road;

ii. If an offsite wastewater conveyance, treatment and disposal system is to be used, 1,000 feet or less from the existing conveyance component of the system, provided:

(1) The existing wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity;

iii. If a commercial development is proposed, one-half mile or less from the nearest existing commercial or industrial development that has more than 20,000 square feet of enclosed building area within a single facility; and

iv. If a residential development is proposed, one-half mile or less from developed land, as described at (b)3 above.

(d) A site upon which a residential or minor commercial development is proposed is a low development potential site if it is neither a high development potential site under (b) above nor a medium development potential site under (c) above.

#### **7:7E-5A.6 Development potential for a major commercial or industrial development site**

(a) Subject to the limitations at N.J.A.C. 7:7E-5A.4(c)4, the development potential for a major commercial or industrial development site is determined under (b) through (d) below.

(b) A site upon which a major commercial or industrial development is proposed is a high development potential site if it meets all of the requirements at (b)1 through 4 below:

1. An existing paved public road abuts the site;
2. If an offsite wastewater conveyance, treatment and disposal system is to be used:
  - i. The existing conveyance component of the system abuts the site; and
  - ii. The existing wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity;
3. A part of the perimeter of the site is adjacent to, or immediately across a paved road from, existing major commercial or industrial development, or, in a region with a development growth rating, the site is adjacent to or immediately across a paved road from any existing commercial development; and
4. In a region with a limited growth or extension growth rating, the site is located either:
  - i. For a major commercial development, within two miles of an existing intersection with a limited access highway; or
  - ii. For an industrial development, either within:
    - (1) Two miles of an existing intersection with a limited access highway; or
    - (2) One-half mile of a freight rail line that shall be used, or the applicant has a written agreement with the owner of a freight rail line to obtain freight rail service directly to the site.

(c) A site upon which a major commercial or industrial development is proposed is a medium development potential site if it is not a high development potential site under (b) above but does meet the requirements at either (c)1 or 2 below:

1. The site is located in a region with a development growth rating and the site is located:
  - i. One thousand feet or less from the nearest existing paved public road, or 1,000 feet or less from the nearest public road that is approved and shall be constructed before or concurrently with the development;
  - ii. If an offsite wastewater conveyance, treatment and disposal system is to be used, 1,000 feet or less from the conveyance component of that system, or 1,000 feet or less from the conveyance component of a system that is approved and shall be constructed before or concurrently with the development, provided:
    - (1) The wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity; and
    - iii. For an industrial development, one-half mile or less from the nearest existing commercial or industrial development that has more than 50,000 square feet of enclosed building area within a single facility; or
2. The site is located in a region with a limited growth or extension growth rating and the site is located:

- i. Either 1,000 feet or less from the nearest existing paved public road, or five miles or less from the nearest intersection with a limited access highway;
- ii. If an offsite wastewater conveyance, treatment and disposal system is to be used, 1,000 feet or less from the existing conveyance component of the system, provided:
  - (1) The existing wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity; and
  - iii. One-half mile or less from the nearest commercial or industrial development that has more than 50,000 square feet of enclosed building area within a single facility.

(d) A site upon which a major commercial or industrial development is proposed is a low development potential site if it is neither a high development potential site under (b) above nor a medium development potential site under (c) above.

**7:7E-5A.7 Development potential for a campground development site**

(a) Subject to the limitations at N.J.A.C. 7:7E-5A.4(b), the development potential for a campground development site is determined using (b) through (d) below.

(b) A site upon which a campground development site is proposed is a high development potential site if it meets all of the requirements at (b)1 through 3 below:

1. An existing paved public or private road abuts the site;
2. If an offsite wastewater conveyance, treatment and disposal system is to be used:
  - i. The existing conveyance component of the system abuts the site; and
  - ii. The existing wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity; and
3. The land surrounding the site is natural; undeveloped; contains beaches, streams, or forests; and is readily accessible by foot to campground users.

(c) A site upon which a campground development is proposed is a medium development potential site if it is not a high development site under (b) above but does meet the requirements of (c)1 and 2 below:

1. The site is one-half mile or less from the nearest existing paved public road; and
2. If an offsite wastewater conveyance, treatment, and disposal system is to be used, the site is 1,000 feet or less from the existing conveyance component of that system, provided:
  - i. The existing wastewater conveyance, treatment and disposal system has adequate capacity to convey, treat, and dispose of the sewage from the proposed development, or the applicant has an agreement with the sewage authority to modify the system to provide adequate capacity.

(d) A site upon which a campground development is proposed is a low development potential site if it is neither a high development potential site under (b) above nor a medium development potential site under (c) above.

**7:7E-5A.8 Development intensity**

(a) The development intensity for a site is based on growth rating, environmental sensitivity, and development potential. Tables A through C below are used to determine the development intensity of a site or portion of a site. Because environmental sensitivity may be different for different portions of a site, development intensity can also be different for different portions of a site.

(b) To determine the development intensity for a site:

1. Determine the growth rating for the site under N.J.A.C. 7:7E-5A.2;
2. Determine the environmental sensitivity for each portion of the site under N.J.A.C. 7:7E-5A.3;
3. Determine the development potential for the site based on the site and the type of development under N.J.A.C. 7:7E-5A.4 through 5A.7;
4. Consult Table A, B, or C below as follows:
  - i. For a site with a development growth rating, consult Table A;
  - ii. For a site with an extension growth rating, consult Table B; and
  - iii. For a site with a limited growth rating, consult Table C.

**TABLE A**  
Development Intensity for a Site with a Development Growth Rating

|                              | Low Environmental Sensitivity | Medium Environmental Sensitivity | High Environmental Sensitivity |
|------------------------------|-------------------------------|----------------------------------|--------------------------------|
| High Development Potential   | High Development Intensity    | High Development Intensity       | Medium Development Intensity   |
| Medium Development Potential | High Development Intensity    | High Development Intensity       | Low development Intensity      |
| Low Development Potential    | Low Development Intensity     | Low Development Intensity        | Low Development intensity      |

**TABLE B**  
Development Intensity for a Site with an Extension Growth Rating

|                            | Low Environmental Sensitivity | Medium Environmental Sensitivity | High Environmental Sensitivity |
|----------------------------|-------------------------------|----------------------------------|--------------------------------|
| High Development Potential | High Development Intensity    | High Development Intensity       | Medium Development Intensity   |

|                              |                              |                              |                           |
|------------------------------|------------------------------|------------------------------|---------------------------|
| Medium Development Potential | Medium Development Intensity | Medium Development Intensity | Low Development Intensity |
| Low Development Potential    | Low Development Intensity    | Low Development Intensity    | Low Development Intensity |

TABLE C  
Development Intensity for a Site with a Limited Growth Rating

|                              |                               |                                  |                                |
|------------------------------|-------------------------------|----------------------------------|--------------------------------|
|                              | Low Environmental Sensitivity | Medium Environmental Sensitivity | High Environmental Sensitivity |
| High Development Potential   | Medium Development Intensity  | Medium Development Intensity     | Low Development Intensity      |
| Medium Development Potential | Medium Development Intensity  | Low Development Intensity        | Low Development Intensity      |
| Low Development Potential    | Low Development Intensity     | Low Development Intensity        | Low Development Intensity      |

**7:7E-5A.9 Impervious cover limits for a site in the upland waterfront development area**

(a) If a site or portion of a site is forested, as determined under N.J.A.C. 7:7E-5.5, the impervious cover limit is the acreage of the net land area on the site or portion as determined under N.J.A.C. 7:7E-5.3(d), multiplied by the impervious cover percentage in Table D below for the development intensity that applies to the site or portion, as determined under N.J.A.C. 7:7E-5A.8.

(b) If a site or portion of a site is unforested, as determined under N.J.A.C. 7:7E-5.5, the impervious cover limit is the limit at (b)1, 2 or 3 below, which ever is higher:

1. The acreage of the net land area on the site or portion, as determined under N.J.A.C. 7:7E-5.3(d), multiplied by the impervious cover percentage in Table E below for the development intensity that applies to the site or portion, as determined under N.J.A.C. 7:7E-5A.8;

2. For a site located in the northern waterfront region or urban area region, as determined under N.J.A.C. 7:7E-5A.2(d), the amount of existing impervious cover located on a site as determined under (c) below; or

3. For a site located in a region other than those identified at (b)2 above, the acreage covered by buildings and/or asphalt or concrete pavement legally existing on the site at the time the application is submitted to the Department.

(c) For the purposes of determining impervious cover limits under (b) above, the amount of existing impervious cover is the highest of the following, provided the impervious cover was legally placed on the site:

1. The amount of impervious cover located on the site at the time the application is submitted to the Department;
2. The amount of impervious cover that appears on the applicable Tidelands Map, as defined at N.J.A.C. 7:7E-5.2; or
3. The amount of impervious cover that was placed on the site under the authority of a coastal permit and after the date the photography was performed for the Tidelands Map identified under (c)2 above.

TABLE D  
Percentages for Calculating Impervious Cover Limit  
for a Forested Site under N.J.A.C. 7:7E-5A.9

| Development intensity        | Impervious Cover Percentage |
|------------------------------|-----------------------------|
| High development intensity   | 70 percent                  |
| Medium development intensity | 40 percent                  |
| Low development intensity    | 5 percent                   |

TABLE E  
Percentages for Calculating the Impervious Cover Limit  
For an Unforested Site under N.J.A.C. 7:7E-5A.9

| Development intensity                                   | Impervious Cover Percentage |
|---|-----------------------------|
| High development intensity in the urban area region     | 90 percent                  |
| High development intensity not in the urban area region | 80 percent                  |
| Medium development intensity                            | 40 percent                  |
| Low development intensity                               | 5 percent                   |

**7:7E-5A.10 Vegetative cover percentages for a site in the upland waterfront development area**

(a) The area (in acres) on a site in the upland waterfront development area in which trees and/or herb/shrub vegetation shall be planted or preserved is calculated as follows:

1. To determine the area (in acres) of tree preservation and/or tree planting on the site:
  - i. Identify the forested and/or unforested portions of the site, as determined under N.J.A.C. 7:7E-5.5;

ii. If a site or portion of a site identified at (a)1i has more than one development intensity, further divide that site or portion into smaller portions based on their respective development intensities;

iii. For each forested site or portion identified at (a)1ii above, multiply the acreage of the net land area on the site or portion, as determined under N.J.A.C. 7:7E-5.3(d), by the tree preservation and tree planting percentages in Table F below for the development intensity that applies to the site or portion, as determined under N.J.A.C. 7:7E-5A.8; and

iv. For each unforested site or portion identified at (a)1ii above, multiply the acreage of the net land area on the site or portion, as determined under N.J.A.C. 7:7E-5.3(d), by the tree planting percentage in Table G below for the development intensity that applies to the site or portion, as determined under N.J.A.C. 7:7E-5A.8; and

2. To determine the area (in acres) of herb/shrub vegetation preservation and/or herb/shrub vegetation planting on the site:

i. For each portion of the site identified at (a)1ii above, subtract both the acreage of impervious cover allowed under N.J.A.C. 7:7E-5A.9 and the acreage of tree planting and/or preservation required under (a)1 above from the acreage of the net land area on the site or portion, as determined under N.J.A.C. 7:7E-5.3(d).

(b) If the sum of the acreage of tree planting required under (a)1 above plus the acreage of either the existing impervious cover on the site as determined under N.J.A.C. 7:7E-5A.9(b)2 or the acreage covered by buildings and/or asphalt or concrete pavement as determined under N.J.A.C. 7:7E-5A.9(b)3 exceeds the net land area on the site, as determined under N.J.A.C. 7:7E-5.3, then trees shall be planted in the area (in acres) remaining after the acreage of impervious cover or acreage covered by buildings and/or asphalt or concrete pavement is subtracted from the acreage of the net land area on the site.

(c) The preservation or planting of trees and/or herb/shrub vegetation areas shall comply with the vegetative cover requirements at N.J.A.C. 7:7E-5.4.

1. The requirement for tree planting at (a)1 above can be satisfied by preserving equivalent forested areas in addition to that required under (a)1 above.

2. The requirement for planting of herb/shrub vegetation at (a)2 above can be satisfied by preserving equivalent wooded areas or planting an equivalent area of trees in addition to that required under (a)1 above.

TABLE F  
Tree Preservation and Planting  
Percentages for a Forested Site

| Development intensity                              | Tree Preservation Percentage | Tree Preservation and/or Planting Percentage |
|--|------------------------------|--|
| High development intensity in an urban area region | 25 percent                   | 5 percent                                    |
| Medium development intensity                       | 25 percent                   | 5 percent                                    |
| Low development intensity                          | 30 percent                   | 0 percent                                    |

TABLE G  
Tree Planting Percentages for an Unforested Site

| Development intensity        | Tree Preservation and/or Planting Percentage |
|------------------------------|--|
| High development intensity   | 5 percent                                    |
| Medium development intensity | 20 percent                                   |
| Low development intensity    | 5 percent                                    |

**SUBCHAPTER 5B. IMPERVIOUS COVER LIMITS AND VEGETATIVE COVER PERCENTAGES IN THE CAFRA AREA**

**7:7E-5B.1 Purpose and scope**

(a) This subchapter sets impervious cover limits and vegetative cover percentages for sites in the CAFRA area. For a site in the CAFRA area, impervious cover limits and vegetative cover percentages are based on the site's location in a coastal center; in a Coastal Planning Area; in a CAFRA center, CAFRA core, or CAFRA node; or on a military installation.

(b) Except as may be required by law, it is not the intent of this subchapter that the extent to which a municipality has or has not conformed its ordinances or development master plan to this subchapter be considered by any department, agency, or instrumentality of State government in:

1. Administering any State grant, loan, or any financial assistance program involving the expenditure of State funds;
2. Making any permitting decision involving infrastructure that is deemed necessary by the permitting authority to alleviate significant and imminent threats to public health and safety; or
3. Making any permitting decision involving transportation infrastructure deemed necessary by the permitting authority solely to meet the needs of existing populations or anticipated populations based on valid development approvals by all relevant entities at the time of permit application, provided the permit application meets all of the substantive requirements of this chapter.

(c) Subsection (b) above shall not be construed to:

1. Prevent the awarding of any financial assistance, grant, or loan for planning purposes;
2. Contravene the legislative intent concerning capital projects pursuant to N.J.S.A. 52:9S-2 et seq.;
3. Contravene the legislative intent concerning coastal planning policies pursuant to N.J.S.A. 52:18A-206; or
4. Prevent the Department from considering secondary impacts in accordance with N.J.A.C. 7:7E-6.3.

(d) Compliance with the impervious cover limits and vegetative cover percentages of this subchapter shall not exempt any development from the Special Areas rules at N.J.A.C. 7:7E-3, the resource rules at N.J.A.C. 7:7E-8, or any other provision of this chapter.

#### **7:7E-5B.2 Coastal Planning Areas**

(a) For purposes of this subchapter and consistent with all other rules in this chapter, descriptions and policy objectives for the Coastal Planning Areas are set forth in (b) through (f) below.

(b) The Coastal Metropolitan Planning Area includes a variety of communities on the New Jersey coast. This Coastal Planning Area generally has a high population density and existing public water and sewer systems. The policy objectives for the Coastal Metropolitan Planning Area are as follows:

1. Guide development and redevelopment to ensure efficient use of scarce land while capitalizing on the inherent public facility and service efficiencies of concentrated development patterns;

2. Accommodate a variety of housing choices through development and redevelopment;

3. Promote economic development by encouraging redevelopment efforts such as infill, consolidation of property, and infrastructure improvements, and by supporting tourism and related activities;

4. Promote high-density development patterns in coastal urbanized areas to encourage the design and use of public transit and alternative modes of transportation to improve air quality, to improve travel among population and employment centers and transportation terminals, and to promote transportation systems that address the special seasonal demands of travel and tourism along the coast;

5. Encourage the reclamation of environmentally damaged sites and mitigate future negative impacts, particularly to waterfronts, beaches, scenic vistas, and habitats;

6. Promote public recreation opportunities in development and redevelopment projects, and ensure meaningful public access to coastal waterfront areas; and

7. Encourage the repair or replacement of existing infrastructure systems where necessary to ensure that existing and future development will cause minimal negative environmental impacts.

(c) The Coastal Suburban Planning Area is generally located adjacent to the more densely developed Coastal Metropolitan Planning Area, but can be distinguished by a lack of high intensity centers and by a more dispersed and fragmented pattern of development. The existing inventory of undeveloped and underdeveloped land in this Coastal Planning Area should be sufficient to accommodate much of the market demand for future growth and development in the CAFRA area. Internally oriented, mixed-use centers should be encouraged in the Coastal Suburban Planning Area. While development patterns are well established here, development intensities should be highest within CAFRA centers to concentrate development and take advantage of infrastructure efficiencies. Development in the Coastal Suburban Planning Area outside of centers should be less intense than in centers, and less intense than in the Coastal Metropolitan

Planning Area. Development in areas not in centers and not in or adjacent to an existing sewer service area should be less intense than in other parts of the Coastal Suburban Planning Area. The policy objectives for the Coastal Suburban Planning Area are as follows:

1. Encourage mixed-use development and redevelopment in compact centers;
2. Guide opportunities for economic development and employment in centers, and promote seasonal and year-round travel and tourism activities in the coastal resort areas;
3. Encourage links from coastal suburban areas to employment centers with public transit, and promote transportation systems that address the special seasonal demands of travel and tourism along the coast; and
4. Ensure adequate wastewater treatment capacity, and minimize off-site stormwater runoff by encouraging the use of best management practices which protect the character of natural drainage systems.

(d) The Coastal Fringe Planning Area is generally located adjacent to the Coastal Metropolitan Planning Area or the Coastal Suburban Planning Area. It is a predominantly rural area that is neither prime agricultural nor environmentally sensitive land, but which supports agriculture and other resource-based activities. The Coastal Fringe Planning Area is served primarily by a rural, two-lane road network and on-site well water and wastewater systems. It generally lacks public wastewater systems except in existing centers. This Coastal Planning Area is characterized by scattered small settlements and free-standing residential and commercial developments. The policy objectives for the Coastal Fringe Planning Area are as follows:

1. Encourage development in more compact, deliberately designed community patterns to minimize land conflicts and to accommodate growth that would otherwise occur elsewhere, encourage development that does not exceed the carrying capacity of natural or built systems and that maintains or enhances the character of existing communities, and maintain existing low-density and low-intensity development patterns that do not exceed the carrying capacity of natural systems and are consistent with the existing landscape;
2. Encourage rural economic activities, such as agriculture and recreation, and guide higher intensity activities to the centers;
3. Encourage transportation systems that link centers in the Coastal Fringe Planning Area to each other and to the Coastal Metropolitan and Coastal Suburban Planning Areas; and
4. Encourage infrastructure that supports development in centers.

(e) The Coastal Rural Planning Area generally contains most of the CAFRA area's remaining prime agricultural land, as well as large contiguous tracts of forested areas and other open lands. It is interspersed with centers and with scattered commercial, industrial, and low density residential development. It is served by rural road networks and on-site wastewater and water supply systems. The Coastal Rural Planning Area also supports rural economic activities such as recreation related business. The policy objectives for the Coastal Rural Planning Area are as follows:

1. Protect and enhance the rural character and agricultural viability of the Coastal Rural Planning Area by guiding growth into centers, maintain existing low-density and

low-intensity development patterns that are supporting rather than conflicting with the rural landscape, encourage creative land use techniques to minimize the impact of new development on rural features, and ensure that development does not exceed the capacity of natural and built systems;

2. Encourage a transportation network that accommodates agriculture and access to markets;

3. Encourage economic activities in centers that complement and support rural and agricultural communities and that provide diversity in the rural economy, accommodate economic activities outside of centers in ways that maintain or enhance the rural environment, have minimal impact on agricultural resources, and minimize the need for infrastructure improvements; and

4. Protect and preserve large contiguous areas of farmland and open space, and protect the critical resources and environmentally sensitive features of the coastal ecosystem, including water resources and wildlife habitat, by maintaining development outside of centers at low densities, and minimize conflicts between development, agricultural practices, resource based activities, and sensitive coastal resources.

(f) The Coastal Environmentally Sensitive Planning Area generally has large contiguous land and water areas with critical coastal ecosystems, wildlife habitats, geological features, and other valuable coastal resources. Some of these lands have remained rural and relatively undeveloped, while others have been dominated by development for many years, such as the coastal barrier islands and spits. The barrier islands represent a major public investment in infrastructure systems that should be maintained while protecting the economic and ecological value of adjacent coastal resources. Centers on the barrier islands are almost all served by public wastewater facilities whereas centers in other environmentally sensitive areas are not often. Centers are usually linked by rural roads and separated by open spaces, or linked to the mainland by State highways crossing coastal wetlands and waterways. Areas outside of centers in the Coastal Environmentally Sensitive Planning Area are by definition more vulnerable to disturbance from new development. Damage may include fragmentation of landscapes, degradation of aquifers and potable water supplies, habitat destruction, extinction of plant and animal species, and destruction of other irreplaceable resources that are vital to the preservation of the ecological integrity of the coastal area. The Coastal Environmentally Sensitive Planning Area also supports recreation and tourism industries, and resource based industries such as mining and forestry. The policy objectives for the Coastal Environmentally Sensitive Planning Area are as follows:

1. Protect environmentally sensitive features by guiding development into centers and maintaining low intensity development patterns elsewhere, carefully link the location, character and magnitude of development to the capacity of natural and built environments to support new growth, accommodate development at higher intensities in the Coastal Environmentally Sensitive Planning Area barrier island centers, compatible with development patterns in existing centers, and discourage the development of public infrastructure facilities outside of centers;

2. Encourage transportation systems that link centers and support the travel and tourism industry, recreational and natural resource-based activities, and address the special seasonal demands of travel and tourism to barrier islands;

3. Locate economic development opportunities in centers that serve the surrounding region and the travel and tourism industry and accommodate in other areas appropriate seasonal, recreational, and natural resource based-activities that have a minimal impact on environmental resources; and

4. Protect sensitive natural resources critical to the maintenance of coastal ecosystems by maintaining large contiguous areas of undisturbed habitat, open space and undeveloped land, maintain the balance of ecological systems and growth, and protect the areas outside of centers from the effects of development by maintaining it as open space.

**7:7E-5B.3 Boundaries for Coastal Planning Areas, CAFRA centers, CAFRA cores, and CAFRA nodes; Non-mainland coastal centers**

(a) The boundaries of the Planning Areas, the community development boundaries of centers, and the boundaries of cores and nodes formally approved by the State Planning Commission as of August 1, 1999 are incorporated by reference into this subchapter. These boundaries are the boundaries of the Coastal Planning Areas, CAFRA centers, CAFRA Cores and CAFRA nodes and shall be operative for the purposes of applying the requirements for impervious cover and vegetative cover under N.J.A.C. 7:7E-5 and this subchapter, unless the Department, in accordance with (b) and (c) below, accepts a State Planning Commission formally approved new or changed boundary, or unless the Department, in accordance with (b) and (e) below, rejects a State Planning Commission formally approved new or changed boundary and subsequently promulgates a revised boundary.

(b) Whenever the State Planning Commission formally approves (see (h) below) any new or changed Planning Area boundary, any new or changed community development boundary, or any new or changed core or node boundary, the Department shall evaluate the new or changed boundary to determine whether it is consistent with the purposes of the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., and this chapter. The Department shall not reject or reject and revise a boundary unless it finds that accepting the State Planning Commission approved boundary would result in unacceptable harm to the coastal ecosystem or the resources of the built or natural environment, or would otherwise be clearly inconsistent with the purposes of the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., or this chapter. For those new or changed community development boundaries or new or changed core or node boundaries which are located within the Pinelands National Reserve, the Department shall also, in consultation with the New Jersey Pinelands Commission, determine whether the boundaries are consistent with the intent, policies and objectives of the National Parks and Recreation Act of 1978, P.L. 95-625, section 502, creating the Pinelands National Reserve, and the State Pinelands Protection Act of 1979 (N.J.S.A. 13:18A-1 et seq.). Within 90 calendar days after the date on which the State Planning Commission formally approves such boundary, the Department shall publish in the New Jersey Register a notice of its determination to accept, reject, or reject and revise the boundary for the purposes of N.J.A.C. 7:7E-5 and this subchapter.

(c) If the Department determines under (b) above to accept the State Planning Commission formally approved new or changed Planning Area boundary, community

development boundary, or core or node boundary, the accepted new or changed boundary is incorporated by reference as the boundary of the Coastal Planning Area, CAFRA center, CAFRA core and CAFRA node, and shall be operative 30 calendar days after the date of publication of the New Jersey Register notice under (b) above. A CAFRA center boundary shall supersede the boundary for a corresponding coastal center, if any, in Appendix 2 or Appendix 3, as applicable. CAFRA centers are listed for informational purposes in Appendix 5 of this chapter. As part of the New Jersey Register notice published under (b) above, the Department shall incorporate into Appendix 5 by administrative change the name of each CAFRA center for which the Department has accepted the boundary. However, in order to determine the location of a site with reference to the accepted boundaries of a CAFRA center, CAFRA core, or CAFRA node for purposes of determining the applicable impervious cover limit, an applicant shall refer to the CAFRA Planning Map in accordance with N.J.A.C. 7:7E-5B.4(b).

(d) If the Department determines under (b) above to reject the State Planning Commission formally approved new or changed Planning Area boundary, community development boundary, or core or node boundary, the boundary incorporated by reference under (a) above shall continue to be operative, except as provided under (e) below.

(e) The Department may determine under (b) above to reject the State Planning Commission formally approved new or changed Planning Area boundary, community development boundary, or core or node boundary and to establish a revised Coastal Planning Area, CAFRA center, CAFRA core, or CAFRA node boundary by promulgating an amendment to this chapter in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq. Until the Department promulgates such revised boundary, the Coastal Planning Area, CAFRA center, CAFRA core, or CAFRA node boundary under (a) above shall continue to be operative.

(f) The CAFRA Planning Map, with all Coastal Planning Area, CAFRA center, CAFRA core, and CAFRA node boundaries operative under this section for purposes of N.J.A.C. 7:7E-5 and this subchapter, is available on the Department's Geographic Information System (GIS) and may be reviewed at the Department, 401 East State Street, Trenton, New Jersey 08625, (609) 292-1143.

(g) The boundaries delineated by the Department for non-mainland coastal centers, as defined at N.J.A.C. 7:7E-5.2, are described in Appendices 3 of this chapter. The boundaries for mainland coastal centers are described in Appendix 2 of this chapter.

(h) For purposes of this section, a State Planning Commission formally approved new or changed boundary is one that the State Planning Commission has amended in accordance with the New Jersey State Planning Act, N.J.S.A. 52:18A-196 et seq., and the State Planning rules, N.J.A.C. 17:32.

(i) A site in the CAFRA area may include land in more than one coastal center, Coastal Planning Area, CAFRA center, CAFRA core, or CAFRA node. Where this

occurs, the impervious cover limits and vegetative cover percentages appropriate to the respective coastal center, Coastal Planning Area, CAFRA center, CAFRA core, or CAFRA node portions of the site apply.

(j) Neither formal approval by the State Planning Commission of a new or changed boundary for a Planning Area, a new or changed community development boundary, or a new or changed core or node boundary, nor the incorporation by reference and acceptance or revision by the Department of such boundary as the Coastal Planning Area, CAFRA center, CAFRA core, or CAFRA node boundary under this section shall exempt any development from this subchapter or from any of the requirements in this chapter.

**7:7E-5B.4 Impervious cover limits for a site in the CAFRA area**

(a) The impervious cover limit for a site in the CAFRA Area shall be determined as follows:

1. If a site is located in a CAFRA center, CAFRA core, or CAFRA node, the impervious cover limit is determined under (c) below. Note that the impervious cover limit for such a site is calculated based on the acreage of the total land area on the site, as opposed to the acreage of the net land area on the site;

2. If a site is not located in a CAFRA center, CAFRA core, or CAFRA node but is located in the Coastal Metropolitan Planning Area or in a coastal center, the impervious cover limit is determined under (d) below;

3. If a site is not located in a CAFRA center, CAFRA core, or CAFRA node, and is not located in the Coastal Metropolitan Planning Area or in a coastal center, the impervious cover limit is determined under (e) below; and

4. If a site is located on a military installation, the impervious cover limit is determined under (f) below.

(b) To determine the location of a site for the purposes of determining the applicable impervious cover limit:

1. Determine if the site is located in a CAFRA center, CAFRA core, or CAFRA node by referring to the CAFRA Planning Map;

2. If the site is not located in a CAFRA center, CAFRA core, or CAFRA node, determine if the site is located in a coastal center by referring to Appendix 2 and 3;

3. If the site is not located in a CAFRA center, CAFRA core, or CAFRA node, and is not located in a coastal center, determine the Coastal Planning Area in which the site is located by referring to the CAFRA Planning Map; and

4. If the site is located on a military installation, see (f) below.

(c) If a site is located in a CAFRA center, CAFRA core, or CAFRA node, the impervious cover limit is the limit at (c)1, 2 or 3 below, whichever is higher:

1. The acreage of the total land area on the site as determined under N.J.A.C. 7:7E-5.3(d)1, multiplied by the impervious cover percentage in Table H below for the type of CAFRA center, CAFRA core, or CAFRA node in which the site is located;

2. For a site located in the Coastal Metropolitan Planning Area, the acreage of the net land area on the site as determined under N.J.A.C. 7:7E-5.3(d), multiplied by the impervious cover percentage in Table H below for the Coastal Metropolitan Planning

Area; or

3. The amount of legal, existing impervious cover located on the site, as determined under (g) below.

(d) Subject to the limitations regarding mainland coastal centers at N.J.A.C. 7:7E-5B.6(g), if a site is located in the Coastal Metropolitan Planning Area or in a coastal center, the impervious cover limit is the limit at (d)1 or 2 below, whichever is higher:

1. The acreage of the net land area on the site as determined under N.J.A.C. 7:7E-5.3(d), multiplied by the impervious cover percentage in Table H below for the type of coastal center in which the site is located; or

2. The amount of legal, existing impervious cover located on the site, as determined under (g) below.

(e) If the site is not located in a CAFRA center, CAFRA core, or CAFRA node, is not located in the Coastal Metropolitan Planning Area, and is not located in a coastal center, the impervious cover limit is the limit at (e)1, 2, or 3 below, whichever is higher:

1. The acreage of the net land area on the site as determined under N.J.A.C. 7:7E-5.3(d), multiplied by the impervious cover percentage in Table H below for the Coastal Planning Area in which the site is located; or

2. The acreage covered by buildings and/or asphalt or concrete pavement legally existing on the site at the time the application is submitted to the Department, excluding any buildings, asphalt and/or concrete paving placed on a site in accordance with (e)3 below; or

3. For a marina support facility at a legally existing and operating commercial marina including a marina operated by a public agency, commission or authority, the limit at (e)1 or 2 above or the amount of legal existing impervious cover located on the site, as determined under (g) below, provided the marina support facility is placed on existing legal impervious cover, whichever is higher. For the purposes of this subsection, marina support facilities are boat rack systems, facilities for sewage treatment and marina support buildings. Marina support buildings, include but are not limited to, showrooms, sheds, restrooms, and buildings for marine supplies, bait and tackle, boat sales, dock masters office(s), and boat repair, maintenance and manufacturing.

(f) If a site is located on a military installation, the impervious cover limit is the limit at (f)1 or 2 below, whichever is higher:

1. The acreage of the net land area on the site as determined under N.J.A.C. 7:7E-5.3(d), multiplied by the impervious cover percentage in Table H below for a military installation; or

2. The amount of legal, existing impervious cover located on the site, as determined under (g) below.

(g) For the purposes of determining impervious cover limits under (c)3, (d)2, (e)3, and (f)2 above, the amount of existing impervious cover is the highest of the following, provided the impervious cover was legally placed on the site:

1. The amount of impervious cover located on the site at the time the application is submitted to the Department;

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2. The amount of impervious cover that appears on the applicable 95-97 imagery; or
3. The amount of impervious cover that was placed under the authority of a coastal permit and after the date the photography was performed for the imagery in (g)2 above.

**TABLE H**  
**Percentages For Calculating Impervious Cover**  
**Limits Under N.J.A.C. 7:7E-5B.4**

| <b>Site Location</b>   | <b>Impervious Cover Percentage</b> |
|--|------------------------------------|
| CAFRA Urban Center   | 90 percent                         |
| CAFRA region center<br>Coastal regional center<br>CAFRA core<br>CAFRA node | 80 percent                         |
| CAFRA town<br>Coastal town<br>Military installation                        | 70 percent                         |
| CAFRA village<br>Coastal Village   | 60 percent                         |
| CAFRA hamlet<br>Coastal hamlet   | 50 percent                         |
| Coastal Metropolitan Planning Area   | 80 percent                         |
| Coastal Suburban Planning Area, within a sewer service area*               | 30 percent                         |
| Coastal Suburban Planning Area, outside a sewer service area*              | 5 percent                          |
| Coastal Fringe Planning Area   | 5 percent                          |
| Coastal Rural Planning Area  | 3 percent                          |
| Coastal Environmentally Sensitive Planning Area                            | 3 percent                          |

\* "Sewer service area," for the purpose of this section, means the "sewer service area" as described at N.J.A.C. 7:15-5.16(a) and 5.18(c)4 and (c)5, and identified in a wastewater management plan in accordance with the Water quality Management Planning rules at N.J.A.C. 7:15-5 and/or in an areawide water quality management plan in accordance with N.J.A.C. 7:15-3. Wastewater management plans and areawide water quality management plans may be reviewed at the Department's Division of Watershed Management, 401 East State Street, Trenton, New Jersey; 609-984-0058.

**7:7E-5B.5 Vegetative cover percentages for a site in the CAFRA area**

(a) The area (in acres) on a site in the CAFRA area in which trees and/or herb/shrub vegetation shall be planted or preserved is calculated as follows:

1. To determine the area (in acres) of tree preservation and/or tree planting on the site:

- i. Determine the location of the site for purposes of determining applicable vegetative cover percentages using the method described at N.J.A.C. 7:7E-5B.5(b);
  - ii. Identify the forested or unforested portions of the site, as determined under N.J.A.C. 7:7E-5.5; and
  - iii. For each forested site or portion identified at (a)1ii above, multiply the acreage of the net land area on the forested site or forested portion as determined under N.J.A.C. 7:7E-5.3(d), by the tree preservation percentage in Table I below for the site location that applies to the site or portion, as determined under (a)1i above; and
  - iv. For each unforested site or portion identified at (a)1ii above, multiply the acreage of the net land area on the site or portion, as determined under N.J.A.C. 7:7E-5.3(d), by the tree planting percentage in Table I below for the site location that applies to the site or portion, as determined under (a)1i above; and
2. To determine the area (in acres) of herb/shrub vegetation preservation or planting on the site, subtract both the acreage of the impervious cover allowed under N.J.A.C. 7:7E-5B.4 and the acreage of tree planting and/or preservation required under (a)1 above from the acreage of the net land area on the site.

(b) If the sum of the acreage of tree planting required under (a)1 above plus the acreage of either the existing impervious cover on the site as determined under N.J.A.C. 7:7E-5B.4(c), (d), (e)3 or (f) or the acreage covered by buildings and/or asphalt or concrete pavement as determined under N.J.A.C. 7:7E-5B.4(e)2, exceeds the net land area on the site, as determined under N.J.A.C. 7:7E-5.3(d), then trees shall be planted in area (in acres) remaining after the acreage of impervious cover or acreage covered by buildings and/or asphalt or concrete pavement is subtracted from the acreage of the net land area on the site.

(c) The preservation or planting of trees and/or herb/shrub vegetation areas shall comply with the vegetative cover requirements at N.J.A.C. 7:7E-5.4.

1. The requirement for tree planting at (a)1 above, can be satisfied by preserving equivalent forested areas in addition to that required under (a)1 above.

2. The requirement for planting of herb/shrub vegetation at (a)2 above, can be satisfied by preserving equivalent wooded areas or planting an equivalent area of trees in addition to that required under (a)1 above.

**TABLE I**  
**Tree Preservation and Planting Percentages**  
**For Forested and Unforested Sites**

| Site Location  | Tree preservation percentage for forested portion of site | Tree preservation and/or planting percentage for Unforested portion of site |
|--|---|---|
| CAFRA urban center<br>CAFRA regional center<br>Coastal regional center<br>CAFRA core<br>CAFRA node | 10 percent  | 0 percent   |

|   |            |           |
|---|------------|-----------|
| Military installation   |            |           |
| CAFRA town<br>Coastal town  | 25 percent | 5 percent |
| CAFRA village<br>Coastal village  | 30 percent | 5 percent |
| CAFRA hamlet<br>Coastal hamlet  | 40 percent | 5 percent |
| Coastal Metropolitan Planning Area  | 10 percent | 0 percent |
| Coastal Suburban Planning Area, within a sewer service area*  | 35 percent | 5 percent |
| Coastal Suburban Planning Area, outside a sewer service area*<br>Coastal Fringe Planning Area<br>Coastal Rural Planning Area<br>Coastal Environmentally Sensitive Planning Area | 70 percent | 5 percent |

\*"Sewer service area, "for the purpose of this section, means the "sewer service area" as described at N.J.A.C. 7:15-5.16(a) and 5.18(c)4 and 5, and identified in a wastewater management plan in accordance with the Water Quality Management Planning rules at N.J.A.C. 7:15-5 and/or in an areawide water quality management plan in accordance with N.J.A.C. 7:15-3. Wastewater management plans and areawide water quality management plans may be reviewed at the Department's Division of Watershed Management, 401 East State Street, Trenton, New Jersey; 609-984-0058.

**N.J.A.C. 7:7E-5B.6 Mainland coastal centers**

(a) On February 7, 2005, the boundaries delineated by the Department for coastal centers not located on barrier islands, oceanfront spits, or peninsulas in the CAFRA area expired. The expired boundaries for such coastal centers are re-established as the boundaries for mainland coastal centers once all conditions set forth at (b)1 or (b)2 below are met. The boundaries of mainland coastal centers are described in Appendix 2 of this chapter. The boundaries for coastal centers that expired on February 7, 2005 that do not meet the conditions set forth at (b) below are described in Appendix 4 of this chapter.

(b) A mainland coastal center is established under this section if, as explained at (a) above, the boundaries of the coastal center expired on February 7, 2005 and the coastal center is:

1. Located in a municipality that, prior to July 5, 2006 held a pre-petition meeting with the Office of Smart Growth in accordance with N.J.A.C. 5:85-7.3; or

2. Located in a municipality that:

- i. By August 4, 2005, submits to the Office of Smart Growth a resolution of the municipal governing body requesting a pre-petition meeting in accordance with N.J.A.C. 5:85-7.3. The resolution shall identify the expired coastal centers described in Appendix 4 that the municipality seeks to re-establish. Only the expired coastal centers identified in the resolution shall be re-established;
- ii. Prior to October 15, 2005, holds a pre-petition meeting with the Office of Smart Growth in accordance with N.J.A.C. 5:85-7.3; and
- iii. Prior to March 15, 2006 obtains a determination from the Executive Director of the Office of Smart Growth, in accordance with N.J.A.C. 5:85-7.5, that its initial petition for plan endorsement is complete.

(c) The boundaries of the mainland coastal centers established in accordance with (b) above and described in Appendix 2 shall expire in accordance with (c)1 or 2 below, as applicable. On and after the expiration of the mainland coastal centers, the impervious cover limits and vegetative cover percentages for all sites in the CAFRA area, except for sites in the non-mainland coastal centers in Appendix 3 of this chapter, shall be determined in accordance with N.J.A.C. 7:7E-5B.4(c), (e) or (f).

1. On March 15, 2006, if the municipality in which the mainland coastal center is located has not obtained a determination from the Executive Director of the Office of Smart Growth, in accordance with N.J.A.C. 5:85-7.5, that its initial petition for plan endorsement is complete; or
2. On March 15, 2007.

(d) To reflect changes in mainland coastal centers occurring after February 6, 2006, the Department shall publish in the New Jersey Register a notice of administrative change when the boundaries of a mainland coastal center are established under (a) and (b) above or expire under (c) above.

(e) The areas identified at (e)1 through 6 below shall not be considered part of a mainland coastal center, except for purposes of (f) below:

1. Areas mapped as endangered or threatened wildlife species habitat on the Department's Landscape Maps of Habitat for Endangered, Threatened or Other Priority Species. The data are available as a download at the CAFRA Planning Map layers webpage: [www.nj.gov/dep/gis/CAFRAlayers.htm](http://www.nj.gov/dep/gis/CAFRAlayers.htm);
2. Areas mapped as Natural Heritage Program priority sites, excluding those lands within the boundaries of these sites mapped in the URBAN lands layer extracted from the most recent NJDEP Land Use/Land Cover GIS data set. Both the Natural Heritage Program priority site data and the URBAN lands data are available as a download at the CAFRA Planning Map layers webpage: [www.nj.gov/dep/gis/CAFRAlayers.htm](http://www.nj.gov/dep/gis/CAFRAlayers.htm);
3. Land that is owned by Federal, State, county or municipal agencies or conservation organizations and dedicated to recreation, conservation of natural resources, wildlife protection, or wildlife management;
4. Special water resource protection areas along a Category One water established under the Stormwater Management rules, N.J.A.C. 7:8. Surface waters that

are designated Category One are listed in the Surface Water Quality Standards at N.J.A.C. 7:9B;

5. Wetlands as defined at N.J.A.C. 7:7E-3.27; and

6. Areas identified as Coastal Critical Environmental Sites. The data are available as a download at the CAFRA Planning Map layers webpage:

[www.nj.gov/dep/gis/CAFRAlayers.htm](http://www.nj.gov/dep/gis/CAFRAlayers.htm).

(f) For purposes of any CAFRA permit application that was received by the Department prior to February 7, 2005, assigned an agency project number pursuant to N.J.A.C. 7:7-4.4(a)1i or ii, and proposes a development in a mainland coastal center established in accordance with (b) above that has not expired pursuant to (c) above, the impervious cover limits and vegetative cover percentages shall be determined in accordance with N.J.A.C. 7:7E-5B.4(d) and N.J.A.C. 7:7E-5B.5, respectively, provided the CAFRA permit application is complete for final review pursuant to N.J.A.C. 7:7-4.6 prior to March 15, 2006.

(g) For purposes of any CAFRA permit application that was received by the Department after February 6, 2005 and proposes a development in a mainland coastal center established in accordance with (b) that has not expired pursuant to (c) above:

1. The impervious cover limits and vegetative cover percentages for those portions of the site located within the mainland coastal center shall be determined in accordance with N.J.A.C. 7:7E-5B.4(d) and N.J.A.C. 7:7E-5B.5, respectively, provided no portion of the proposed development, as defined at N.J.A.C. 7:7E-1.8, is located outside the boundaries of the mainland coastal center, or in one of the areas identified at (e)1 through 6 above.

2. If any portion of the proposed development, as defined at N.J.A.C. 7:7E-1.8, is located outside of the mainland coastal center boundaries, or in one of the areas identified at (e)1 through 6 above, then the impervious cover limits and vegetative cover percentages for the entire development shall be determined in accordance with N.J.A.C. 7:7E-5B.4(e) and 7:7E-5B.5, respectively, for the appropriate Coastal Planning Area.

(h) For purposes of any CAFRA permit application that proposes a 100 percent affordable housing development in a mainland coastal center established in accordance with (b)1 above or an expired coastal center located in a municipality that, prior to October 15, 2005 held a pre-petition meeting with the Office of Smart Growth in accordance with N.J.A.C. 5:85-7.3, the impervious cover limits and vegetative cover requirements shall be determined in accordance with N.J.A.C. 7:7-5B.4(d) and 5B.5, respectively, provided the CARA permit application is complete for final review pursuant to N.J.A.C. 7:L7-4.6 prior to March 15, 2007. Such applications shall no longer be applicable to developments proposed within a mainland coastal center or an expired coastal center if the Department establishes a corresponding CAFRA center pursuant to N.J.A.C. 7:7E-5B.2(c) or (e).

(i) For the purposes of (e)5 above, the boundaries of the Critical Environmental Sites on the State Plan Policy Map adopted by the State Planning Commission on March 1, 2001 are incorporated by reference into this subchapter. These boundaries are the boundaries of the Coastal Critical Environmental Sites. Whenever the State Planning Commission

formally approves any new or changed Critical Environmental Site boundary within a mainland coastal center, the Department shall evaluate the new or changed boundary to determine whether it is consistent with the purposes of the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq., and this chapter. The Department shall not reject, or reject and revise, a boundary unless it finds that accepting the State Planning Commission approved boundary would result in unacceptable harm to the coastal ecosystem or the resources of the built or natural environment, or would otherwise be inconsistent with the purposes of the Coastal Area Facility Review Act, N.J.S.A. 13:19-1 et seq. or this chapter. For those new or changed Critical Environmental Site boundaries located within the Pinelands National Reserve, the Department shall also, in consultation with the New Jersey Pinelands Commission, determine whether the boundaries are consistent with the intent, policies and objectives of the National Parks and Recreation Act of 1978, P.L. 95-625, section 502, creating the Pinelands National Reserve, and the State Pinelands protection Act of 1979 (N.J.S.A. 13:18A-1 et seq.). Within 90 calendar days after the date on which the State Planning Commission formally approves such boundary, the Department shall publish in the New Jersey Register a notice of its determination to accept, reject, or reject and revise the boundary for the purposes of (e) above.

1. If the Department accepts the State Planning Commission formally approved new or changed Critical Environmental Site boundary, the accepted new or changed boundary is incorporated by reference as the boundary of the Coastal Critical Environmental Site, and shall be operative 30 calendar days after the date of publication of the New Jersey Register notice under this subsection.

2. If the Department determines under this subsection to reject the State Planning Commission formally approved new or changed Critical Environmental Site boundary, any applicable boundary incorporated by reference under this subsection shall continue to be operative, except as provided under (i)3 below.

3. The Department may determine under this subsection to reject the State Planning Commission formally approved new or changed Critical Environmental Site boundary and to establish a revised Coastal Critical Environmental Site boundary by promulgating an amendment to this chapter in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq. Until the Department promulgates such revised boundary, any applicable Coastal Critical Environmental Site boundary under this subsection shall continue to be operative.

## **SUBCHAPTER 6. GENERAL LOCATION RULES**

### **7:7E-6.1 Rule on location of linear development**

(a) A linear development as defined at N.J.A.C. 7:7E-1.8, shall comply with the specific location rules to determine the most acceptable route, to the maximum extent practicable. If part of the proposed alignment of a linear development is found to be unacceptable under the specific location rules, that alignment (perhaps not the least possible distance) may nonetheless be acceptable, provided the following conditions are met:

1. There is no prudent or feasible alternative alignment which would have less impact on sensitive areas and marine fish or fisheries as defined at N.J.A.C. 7:7E-8.2;
2. There will be no permanent or long-term loss of unique or irreplaceable areas;

3. Appropriate measures will be used to mitigate adverse environmental impacts to the maximum extent feasible, such as restoration of disturbed vegetation, habitats, and land and water features; and
4. The alignment is located on or in existing transportation corridors and alignments, to the maximum extent practicable.

**7:7E-6.2 Basic location rule**

(a) A location may be acceptable for development under N.J.A.C. 7:7E-3, 4, 5, 5A, 5B, and 6, but the Department may reject or conditionally approve the proposed development of the location as reasonably necessary to:

1. Promote the public health, safety, and welfare;
2. Protect public and private property, wildlife and marine fisheries; and
3. Preserve, protect and enhance the natural environment.

**7:7E-6.3 Secondary impacts**

(a) Secondary impacts are the effects of additional development likely to be constructed as a result of the approval of a particular proposal. Secondary impacts can also include traffic increases, increased recreational demand and any other offsite impacts generated by onsite activities which affect the site and surrounding region.

(b) Coastal development that induces further development shall demonstrate, to the maximum extent practicable, that the secondary impacts of the development will satisfy the Coastal Zone Management rules. The Department may restrict coastal development from connecting to an approved infrastructure in order to prevent adverse impacts to special areas and to protect and preserve coastal resources.

1. The level of detail and areas of emphasis of the secondary impact analysis are expected to vary depending upon the type of development. Minor projects may not even require such an analysis. Transportation and wastewater treatment systems are the principal types of development that require a secondary impact analysis, but major industrial, energy, commercial, residential, and other projects may also require a rigorous secondary impact analysis.

2. Secondary impact analysis must include an analysis of the likely geographic extent of induced development, its relationship to the State Development and Redevelopment Plan, an assessment of likely induced point and non-point air and water quality impacts, and evaluation of the induced development in terms of all applicable Coastal Zone Management rules.

3. Models for secondary impact analysis may be found in New Jersey Department of Community Affairs, Division of State and Regional Planning, Secondary Impacts of Regional Sewerage Systems (1975), and in USEPA, Manual for Evaluating Secondary Impacts of Wastewater Treatment Facilities (EPA-600/5-78-003, 1978).

(c) See note at the beginning of this Chapter.

**SUBCHAPTER 7. USE RULES**

**7:7E-7.1 Purpose and scope**

Many types of development seek to locate in the coastal zone. The second stage in

the screening process of the Coastal Zone Management rules involves analysis of appropriate uses of coastal resources. Use rules are rules and conditions applicable to particular kinds of development. Use rules do not preempt location rules which restrict development, unless specifically stated. In general, conditions contained in the use rules must be satisfied in addition to the location rules (N.J.A.C. 7:7E-2 through 6), and the resource rules described in the following subchapter (N.J.A.C. 7:7E-8).

**7:7E-7.2 Housing use rules**

(a) "Housing" includes single family detached houses, multi-family units with apartments or town houses, high-rise buildings and mixed use developments.

(b) Standards relevant to water area and water's edge housing are as follows:

1. New housing or expansion of existing habitable housing is prohibited in Water Areas. Reconstruction of existing habitable structures on pilings located over water areas is conditionally acceptable except when damaged by wind, water or waves, in which case reconstruction is prohibited.

2. In special urban areas and along large rivers where water dependent uses are demonstrated to be infeasible, new housing is also acceptable on structurally sound existing pilings, or where piers have been removed as part of the harbor clean up program, the equivalent pier area may be replaced in the same or another location.

i. Structurally sound existing pilings may be reconfigured provided that the total area of water coverage is not increased and fisheries resources are not adversely impacted.

ii. Expansion of the total area of water coverage is discouraged, except where it can be shown that extensions are functionally necessary for water dependent uses.

iii. New housing acceptable under this rule shall be consistent with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11.

3. Housing is conditionally acceptable in the filled water's edge, provided that it meets the requirements of the Filled Water's Edge rule, N.J.A.C. 7:7E-3.23, lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11. The residential development shall comply with the requirements for impervious cover and vegetative cover that apply to the site under N.J.A.C. 7:7E-5 and either N.J.A.C. 7:7E-5A or 5B, except on bay islands where the requirements of the Bay Island Corridor rule (N.J.A.C. 7:7E-3.21) shall apply.

4. New housing involving the stabilization of existing lagoons through revegetation, bulkheading or other means is conditionally acceptable provided that the conditions of the Existing Lagoon Edge rule (N.J.A.C. 7:7E-3.24) and the Filling rule (N.J.A.C. 7:7E-4.10) are satisfied.

5. On sites with existing shore protection structures, the residential structure shall be set back a minimum of 25 feet from the oceanfront shore protection structures, and a minimum of 15 feet from shore protection structures elsewhere. This distance shall be measured from the waterward face of a bulkhead or seawall and from the top of slope on the seaward side of the revetment.

6. Water area and water's edge housing shall include a provision for boat ramps wherever feasible unless an accessible boat ramp is nearby.

7. Rationale: See the note at the beginning of this Chapter.

(c) Standards relevant to floating homes are as follows:

1. A floating home is any waterborne structure designed and intended primarily as a permanent or seasonal dwelling, not for use as a recreational vessel, which will remain stationary for more than 10 days.

2. Floating homes are prohibited in the coastal zone. Those floating homes registered with the New Jersey Department of Motor Vehicles prior to June 1, 1984 are not subject to this paragraph.

3. Rationale: See the note at the beginning of this Chapter.

(d) Standards relevant to cluster development are as follows:

1. Housing developments are encouraged to cluster dwelling units on the areas of sites most suitable for development. "Clustering" is defined as an increase of net density realized by reducing the size of private lots and retaining or increasing the gross density of a project.

2. Rationale: See the note at the beginning of this Chapter.

(e) Standards relevant to the development of a single family home or duplex and/or accessory development (such as garages, sheds, pools, driveways, grading, excavation, filling, and clearing, excluding shore protection structures) which does not result in the development of more than one single family home or duplex either solely or in conjunction with a previous development as defined at N.J.A.C. 7:7-2.1(b)8, and provided the single family home or duplex and accessory development are located landward of the mean high water line are as follows:

1. Development shall comply with N.J.A.C. 7:7E-3.22, Beaches, 7:7E-3.27, Wetlands, 7:7E-3.28, Wetland buffers, and 7:7E-3.38, Endangered or threatened wildlife or vegetation species habitats;

2. Development shall comply with N.J.A.C. 7:7E-3.16, Dunes, except as provided under (e)2i or ii below.

i. Development that is located on the landward slope of a secondary or tertiary dune as described at (e)2i(2) below, whichever is most landward, need not comply with the dunes rule, N.J.A.C. 7:7E-3.16, if the site and the development meet all of the following criteria:

(1) The area of the site proposed to be developed is located greater than 500 feet landward of the mean high water line of the adjacent water body;

(2) The cross-sectional volume per linear foot of the primary frontal dune waterward of the proposed single family home or duplex as measured above the 100-year stillwater elevation and waterward of the primary frontal dune crest, is greater than 1,100 square feet. For the purposes of this section, primary frontal dune means a continuous or nearly continuous mound or ridge of sand with relatively steep waterward and landward slopes immediately landward of and adjacent to the beach, and subject to erosion and overtopping from high tides and waves during major coastal storms. Secondary and tertiary dunes means the second and third dune mound or ridge, respectively, landward from and adjacent to the primary frontal dune;

(3) The beach area adjacent to the proposed development is either naturally stable without beach nourishment or naturally accretional without beach nourishment, as

determined by using the method described at N.J.A.C. 7:7E-3.19, Erosion Hazard Areas, and the information in the Department's Geographic Information System (GIS) database as found in the Historical Shoreline coverage 1836-1986; and

(4) The site disturbance, including grading, excavation and vegetation removal, is limited to that necessary to develop the single family home or duplex and/or accessory structures; or

ii. Development that is located on a dune which is isolated from a beach and dune system by a paved public road, public seawall or public bulkhead, existing on July 19, 1993, need not comply with the Dunes rule at N.J.A.C. 7:7E-3.16, if the site and the development meet all of the following criteria:

(1) The road, seawall or bulkhead is of sufficient size to be designated as the V-zone boundary on the municipal flood insurance rate map;

(2) The road, seawall or bulkhead has eliminated the protective function of the isolated dune, by providing a significant barrier to coastal processes, including storm waves and flooding;

(3) The road, seawall or bulkhead is functional and is currently maintained by a public entity;

(4) The area of proposed construction is designated as an A-Zone, B-Zone or C-Zone on the municipal Flood Insurance Rate Map;

(5) The site disturbance, including grading, excavation and vegetation removal, is limited to that necessary to develop the single family home or duplex and/or accessory structures; and

(6) The proposed development does not include the construction of a shore protection structure;

3. Development shall comply with N.J.A.C. 7:7E-3.31, Coastal bluffs, if the site is located on the Atlantic Ocean, Delaware Bay, Raritan Bay, or Sandy Hook Bay. Coastal bluffs are defined at N.J.A.C. 7:7E-3.31(a). If the site is not located on one of the four water bodies listed above, the development shall comply with the setback requirements at (e)10i below, unless the development meets either (e)3i or ii below:

i. The development is located in the "developed bluff area." For the purposes of this paragraph, a "developed bluff area" is an area delineated by the limit of existing buildings, in-ground pool or tennis court that existed on July 19, 1993; or

ii. The development on the coastal bluff is located landward of the developed bluff area as defined at (e)3i above, and does not exceed the cumulative surface area of the developed bluff area on the site. If all or part of the proposed development on the coastal bluff is located landward of the existing developed bluff area, an equivalent area of the existing developed bluff area shall be restored through the planting of native woody vegetation species.

4. Development shall comply with N.J.A.C. 7:7E-3.18, Coastal High Hazard Areas, and N.J.A.C. 7:7E-3.19, Erosion Hazard Areas, except as excluded under (i) below;

i. Development that is located on a site partially or completely within a coastal high hazard area or erosion hazard area need not comply with the Coastal High Hazard Areas rule, N.J.A.C. 7:7E-3.18, or Erosion Hazard Areas rule at N.J.A.C. 7:7E-3.19 if:

(1) The lot was shown as a subdivided lot prior to July 19, 1993;

(2) The lot is served by a municipal sewer system; and

(3) A house or commercial building is located within 100 feet of each of the lot lines that run roughly perpendicular to the mean high water line. The 100 feet shall be measured outward from each lot line, along a line generally parallel to the mean high water line;

5. Except as provided in (e)5i below, public access shall be provided in accordance with the Public trust rights rule, N.J.A.C. 7:7E-8.11. Public access requirements may also be imposed as a condition of Shore Protection Program funding, pursuant to N.J.A.C. 7:7E-8.11(p).

i. In accordance with N.J.A.C. 7:7E-8.11(f)5, the Department shall not require public access for the development listed under (e) above provided no beach and dune maintenance activities are proposed and the site does not include a beach on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay or their shores.

6. The use of plastic under landscaped or gravel areas is prohibited. All sub-gravel liners shall be made of filter cloth or other permeable material;

7. Any driveway shall be covered with a permeable material or else shall be pitched to drain all runoff onto permeable areas of the site;

8. For a wooded site, site clearing shall be limited to an area no more than 20 feet from the footprint of the single family home or duplex and the area necessary for driveway, septic, and utility line installations;

9. The development shall comply with the requirements of the Flood hazard areas rule at N.J.A.C. 7:7E-3.25;

10. For a site adjacent to or including surface water bodies or wetlands, a silt fence with a 10-foot landward return shall be erected at the limit of disturbance along the waterward and wetland sides of the development before construction begins. This fence shall be maintained and remain in place until all construction and landscaping is completed;

11. Development shall comply with the following setbacks:

i. On a site with coastal bluffs that is not located on the Atlantic Ocean, Delaware Bay, Raritan Bay, or Sandy Hook Bay, the single family home or duplex and/or accessory structures shall be set back a minimum of 10 feet from the crest of the bluff provided that development will not result in a loss of stability of the bluff or vegetation on the bluff face. Any structure that requires excavation shall be set back one foot beyond the 10 foot setback for every foot of excavation below existing grade;

ii. On an oceanfront site with existing or proposed shore protection structures, the single family home or duplex and/or accessory structures (except decks) shall be set back at least 25 feet from existing or proposed oceanfront shore protection structures. This distance shall be measured from the waterward face of a bulkhead or seawall and from the top of slope on the waterward face of the revetment. This setback shall not apply to below grade structures;

iii. On a non-oceanfront site with existing or proposed shore protection structures, the single family home or duplex and/or accessory structures (except decks) shall be set back at least 15 feet from existing or proposed shore protection structures. If there is no alternative to locating the proposed development at least 15 feet landward of the shore protection structure, the Department shall reduce the required setback if an engineering certification is submitted demonstrating that, after the proposed development has been constructed, the shore protection structure can be replaced within 18 inches of the

existing shore protection structure and a conservation restriction in a form approved by the Department is recorded for the property which states that any reconstruction of a shore protection structure shall be within 18 inches of the existing shore protection structure. A site with coastal bluffs shall instead comply with (e)10i above;

12. The standards for the expansion or reconstruction (with or without expansion) of a single family home or duplex are found at N.J.A.C. 7:7E-7.2(f);

13. Rationale: See the note at the beginning of this Chapter.

(f) Standards relevant to the expansion, or reconstruction (with or without expansion) of a legally constructed habitable single family home or duplex and/or accessory development (such as garages, sheds, pools, driveways, grading, excavation, filling, and clearing, excluding shore protection structures) which does not result in the development of more than one single family home or duplex either solely or in conjunction with a previous development as defined at N.J.A.C. 7:7-2.1(b)8, and provided the single family home or duplex and accessory development are located landward of the mean high water line are as follows:

1. Development shall comply with N.J.A.C. 7:7E-3.22, Beaches, 7:7E-3.27, Wetlands, 7:7E-3.28, Wetland buffers, and 7:7E-3.38, Endangered or threatened wildlife or vegetation species habitats;

2. Development shall comply with N.J.A.C. 7:7E-3.16, Dunes, except as provided under (f)2i through iv below.

i. Development that is located on the landward slope of a secondary or tertiary dune as described at (f)2i(2) below, whichever is most landward, need not comply with the dunes rule, N.J.A.C. 7:7E-3.16, if the site and the development meet all of the following criteria:

(1) The area of the site proposed to be developed is located greater than 500 feet landward of the mean high water line of the adjacent water body;

(2) The cross-sectional volume per linear foot of the primary frontal dune waterward of the proposed single family home or duplex as measured above the 100-year stillwater elevation and waterward of the primary frontal dune crest, is greater than 1,100 square feet. For the purpose of this section, primary frontal dune means a continuous or nearly continuous mound or ridge of sand with relatively steep waterward and landward slopes immediately landward of and adjacent to the beach, and subject to erosion and overtopping from high tides and waves during major coastal storms. Secondary and tertiary dunes means the second and third dune mound or ridge, respectively, landward from and adjacent to the primary frontal dune;

(3) The beach area adjacent to the proposed development is either naturally stable without beach nourishment or naturally accretional without beach nourishment, as determined by using the method described at N.J.A.C. 7:7E-3.19, Erosion Hazard Areas, and the information in the Department's Geographic Information System (GIS) database as found in the Historical Shoreline coverage 1836-1986; and

(4) The site disturbance, including grading, excavation and vegetation removal, is limited to that necessary to expand or reconstruct the single family home or duplex and/or accessory structures;

ii. Development that is located on a dune which is isolated from a beach and dune system by a paved public road, public seawall or public bulkhead, existing on July 19,

1993, need not comply with the dunes rule at N.J.A.C. 7:7E-3.16, if the site and the development meet all of the following criteria:

(1) The road, seawall or bulkhead is of sufficient size to be designated as the V-zone boundary on the municipal flood insurance rate map;

(2) The road, seawall or bulkhead has eliminated the protective function of the isolated dune, by providing a significant barrier to coastal processes, including storm waves and flooding

(3) The road, seawall or bulkhead is functional and is currently maintained by a public entity;

(4) The area of proposed construction is designated as an A-Zone, B-Zone or C-Zone on the municipal Flood Insurance Rate Map;

(5) The site disturbance, including grading, excavation and vegetation removal, is limited to that necessary to expand or reconstruct the single family home or duplex and/or accessory structures; and

(6) The proposed development does not include the construction of a shore protection structure.

iii. Development that is located on a dune need not comply with the Dunes rule, N.J.A.C. 7:7E-3.16, if the development meets the following criteria:

(1) The single family home or duplex legally existed on July 19, 1993;

(2) The development constructed after July 19, 1993 does not exceed a cumulative surface area of 750 square feet on the dune, excluding the area of reconstruction within the existing footprint of development and the area of development authorized under (f)iv below above;

(3) The development is located within the footprint of development of the existing single family home or duplex and/or on the landward side of the existing footprint of development and within the area between lines extended landward and perpendicular to the mean high water line from the widest shore parallel points of the existing footprint of development, except as provided at (f)2iii(4) below;

(4) For every 10 feet the footprint of development of the single family home or duplex is set back landward on the lot from the existing footprint of development of the single family home or duplex, the total area of development may be increased by 200 square feet in addition to that authorized in (f)2iii(2), provided the additional square footage is constructed on the non-waterward side of the single family home or duplex;

(5) The dune area waterward of the single family home or duplex is enhanced as follows:

(A) Sand fill shall be placed as necessary to establish a uniform dune crest elevation matching the highest dune crest elevation at the site; and

(B) Native dune vegetation shall be planted as necessary to establish vegetative cover in accordance with the specifications contained in the Guidelines and Recommendations for Coastal Dune Restoration and Creation Projects (DEP, 1985) and/or Restoration of Sand Dunes Along the Mid-Atlantic Coast (U.S. Soil Conservation Service, 1992). These documents are available upon request from the Department's Land Use Regulation Program, PO Box 439, Trenton, New Jersey 08625-0439, (609) 292-0060; and

(6) A conservation restriction for the dune areas waterward of the existing and/or approved single family home or duplex and/or accessory development is recorded in accordance with N.J.A.C. 7:7-1.5(b)18.

iv. Development that is located on a dune and entails the enclosure of an existing deck, patio, or porch, need not comply with the Dunes rule, N.J.A.C. 7:7E-3.16, if the development meets the following criteria:

- (1) The development is the enclosure of a deck, patio, or porch;
- (2) The deck, patio, or porch enclosure is located on the non-waterward side of the single family home or duplex, as defined at N.J.A.C. 7:7-1.3;
- (3) The deck, patio, or porch legally existed on July 19, 1993;
- (4) The deck, patio, or porch abuts the dwelling;
- (5) The enclosure does not extend beyond the limit of the existing deck, patio, or porch as it existed on July 19, 1993;
- (6) The footprint of development of the deck, patio, or porch enclosure does not exceed 400 square feet;
- (7) The dune area waterward of the single family home or duplex is enhanced as follows:

(A) Sand fill shall be placed as necessary to establish a uniform dune crest elevation matching the highest existing dune crest elevation at the site; and

(B) Native dune vegetation shall be planted in accordance with the specifications contained in the Guidelines and Recommendations for Coastal Dune Restoration Projects (DEP, 1985) and/or Restoration of Sand Dunes Along the Mid-Atlantic Coast (U.S. Soil Conservation Service, 1992). These documents are available upon request from the Department's Land Use Regulation Program, PO Box 439, Trenton, New Jersey 08625-0439, (609) 292-0060; and

(8) A conservation restriction for the dune areas waterward of the existing and/or approved single family home or duplex and/or accessory development is recorded in accordance with N.J.A.C. 7:7-1.5(b)18.

3. Development shall comply with N.J.A.C. 7:7E-3.31, Coastal bluffs, if the site is located on the Atlantic Ocean, Delaware Bay, Raritan Bay, or Sandy Hook Bay. Coastal bluffs are defined at N.J.A.C. 7:7E-3.31(a) If the site is not located on one of the four water bodies listed above, the development shall comply with the setback requirements at (f)10i below, unless the development meets either (f)3i or ii below:

i. The development is located in the "developed bluff area." For the purposes of this paragraph, a "developed bluff area" is an area delineated by the limit of existing buildings, in-ground pool or tennis court that existed on July 19, 1993; or

ii. The development on the coastal bluff is located landward of the developed bluff area as defined at (f)3i above, and does not exceed the cumulative surface area of the developed bluff area on the site. If all or part of the proposed development on the coastal bluff is located landward of the existing developed bluff area, an equivalent area of the existing developed bluff area shall be restored through the planting of native woody vegetation species.

4. Development shall comply with N.J.A.C. 7:7E-3.18, Coastal High Hazard Areas, and N.J.A.C. 7:7E-3.19, Erosion Hazard Areas, except as excluded under (i) below.

i. Development that is located on a site partially or completely within a coastal high hazard area or erosion hazard area need not comply with the Coastal High Hazard Areas rule, N.J.A.C. 7:7E-3.18, or Erosion Hazard Areas rule at N.J.A.C. 7:7E-3.19 if:

- (1) The lot was shown as a subdivided lot prior to July 19, 1993;
- (2) The lot is served by a municipal sewer system; and

(3) A house or commercial building is located within 100 feet of each of the lot lines that run roughly perpendicular to the mean high water line. The 100 feet shall be measured outward from each lot line, along a line generally parallel to the mean high water line;

5. Except as provided in (e)5i below, public access shall be provided in accordance with the Public trust rights rule, N.J.A.C. 7:7E-8.11. Public access requirements may also be imposed as a condition of Shore Protection Program funding, pursuant to N.J.A.C. 7:7E-8.11(p).

i. In accordance with N.J.A.C. 7:7E-8.11(f)5, the Department shall not require public access for the development listed under (f) above provided no beach and dune maintenance activities are proposed and the site does not include a beach on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay or their shores.

6. The use of plastic under landscaped or gravel areas is prohibited. All sub-gravel liners shall be made of filter cloth or other permeable material;

7. Any driveway shall be covered with a permeable material or else shall be pitched to drain all runoff onto permeable areas of the site;

8. For a wooded site, site clearing shall be limited to an area no more than 20 feet from the footprint of the single family home or duplex and the area necessary for driveway, septic, and utility line installations;

9. The development shall comply with the requirements of the Flood hazard areas rule at N.J.A.C. 7:7E-3.25;

10. For a site adjacent to or including surface water bodies or wetlands, a silt fence with a 10-foot landward return shall be erected at the limit of disturbance along the waterward and wetland sides of the development before construction begins. This fence shall be maintained and remain in place until all construction and landscaping is completed;

11. Development shall comply with the following setbacks:

i. On a site with coastal bluffs that is not located on the Atlantic Ocean, Delaware Bay, Raritan Bay, or Sandy Hook Bay, the single family home or duplex and/or accessory structures shall be set back a minimum of 10 feet from the crest of the bluff provided that the development will not result in a loss of stability of the bluff or vegetation on the bluff face. Any structure that requires excavation shall be set back one foot beyond the 10 foot setback for every foot of excavation below existing grade;

ii. On an oceanfront site with existing or proposed shore protection structures, the single family home or duplex and/or accessory structures (except decks) shall be set back at least 25 feet from existing or proposed oceanfront shore protection structures. This distance shall be measured from the waterward face of a bulkhead or seawall and from the top of slope on the waterward face of the revetment. This setback shall not apply to below grade structures;

iii. On a non-oceanfront site with existing or proposed shore protection structures, the single family home or duplex and accessory structures (except decks) shall be set back at least 15 feet from existing or proposed shore protection structures. If there is no alternative to locating the proposed development at least 15 feet landward of the shore protection structure, the Department shall reduce the required setback if an engineering certification is submitted demonstrating that, after the proposed development has been constructed, the shore protection structure can be replaced within 18 inches of the

existing shore protection structure and a conservation restriction in a form approved by the Department is recorded for the property which states that any reconstruction of a shore protection structure shall be within 18 inches of the existing shore protection structure. A site with coastal bluffs shall instead comply with (f)10i above;

12. The standards for the development of a single family home or duplex are found at N.J.A.C. 7:7E-7.2(e);

13. Rationale: See the note at the beginning of this Chapter.

(g) The standards relevant to housing and transportation are as follows:

1. The development of housing at locations and densities that contribute to the feasibility of public transportation is encouraged.

2. Residential developments are encouraged to include bicycle paths to activity centers and bicycle storage facilities.

3. Residential developments are encouraged to provide pedestrian amenities which include lighted walkways with benches, lighted sidewalks with curb ramps and intersections, shade trees, and pedestrian controlled traffic lights.

4. Rationale: See the note at the beginning of this Chapter.

### **7:7E-7.3 Resort/Recreational Use**

(a) Resort/recreation uses include the wide range of small and large developments attracted to and often dependent upon locations along the coast. These uses include hotels, motels, marinas, boating facilities, campgrounds, amusement piers, parks and recreational structures such as bathhouses, natural areas, open space for active and passive recreation, and linear paths for bicycling and jogging (see N.J.A.C. 7:7E-7.10 and N.J.A.C. 7:7E-5.5(d)).

(b) Standards relevant to recreation priority are as follows:

1. Each waterfront municipality should contain at least one waterfront park on each body of water within the municipality. Municipalities that do not currently provide, or have active plans to provide, access to the water will not be eligible for Green Acres or Shore Protection Bond Funding.

2. Resort/recreation uses and commercial fisheries uses shall have priority over all other uses in Monmouth, Ocean, Atlantic, and Cape May counties with highest priority reserved for those uses that serve a greater rather than a lesser number of people, and those uses that provide facilities for people of all ages and for people with physical handicaps.

3. Rationale: See the note at the beginning of this Chapter.

(c) Standards relevant to recreation areas within developments are as follows:

1. "Recreation areas" include a variety of types and sizes of open space adequate to accommodate appropriate recreational activities or facilities.

2. Appropriate recreation areas shall be incorporated in the design of all residential, industrial and commercial development to the maximum extent practicable, as necessary to ensure that needed on-site recreation opportunities will not be precluded by a lack of suitable open space. The "maximum extent practicable" will be determined based on guidelines of the Green Acres Program (N.J.S.A. 13:8A-1 et seq.) which consider the

recreation resource supply and demand, the natural characteristics of the site, and the ability to identify a public agency or other organization willing to manage, maintain and develop the open space as a recreational resource. What is necessary will be determined by consideration of recreation resource supply and demand and municipal and county open space and recreation master plans.

3. Rationale: See the note at the beginning of this Chapter.

(d) Standards relevant to marinas are as follows:

1. Marina means any dock, pier, bulkhead, mooring or similar structure or a collection of adjacent structures under singular or related ownership providing permanent or semi-permanent dockage to five or more vessels.

2. New marinas or expansion or renovation (including, but not limited to, dredging, bulkhead construction and reconstruction, and relocation of docks) of existing marinas for recreational boating are conditionally acceptable if:

i. The marina includes the development of an appropriate mix of dry storage areas, public launching facilities, berthing spaces, repair and maintenance facilities, and boating and hardware supply facilities, depending upon site conditions.

ii. The marina posts prominent signs indicating discharges shall not be allowed within the basin and provides restrooms and marine septic disposal facilities for wastewater disposal from boats. For marinas with dockage for 25 or more vessels or any on vessel with live-aboard arrangement, adequate and conveniently located pumpout stations shall be provided.

iii. Restrooms and at least one portable toilet emptying receptacle shall be provided at a marina. The portable toilet emptying receptacle requirement may be satisfied either by the installation of a receptacle device or by the designation of either a pumpout or restroom facility for this use; and

(1) Discharge to a municipal or regional treatment plant where practicable;

(2) Discharge to a subsurface sewerage disposal system constructed in accordance with N.J.A.C. 7:9-2 and N.J.A.C. 7:7E- 8.21; or

(3) Discharge to a holding tank with waste being removed by a licensed septage hauler. A marina employing this method shall maintain a record of waste removal; and

iv. New marina facilities and expansions and renovation of existing marinas shall provide public access in accordance with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and public trust rights rule, N.J.A.C. 7:7E-8.11.

3. New marinas or boat launching facilities that provide primarily for sail, oar or rental boating are encouraged.

4. Expansions of existing marinas shall be encouraged by limiting non-water dependent land uses that preclude support facilities for boating.

5. Publicly funded marinas shall be designed to be part of multiple use parks, to the maximum extent practicable.

6. Recreational boating facilities are acceptable provided that they are designed and located in order to cause minimum feasible interference with the commercial boating industry.

7. New marinas are encouraged to locate on filled water's edge sites, where minimal dredging is required.

8. Construction of new marinas within areas designated by the Department as shellfish habitat is prohibited. Expansions of existing marinas within shellfish habitat areas shall comply with the standards of the Shellfish Habitat rule (N.J.A.C. 7:7E-3.2) and Submerged Vegetation rule (N.J.A.C. 7:7E-3.6).

9. Marinas shall comply with the design standards set forth in N.J.A.C. 7:7E-7.3A to the maximum extent practicable.

10. In addition to complying with all other applicable portions of these rules, all new, expanded and renovated boat mooring facilities with five or more slips which are located on any portion of the Navesink River, Shrewsbury River or Manasquan River (upstream of the Route 35 Bridge) or the St. George's Thorofare shall meet the conditions in (d)10i through iii below. Renovation shall include complete or partial alteration of any portion of a structure, including construction, reconstruction of or relocation of existing docks, piers, moorings and bulkheads and dredging. The conditions are:

i. A pumpout facility shall be constructed and maintained at those facilities at which boats over 24 feet in length or those with on-board septic facilities (heads) shall be docked. All other facilities shall construct and maintain on site marine septic disposal facilities;

ii. No pressure treated lumber or other lumber treated with any other substance shall be used in any portion of the project. This restriction applies only to bulkhead sheathing and planking, and dock planking, and does not apply to pilings. In addition, this restriction does not apply to any construction upland of the mean high water line; and

iii. The applicant and/or property owner shall finance monthly sampling and testing of fecal coliform levels per milliliter of water at five locations selected by the Department in the water in which the project is located. Testing shall be performed by a State-certified laboratory and shall be conducted beginning in the first month following the mooring of vessels and monthly thereafter for two full seasons of operation (that is, May 1 through October 31). The monitoring shall occur on the day of the month selected by the Department and no advance notice of the sampling day shall be given to the property-owner. Results of the monitoring shall be provided to the Department and the property-owner in writing by the laboratory within 10 calendar days after the date of sampling.

(1) The State-certified laboratory shall determine the pre-construction median level of fecal coliform in the water at each of the Department selected test sites at the applicant's expense, and advise the Department and the applicant in writing of these results within 10 calendar days after the date of sampling. If any post-construction test at any single site yields fecal coliform levels which exceed the pre-construction reading at that site by 100 percent, the property owner shall allow Department personnel access to the property during day-light hours to assess whether the operation of the project is causing or contributing to the elevated reading.

(2) In the event the Department determines in writing that the elevated readings of fecal coliform are caused, in whole or in part, by the operation of the project, the property owner shall, as a condition of the permit, cease such uses and practices as described in writing by the Department and shall implement such practices as determined by the Department in writing to be minimally necessary to reduce the levels of fecal coliform emanating from the project.

(3) In the event the Department determines that the laboratory has twice or more failed to sample in the correct location, failed to comply with commonly accepted

sampling techniques and laboratory methods or has divulged the date of sampling to the applicant and/or property-owner in advance of sampling, the property owner shall immediately discontinue use of such laboratory upon receipt of written notice to this effect from the Department and shall arrange for all future sampling to be conducted by another State-certified laboratory. For every month in which sampling does not occur as a result of a change in laboratory, an extra month of sampling shall be required from the property owner during the next season of operation.

(4) If the property owner fails to arrange for water sampling as required herein without first securing the express written permission of the Department to omit sampling for that month, the property owner shall be in violation of the terms of the permit issued under these rules and the Department shall notify the property owner in writing of its intention to revoke the permit and prohibit use of the project pending final revocation of the permit in accordance with N.J.A.C. 7:7-4.11(b).

11. Rationale: See the note at the beginning of this Chapter.

(e) Standards relevant to amusement piers, parks and boardwalks are as follows:

1. For the purposes of this subsection, "amusement pier" means an elevated, pile-supported structure located on a beach and/or tidal water, seaward of a bulkhead or boardwalk, and perpendicular to the mean high water line, on which amusements are located. For purposes of this definition, "amusements" includes rides, games of skill or chance for prizes other than cash payoffs, vendors of toys and/or other merchandise. "Amusements" do not include games for cash payoffs, or bars or restaurants;

2. New amusement piers are prohibited, except in areas with privately held riparian grants, where they are discouraged. Expanded or extended amusement piers, parks, and boardwalks at the water's edge or in the water, and the on-site improvement or repair of existing amusement piers, parks and boardwalk areas are discouraged unless the proposed development meets the following conditions:

i. The amusement pier, park, or boardwalk does not reasonably conflict with aesthetic values, ocean views, or other beach uses and wildlife functions;

ii. The proposed pier expansion will not eliminate or affect the existing direct public access to the beach, unless another access point is provided immediately adjacent to the expanded pier, for each access point eliminated;

iii. The surrounding community can adequately handle the activity and uses to be generated by the proposed development;

iv. The pier expansion is constructed on pilings at the same elevation as the existing pier;

v. The pier expansion includes a provision for public seating and viewing at the terminal end of the expansion; and

vi. Public access shall be provided in accordance with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11;

3. The expansion of a pier qualifying for a General Permit under N.J.A.C. 7:7-7 is acceptable.

4. Rationale: See the note at the beginning of this Chapter.

**7:7E-7.3A Marina Development**

(a) The following pertains to marina project design:

1. The following should be followed to promote water quality in the marina basin:
  - i. Basin depths must never exceed the depths of access channels nor the open water to which the basin is connected.
  - ii. Deep-draft slips shall be constructed in naturally deep portions of the site in order to minimize the need for dredging.
  - iii. Floating breakwaters are preferred in low-energy areas (where wavelengths are less than twice the width of the breakwater).
  - iv. Sharp angles are to be avoided; corners should be gently rounded, never square.
  - v. Basin depths should uniformly deepen toward the exit and waterway outside the basin.
  - vi. Entrance channels should not be located on corners.
  - vii. Where possible, entrance channels should be oriented in the direction of the prevailing winds to promote wind-driven circulation.
  - viii. Enclosed basins should include openings at opposite ends to promote circulation.
  - ix. Slips should be oriented parallel to currents, never broadside; this promotes circulation and reduces the load on the pier structure.
  - x. Fuel pumps shall include back pressure cut-off valves. Main cut-off valves shall be available both at the dock and in the upland area of the marina.
  - xi. Fuel docks should be sturdy using a floating design wherever possible in order to withstand significant storm affected tidal ranges.
  - xii. To control stormwater runoff, upland portions of the site should include water quality features such as detention basins and limit pollutants from entering the waterway.
2. Sloping rip-rap bulkheads are preferred over solid vertical structures; they better dissipate wave energy and provide a more diverse habitat for marine organisms.
3. To avoid standing waves, bulkheads should never be parallel to one another.
4. To minimize the impact on the photic zone, dock and pier widths should be minimized. In addition, the structures should stand as high above mean high water as possible and should be oriented north-south to the maximum extent practicable.
5. The distance from a parked car to a slip should never exceed 180 meters.
6. Septic systems shall be installed with a minimum setback of 100 feet and in soils with a minimum depth to the seasonal high water table of four feet or more.
7. For safety, the usable width of the entrance channel should be at least four times the beam of the widest expected vessel, or a minimum of 19 meters.
8. The marina shall provide pumpout station(s) (fixed or portable). Marinas which allow occupation of berthed vessels for a period of 72 hours or more shall provide slipside pumpout facilities.
9. The marina shall provide abundant trash receptacles along with adequate fish cleaning areas, including separate and well-marked dispensers for organic refuse.
10. Ample parking facilities shall be provided, with a minimum of 0.6 spaces per slip (the number will range from 0.6 to 2.5 spaces per slip, depending on the nature of the marina).
11. The design should include an aesthetically pleasing landscape design.
12. Maintenance areas shall be screened by proper landscaping and shall include techniques which will prevent materials from entering the water.

13. The fueling facility shall be designed to accommodate four of the largest expected vessels.

14. For safety, the turning area of the basin should be at least 2.25 times the length of the longest expected vessel.

15. Marinas shall provide restroom facilities according to the following schedule:

i. For a small marina (up to 40 boats):

(1) Men: One toilet stall, one urinal, and one washbasin.

(2) Women: Two toilet stalls and one washbasin.

ii. For a small "quality" or medium marina (40 to 80 boats):

(1) Men: One urinal, one toilet stall, one shower stall, and one washbasin.

(2) Women: Two toilet stalls, one washbasin, and one shower stall.

iii. For a large marina (over 80 boats):

(1) Add:

(A) One urinal per 30 boats (men);

(B) One toilet stall per 60 boats (men);

(C) One toilet stall per 30 boats (women);

(D) One washbasin per 30 boats (men and women);

(E) One shower stall per 60 boats (men and women).

16. For safety, comfort, and to avoid interference with commercial boating activity, marinas will be designed such that wave heights do not exceed two to four feet in the entrance channel and one to 1.5 feet in the berthing area. Such a design will assume four foot external wave conditions.

17. The marina shall develop and implement a recycling plan for solid waste as appropriate to county requirements.

(b) The following pertains to marina construction:

1. Only high-grade, slow leaching wood preservatives shall be used on pilings and other dock/pier woods.

2. If dredging is necessary, it shall be scheduled around critical life stages of marine organisms.

3. Dredging shall take place during the colder months when the dissolved oxygen levels are naturally high.

4. Erosion and sediment controls shall be in place prior to construction.

5. Where appropriate (currents under 1.5 knots), sediment curtains shall be used during dredging.

6. Clean dredge spoil with adequate grain size shall be used for beach nourishment.

(c) The following pertains to marina operation:

1. The marina must have available adequate floating containment booms and absorbant materials in the event of hydrocarbon spills. Employees shall be trained in the deployment and proper usage of such equipment.

2. Operators shall immediately notify the Department and the Coast Guard of all significant hydrocarbon spills.

3. Operators shall take immediate action in the event of a spill, including boom deployment and spreading of absorbent materials.

4. Waste receptacles shall be emptied daily.

5. Boat maintenance shall be undertaken as far from the water as possible.
6. Clean dredged material with adequate grain size shall be used for beach nourishment.
7. No-discharge signs shall be posted through-out the marina basin.

**7:7E-7.4 Energy facility use rule**

(a) Energy facilities include facilities, plants or operations for the production, conversion, exploration, development, distribution, extraction, processing, or storage of energy or fossil fuels. Energy facilities also include onshore support bases and marine terminals. Energy facilities do not include operations conducted by a retail dealer, such as a gas station, which is considered a commercial development.

(b) Standards relevant to siting of new energy facilities, including all associated development activities, are as follows:

1. Energy facilities shall not be sited in Special Areas as defined at N.J.A.C. 7:7E-3.1 through 3.42, 3.44, 3.46, and marine fish and fisheries areas defined at N.J.A.C. 7:7E-8.2, unless site-specific information demonstrates that such facilities will not result in adverse impacts to these areas;

2. Except for water dependent energy facilities, energy facilities shall be sited at least 500 feet inland of the mean high water line of tidal waters in the following areas:

- i. The CAFRA area; and

- ii. The Western Ocean, Southern, Mullica-Southern Ocean, Great Egg Harbor River and Delaware Estuary regions, as defined at N.J.A.C. 7:7E-5A.2(d);

3. Public access shall be provided in accordance with the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.; and

4. The scenic and visual qualities of coastal areas shall be maintained as important public resources in the siting of energy facilities, pursuant to N.J.A.C. 7:7E-8.12.

(c) Coastal energy facilities construction and operation shall not directly or indirectly result in net loss of employment in the State for any single year.

1. Coastal energy facility construction and operation which results in loss of 200 or more person-years of employment in jobs in New Jersey directly or indirectly related to the State's coastal tourism industry in any single year is prohibited.

2. Rationale: See the note at the beginning of this Chapter.

(d) Standards relevant to Outer Continental Shelf (OCS) oil and gas exploration and development are as follows:

1. Exploration of the Mid-Atlantic, North Atlantic, and other offshore areas with potential reserves of oil and natural gas is discouraged, as long as there are other viable alternatives with less or no environmental threats to the coastal environment, including energy conservation, which have not been fully explored. Should exploration occur and commercially recoverable amounts of oil or natural gas be found, development and production of offshore hydrocarbons shall be carried out according to the specific energy facility policies of this section.

2. Rationale: See the note at the beginning of this Chapter.

(e) Standards relevant to onshore support bases are as follows:

1. New or expanded onshore support bases and marine terminals to support offshore oil and gas exploration, development, and production (including, but not limited to, facilities for work boats, crew boats and helicopters, pipelaying barges, pipeline jet barges, ocean-going tugs, anchor handling vessels, and limited, short-term storage facilities) are encouraged at locations in the Urban Area, Delaware River and Northern Waterfront regions and discouraged in the CAFRA area.

i. Preferable locations for water-dependent onshore support bases include urban waterfront areas, where onshore adverse physical, economic, and institutional impacts will be less than the impacts likely to be placed on less industrially developed areas which are more dependent upon tourism and the resort industry.

ii. Small facilities for storing oil spill containment and cleanup equipment for offshore operations, and emergency crew transport facilities, including crew boat operations, will, however, be acceptable along the Atlantic Ocean or Delaware Bay where such a location would facilitate and expedite offshore emergency operations.

2. Rationale: See the note at the beginning of this Chapter.

(f) Standards relevant to platform fabrication yards and module construction are as follows:

1. Platform fabrication yards and module construction are encouraged in the Urban Area, Delaware River and Northern Waterfront regions, which have the requisite acreage, adequate industrial infrastructure, ready access to the open sea, and adequate water depth, and where the operation of such a yard would not alter existing recreational uses of the ocean and waterways in the areas. They are discouraged elsewhere in the coastal zone.

2. Rationale: See the note at the beginning of this Chapter.

(g) Standards relevant to repair and maintenance facilities are as follows:

1. Repair and maintenance facilities for vessels and equipment for offshore activities are encouraged in the Urban Area, Delaware River and Northern Waterfront regions. Repairs can be accommodated on an emergency basis in existing ship repair facilities in the CAFRA area as defined at N.J.A.C. 7:7E-1.8, but not on a continual, long-term basis.

2. Rationale: See the note at the beginning of this Chapter.

(h) Standards relevant to pipe coating yards are as follows:

1. Pipe coating yards are discouraged in the CAFRA area and encouraged in the Port of New York and New Jersey and the Port of Camden and Philadelphia.

2. Rationale: See the note at the beginning of this Chapter.

(i) Standards relevant to pipelines and associated facilities are as follows:

1. Crude oil and natural gas pipelines to bring hydrocarbons from offshore of the New Jersey coast to existing refineries, oil and gas transmission and distribution systems, and other new oil and natural gas pipelines are conditionally acceptable, provided:

i. For safety and conservation of resources, the number of pipeline corridors, including trunk pipelines for natural gas and oil, shall be limited, to the maximum extent

feasible, and designated following appropriate study and analysis by interested Federal, State and local agencies, affected industries, and the general public;

ii. The pipeline corridors for landing oil or natural gas are to be located in or adjacent to existing already developed or disturbed road, railroad, pipeline, electrical transmission or other rights-of-way, to the maximum extent practicable;

iii. Proposals to construct offshore oil and gas pipelines, originating on the Outer Continental Shelf, and all of the contemplated ancillary facilities along the pipeline route such as, for example, gas separation and dehydration facilities, gas processing plants, oil storage terminals, and oil refineries, will be evaluated in terms of the entire pipeline corridor through the State of New Jersey and its coastal waters;

iv. Pipeline corridors through the State coastal waters shall, to the maximum extent feasible, avoid offshore munitions, chemical and waste disposal areas, heavily used waterways, geological faults, wetlands and significant fish or shellfish habitats;

v. Pipelines shall be buried to a depth sufficient to minimize exposure by scouring, ship groundings, anchors, fishing and clamming and other potential obstacles on the sea floor. Trenching operations shall be conducted in accordance with applicable Federal regulations;

2. New major pumping stations and other ancillary facilities associated with offshore oil and gas pipelines, not specifically identified in this section, are discouraged in the CAFRA area and coastal waters;

3. Oil and gas pipeline related facilities shall provide adequate visual, sound, and vegetative buffers; and

4. Offshore platforms for pumping or compressor stations are encouraged to be located out of sight of the shoreline.

5. Rationale: See the note at the beginning of this Chapter.

(j) Standards relevant to gas separation and dehydration facilities are as follows:

1. For the purposes of this subsection, the following terms have the following meanings:

i. "Separation" means the removal of free liquids from a gas stream. Free liquids may be either hydrocarbon liquids (which may be processed into fuels such as ethane, butane (and propane) or free water.

ii. "Dehydration" means the removal of water vapor from the gas stream after separation of the liquid from the gas.

2. Separation and dehydration facilities are discouraged in the CAFRA area and coastal waters.

3. Separation and dehydration facilities shall:

i. Provide adequate visual, sound, and vegetative buffers; and

ii. Be reviewed as part of the overall proposed gas transportation system.

4. Rationale: See the note at the beginning of this Chapter.

(k) Standards relevant to gas compressor stations are as follows:

1. "Compressor stations" are facilities located along natural gas pipelines which raise the pressure of the gas in order to transport the resource more efficiently and economically.

2. Compressor stations are encouraged to be located out of the sight of the shoreline

on platforms in offshore waters. They are discouraged in the CAFRA area and coastal waters.

3. Rationale: See the note at the beginning of this Chapter.

(l) Standards relevant to gas pigging facility are as follows:

1. A "pig" is a scraping tool that is forced through a pipeline to clean out accumulations of wax, scale, gas liquids or any foreign materials from the inside walls of the pipe. The pig is inserted offshore and would be removed at an onshore location called a "pigging facility."

2. A pigging facility, which may or may not be associated with a separation and dehydration facility, is discouraged in the CAFRA area. The need for and location of the facility will be reviewed within the context of the entire natural gas pipeline system.

3. Rationale: See the note at the beginning of this Chapter.

(m) Standards relevant to gas processing plants are as follows:

1. A "gas processing plant" is designed to recover liquifiable hydrocarbons from a gas stream before it enters a commercial transmission line. A gas processing facility may include treatment, recovery and fractionation equipment to separate the recovered liquid hydrocarbon stream into its various components including, for example, ethane, butane and propane.

2. Gas processing plants proposed for locations between the offshore pipeline landfall and interstate natural gas transmission lines shall be prohibited from sites within the CAFRA area and shall be located the maximum distance from the shoreline. The siting of gas processing plants will be reviewed in terms of the total pipeline routing system.

3. Rationale: See the note at the beginning of this Chapter.

(n) Standards relevant to other gas-related facilities are as follows:

1. Additional facilities related to a natural gas pipeline such as metering and regulating stations, odorization plants, and block valves are conditionally acceptable in the CAFRA area if adequate visual, sound, and vegetative buffer areas are provided.

2. Rationale: See the note at the beginning of this Chapter.

(o) Standards relevant to oil refineries and petrochemical facilities are as follows:

1. New oil refineries and petrochemical facilities are conditionally acceptable outside of the CAFRA area provided they are consistent with all applicable location and resource rules.

2. New oil refineries and petrochemical facilities outside the CAFRA area are encouraged to locate in established industrial areas accessible to their potential labor force and existing infrastructure.

3. New oil refineries and petrochemical facilities are prohibited in the CAFRA area.

4. Expansion in capacity of existing oil refineries and petrochemical facilities at existing sites, which are all located outside of the CAFRA area, will be acceptable if such expansion does not violate applicable State air and water quality standards.

5. Rationale: See the note at the beginning of this Chapter.

(p) Standards relevant to storage of crude oil, gases and other potentially hazardous

liquid substances are as follows:

1. The storage of crude oil, gases and other potentially hazardous liquid substances as defined in N.J.A.C. 7:1E-1.1 under the Spill Compensation and Control Act (N.J.S.A. 58:10-23.11 et seq.) is prohibited on barrier islands and discouraged elsewhere in the CAFRA area.
2. The storage of crude oil, gases and other potentially hazardous liquid substances is conditionally acceptable in the Urban Area, Northern Waterfront and Delaware River regions if it is compatible with or adequately buffered from surrounding uses.
3. The storage of crude oil, gases and other potentially hazardous liquid substances is not acceptable where it would limit or conflict with a potential recreational use.
4. The storage of crude oil, gases and other potentially hazardous liquid substances is not acceptable along the water's edge unless the storage facility is supplied by ship, in which case it is acceptable on the filled water's edge provided the storage facility complies with (p)1, 2 and 3 above.
5. Rationale: See the note at the beginning of this Chapter.

(q) Standards relevant to tanker terminals are as follows:

1. New or expanded tanker facilities are acceptable only in existing ports and harbors where the required channel depths exist to accommodate tankers.
  - i. Multi-company use of existing and new tanker terminals is encouraged in the Port of New York and New Jersey and the Port of Camden and Philadelphia, where adequate infrastructure exists to accommodate the secondary impacts which may be generated by such terminals, such as processing and storage facilities.
2. New tanker terminals are discouraged in areas not identified in (q)1 above.
3. Offshore tanker terminals and deepwater ports are discouraged.
4. Rationale: See the note at the beginning of this Chapter.

(r) Standards relevant to electric generating stations are as follows:

1. New or expanded electric generating facilities (for base load, cycling, or peaking purposes) and related facilities are conditionally acceptable provided:
  - i. The proposed location and site design of the electric generating facility is the alternative which has the least practicable impacts to the coastal zone, based on a comparative evaluation of alternative sites within the coastal zone and inland.
  - ii. Fossil fuel (coal, oil or gas) and hydroelectric generating stations are discouraged in scenic or natural areas that are important to recreation and open space purposes.
  - iii. Nuclear generating stations shall be located in generally remote, rural, and low density areas, consistent with the criteria of 10 CFR 100 (United States Nuclear Regulatory Commission rules on siting nuclear generating stations) and/or any other related Federal regulations. In addition, the nuclear generating facility shall be located in an area where the appropriate low population zone and population center distance are likely to be maintained around the nuclear generating facility, through techniques such as land use controls or buffer zones.
  - iv. The construction and operation of a nuclear generating station shall not be approved unless the proposed method for disposal of the spent fuel to be produced by the facility will be safe, conforms to standards established by the United States Nuclear Regulatory Commission, and will effectively remove danger to life and the environment

from the radioactive waste material. This finding is required under present State law (N.J.S.A. 13:19-11) and will be made consistent with judicial decisions (see *Public Interest Research Group v. State of New Jersey*, 152 N.J. Super. 191 (App.Div.,certif. Den., 75 N.J. 538 (1977)) and Federal law.

v. The construction and operation of a nuclear generating station shall not be approved unless DEP finds that the proposed method for disposal of the spent fuel to be produced by the facility will be safe, conforms to standards established by the United States Nuclear Regulatory Commission, and will effectively remove danger to life and the environment from the radioactive waste material. This finding is required under present State law (N.J.S.A. 13:19-11) and will be made consistent with judicial decisions (see *Public Interest Research Group v. State of New Jersey*, 152 N.J. Super. 191 (App.Div.1977)) and Federal law.

2. Conversion or modification of existing generating facilities for purposes of fuel efficiency, cost reduction, or national interest is conditionally acceptable provided it meets applicable State and Federal laws and standards.

3. Rationale: See the note at the beginning of this Chapter.

(s) Standards relevant to liquefied natural gas (LNG) facilities are as follows:

1. New marine terminals and associated facilities that receive, store, and vaporize liquefied natural gas for transmission by pipeline are discouraged in the coastal zone unless a clear and precise justification for such facilities exists in the national interest; the proposed facility is located and constructed so as to neither unduly endanger human life and property, nor otherwise impair the public health, safety and welfare, as required by N.J.S.A. 13:19-10f; and such facilities comply with the Coastal Zone Management rules.

i. LNG facilities shall be sited and operated in accordance with the standards set forth in the Natural Gas Act of 1938, 15U.S.C. 717-717z, the Natural Gas Policy Act of 1978, 15 U.S.C. 3301-3432, the Outer Continental Shelf Lands Act, 43 U.S.C. 1331 et seq., the Energy Policy Act of 1992, P.L. 102-486, 106 Stat. 2776, October 24, 1992, and the National Environmental Policy Act, 42 U.S.C. 4321 et seq., which set forth standards for siting, design, installation, inspection, testing, construction, operation, transportation of gas, replacement, and maintenance of facilities.

ii. In determining the acceptability of proposed LNG facilities the Department will consider siting criteria including but not limited to:

(1) The risks inherent in tankering LNG along New Jersey's waterways;

(2) The risks inherent in transferring LNG onshore; and

(3) The compatibility of the facility with surrounding land uses, population densities, and concentrations of commercial or industrial activity.

iii. New LNG facilities that liquefy, store and vaporize LNG to serve demand during peak periods shall be located in generally remote, rural, and low-density areas where land use controls and/or buffer zones are likely to be maintained.

2. Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.5 Transportation Use rule**

(a) Standards relevant to roads are as follows:

1. New road construction must be consistent with the rule on location of linear development at N.J.A.C. 7:7E-6.1, and shall be limited to situations where:

- i. A clear need exists, taking into account the alternatives of upgrading existing roads and of using public transportation to meet the need;
- ii. Provision is made to include construction of bicycle and foot paths, except where these would not be feasible;
- iii. Provision is made to include, where appropriate, catwalks and parking access to nearby water bodies.
- iv. Provision is made for coordinated construction of public transportation rights-of-way and facilities, such as bus lanes, rail lines, and related transit stop or station facilities and parking, except where such construction would not be feasible;
- v. Visual and physical access to the coastal waters is maintained, to the maximum extent practicable; and
- vi. Induced development in conflict with coastal rules would not be expected to result.

2. Rationale: See the note at the beginning of this Chapter.

(b) Standards relevant to public transportation are as follows:

1. New and improved public transportation facilities, including bus, rail, air, boat travel, people mover systems and related parking facilities, are encouraged.
2. Development of existing rights-of-way which would preclude either their use for public transportation or public recreation trails is discouraged.
3. Rationale: See the note at the beginning of this Chapter.

(c) Standards relevant to bicycle and foot paths are as follows:

1. The construction of internal bicycle paths, foot paths and sidewalks in residential, commercial, and industrial developments is required to the maximum extent practicable.
2. Linear bicycle and foot paths are encouraged along the edges of all water bodies, and from the water body to the nearest public road, provided they would not disturb Special Areas, excluding flood hazard areas (N.J.A.C. 7:7E-3.25) and riparian zones (N.J.A.C. 7:7E-3.26, or subject to the user to danger.
3. Existing bicycle and foot paths shall be continued around development when it is not practical to pass through development.
4. Rationale: See the note at the beginning of this Chapter.

(d) Standards relevant to parking facilities are as follows:

1. Parking facility standards apply to all of the following:
  - i. Any parking facility of which any part is within the area subject to the Waterfront Development Act (N.J.S.A. 12:5-1 et seq.);
  - ii. Any parking facility and related access, of which any part of the facility or related access is located in the coastal zone; or
2. Parking lots, garages and large paved areas are conditionally acceptable, provided that they will not interfere with existing or planned mass transit services, the extent of paved surfaces is minimized, and landscaping with indigenous species is maximized.
3. Rationale: See note at the beginning of the Chapter.

#### **7:7E-7.6 Public facility use rule**

THIS IS A COURTESY COPY OF THIS RULE. ALL OF THE DEPARTMENT'S RULES ARE COMPILED IN TITLE 7 OF THE NEW JERSEY ADMINISTRATIVE CODE.

(a) Public facilities include a broad range of public works for production, transfer, transmission, and recovery of water, sewerage and other utilities. The presence of an adequate infrastructure makes possible future development and responds to the needs created by present development.

(b) Solid waste facility means any system, site, equipment or building which is utilized for the storage, collection, processing, transfer, transportation, separation, recycling, recovering or disposal of solid waste, but shall not include a recycling center, a regulated medical waste collection facility authorized pursuant to N.J.A.C. 7:26-3A.39, or an intermodal container facility authorized pursuant to N.J.A.C. 7:26-3.6.

1. Solid waste facilities are conditionally acceptable provided:
  - i. Solid waste conservation techniques such as recycling, resource and energy recovery, and volume reduction are explored and proved infeasible before a new or expanded sanitary landfill, preferably at a regional scale, is deemed acceptable;
  - ii. The solid waste facility is not located in a coastal wetland as provided at N.J.A.C. 7:7-2.2(b); and
  - iii. The solid waste facility complies with the Solid and hazardous waste rule at N.J.A.C. 7:7E-8.22.
2. Rationale: See the note at the beginning of this Chapter.

- (c) Wastewater treatment facilities are conditionally acceptable provided:
1. The wastewater treatment facility, including sewer lines, is consistent with an approved Water Quality Management (208) Plan;
  2. The secondary impacts associated with the facility are consistent with the Coastal Zone Management rules; and
  3. The facility shall provide for multiple use of the site, including open space and recreation use, to the maximum extent feasible.
  4. Rationale: See the note at the beginning of this Chapter.

(d) New or expanded public facilities other than those listed at (b) and (c) above are conditionally acceptable provided:

1. The public facility would serve a demonstrated need that cannot be met by an existing public facility at the site or region;
2. Alternate technologies, including conservation, are an impractical or infeasible approach to meeting all or part of the need for the public facility; and
3. The public facility would not generate significant secondary impacts inconsistent with the Coastal Zone Management rules.

#### **7:7E-7.7 Industry Use rule**

(a) Industry uses are uses that involve industrial processing, manufacturing, storage or distribution activities. These uses include, but are not limited to, electric power production, food and food by-product processing, paper production, agri-chemical production, chemical processes, storage facilities, metallurgical processes, mining and excavation processes, and processes using mineral products. Industrial uses do not include petroleum refining which is considered an energy use and, therefore subject to the standards of N.J.A.C. 7:7E-7.4.

(b) Industrial uses are encouraged in special urban areas. Elsewhere, industrial uses are conditionally acceptable provided they comply with all applicable location and resource rules. Particular attention should be given to Location rules which reserve the water's edge for water dependent uses (N.J.A.C. 7:7E-3.16 and 7:7E-3.32); to the Buffers and compatibility of uses rule N.J.A.C. 7:7E-8.13, which requires that the use be compatible with existing uses in the area or adequate buffering be provided; and the lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50, and public trust rights rule, N.J.A.C. 7:7E-8.11, which places public access requirements upon the use.

(c) New industrial development is encouraged to locate at or adjacent to existing industrial sites, to the maximum extent practicable.

(d) Industry that is easily accessible to its labor force by foot or public transportation is encouraged.

(e) Marine resource-dependent industry, such as commercial fishing, is encouraged and shall have priority over other waterfront uses, except for recreation.

(f) The cogeneration of electricity with process steam is encouraged.

(g) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.8 Mining use rule**

(a) New or expanded mining operations on land, and directly related development, for the extraction and/or processing of construction sand, gravel, ilmenite, glauconite, and other minerals are conditionally acceptable, provided that the following conditions are met (mining is otherwise exempted from the General Land Areas rule, but shall comply with the Special Areas, and General Water Area rules):

1. The location of mining operations, such as pits, plants, pipelines, and access roads, causes minimal practicable disturbance to significant wildlife habitats, such as wetlands and stands of mature vegetation;

2. The location of new or expanded mining operations is generally contiguous with or adjacent to sites of existing mining operations, or probable locations of mineral resources on nearby sites, in order to concentrate and not scatter the location of mineral extraction areas within a region, recognizing that mineral resources occur only in certain limited areas;

3. Buffer areas are provided in accordance with N.J.A.C. 7:7E-8.13, using existing vegetation and/or new vegetation and landscaping, to provide maximum feasible screening of new on-land extractive activities and related processing from roads, water bodies, marshes and recreation areas. The Buffers and Compatibility of Uses rule (N.J.A.C. 7:7E-8.13) provides guidance related to buffer treatment. A minimum buffer area of 500 feet will be required to existing residential development;

4. The mine development and reclamation plan, including the timetable, phasing, and activities of the new or expanded mining operations, has been designed with explicit and

adequate consideration of the ultimate reclamation, restoration, and reuse of the site and use of its surrounding region, once the mineral resource is depleted;

5. The mineral extraction areas shall be reclaimed, contoured and replanted to ensure slope stability, control erosion, afford adequate drainage, provide as natural an appearance as possible, and increase the recreation potential of the restored site within two years of the termination of mining operations;

6. The mining operations control and minimize to the maximum extent practicable adverse impacts from noise and dust, surface and groundwater pollution, and disposal of spoils and waste materials and conform to all applicable Federal, State, and local regulations and standards;

7. The mineral extraction operation will not have a substantial or longlasting adverse impact on coastal resources, including local economies, after the initial adverse impact of removal of vegetation, habitat, and soils, and not including the long-term irretrievable impact of use of the non-renewable mineral resource; and

8. The mine development and reclamation plan minimizes the area and time of disruption of agricultural operations and provides for storage and restoration of all Agricultural Class I, II, and III soils, so that there will be no net loss in the area covered by these soils whenever feasible. The placement of soils may be acceptable to an alternate location if a need is demonstrated, there is no net loss in the area covered by these soils and the placement is consistent with all other coastal rules.

(b) The proposed mining, extension of existing mining or associated mining activities in freshwater wetlands or freshwater wetlands transition areas is subject to the Freshwater Wetlands Protection Act (N.J.S.A. 13:9B-1 et seq.) In addition, proposed mining extension of existing mining or associated mining activities within the 100-year floodplain is subject to the flood hazard areas rule at N.J.A.C. 7:7E-3.25.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.9 Port Use rule**

(a) Port uses are concentrations of shoreside marine terminals and transfer facilities for the movement of waterborne cargo (including fluids), and including facilities for loading, unloading and temporary storage.

(b) Port-related development and marine commerce is encouraged in and adjacent to established port areas. Water-dependent development shall not be preempted by non-water dependent development in these areas.

(c) New port uses outside of existing ports as defined at N.J.A.C. 7:7E-3.11(a) are acceptable only when there is a clear demonstration of need, and when suitable land and water area is not available in or adjacent to an existing port.

(d) New or expanded ports must be compatible with surrounding land uses and provide for maximum open space and physical and visual access to the waterfront, provided that this access does not interfere with port operations or endanger public health

and safety. New or expanded ports must also not interfere with national, State, county or municipal parks, recreational areas, or wildlife refuges.

(e) New, expanded or redeveloped port facilities must have direct access to navigation channels of sufficient depth for anticipated vessel access, with minimal dredge and fill requirements, adequate access to road, rail transportation, and adjacent land with sufficient load bearing capacity for structures.

(f) Limited water-dependent, port-related activity, such as commercial fishing, support facilities and emergency oil spill cleanup storage, is acceptable at the small commercial harbors in the coastal zone.

(g) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.10 Commercial facility use rule**

(a) Standards relevant to hotels and motels are as follows:

1. Hotels and motels are commercial establishments, known to the public as hotels, motor-hotels, motels, or tourist courts, primarily engaged in providing lodging, or lodging and meals, for the general public. Also included are hotels and motels operated by membership organizations, whether open to the general public or not.

2. New, expanded or improved hotels and motels are conditionally acceptable provided that the development complies with all Location and Resource rules and with the rule for high-rise structures and is compatible in scale, site design, and architecture with surrounding development.

3. Hotels, motels or restaurants may be water oriented if they take full advantage of a waterfront location.

4. In special urban areas, new hotel, motel, or restaurant development is acceptable in the filled water's edge and over large rivers on structurally sound pilings, provided it is consistent with rules on Filled Water's Edge (N.J.A.C. 7:7E-3.23) and Special Urban Areas (N.J.A.C. 7:7E-3.43), and the existing total area of water coverage is not expanded except where it can be demonstrated that extensions are functionally necessary for water dependent uses.

5. Rationale: See the note at the beginning of this Chapter.

(b) Standards relevant to retail trade and services are as follows:

1. Retail and trade service is a broad category including, but not limited to, establishments selling merchandise for personal and household consumption, such as food stores and clothing stores; offices; service establishments such as banks and insurance agencies; establishments such as restaurants and night clubs; and establishments for participant sports such as bowling alleys and indoor tennis courts.

2. In special urban areas, new or expanded retail trade and service establishments are conditionally acceptable in filled water's edge areas and over large rivers on structurally sound existing pilings as part of mixed use developments, provided that the development is consistent with the rule on Filled Water's Edge (N.J.A.C. 7:7E-3.23) and Special Urban Areas (N.J.A.C. 7:7E-3.43), and the existing total area of water coverage is not expanded

except where it can be demonstrated that extensions are functionally necessary for water dependent uses.

3. Elsewhere in the coastal zone, new or expanded retail trade and service establishments are conditionally acceptable provided that the development:

- i. Complies with all applicable Location and Resource rules;
  - ii. Is compatible in scale, site design, and architecture with surrounding development; and
  - iii. Where appropriate, utilizes the water area as the central focus of the development.
4. Rationale: See the note at the beginning of this Chapter.

(c) Standards relevant to convention centers and arenas are as follows:

1. "Convention centers" are facilities designed primarily for holding conventions. "Arenas" are commercial facilities designed primarily for spectator sporting events. Arenas do not include indoor tennis courts, bowling alleys and other facilities primarily designed for participant sports, nor arenas affiliated with schools and colleges.

2. New convention centers and arenas are encouraged in special urban areas, and conditionally acceptable in Development regions, provided that the development is compatible in scale, site design, and architecture with surrounding development, and is accessible by public transportation. New convention centers and arenas are discouraged in Barrier Island, Extension and Limited Growth regions.

3. Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.11 Coastal engineering**

(a) Coastal engineering includes a variety of structural and non-structural measures to manage water areas and the shoreline for natural effects of erosion, storms, and sediment and sand movement. Beach nourishment, sand fences, pedestrian control on dunes, stabilization of dunes, dune restoration projects, dredged material disposal and the construction of retaining structures such as bulkheads, gabions, revetments and seawalls are all examples of coastal engineering.

1. The standards relevant to shore protection priorities in (b) below do not apply to water dependent uses within existing ports.

(b) Standards relevant to shore protection priorities are as follows:

1. Non-structural solutions to shoreline erosion problems are preferred over structural solutions. Vegetative shore protection measures have been proven effective, and are preferred at shoreline sites in which they are feasible. Feasibility is dependent on the following factors: shoreline geometry; shoreline slope; sediment type; boat traffic; and wind and extent of exposed land/water surface (fetch). The infeasibility and impracticability of a non-structural solution must be demonstrated before structural solutions may be deemed acceptable.

2. Rationale: See the note at the beginning of this Chapter.

(c) Standards relevant to dune management are as follows:

1. Dune restoration, creation and maintenance projects as non-structural shore protection measures, including sand fencing, revegetation, additions of non-toxic appropriately sized material, control of pedestrian and vehicular traffic, are encouraged.

These projects shall comply with N.J.A.C. 7:7E-3A, Standards for Beach and Dune Activities.

2. Rationale: See the note at the beginning of this Chapter.

(d) Standards relevant to beach nourishment are as follows:

1. Beach nourishment projects, such as non-structural shore protection measures, are encouraged, provided that:

i. The particle size and type of the fill material is compatible with the existing beach material to ensure that the new material will not be removed to a greater extent than the existing material would be by normal tidal fluctuations;

ii. The elevation, width, slope and form of the proposed beach nourishment projects are compatible with the characteristics of the existing beach;

iii. The sediment deposition will not cause unacceptable shoaling in downdrift inlets and navigation channels;

iv. Public access to the nourished beach is provided in accordance with the lands and waters subject to the public trust rights rule, N.J.A.C. 7:7E-3.50, and the public trust rights rule, N.J.A.C. 7:7E-8.11.

2. Rationale: See the note at the beginning of this Chapter.

(e) Standards relevant to structural shore protection are as follows:

1. The construction of new shore protection structures or expansion or fortification of existing shore protection structures, including, but not limited to, jetties, groins, seawalls, bulkheads, gabions and other retaining structures to retard longshore transport and/or to prevent tidal waters from reaching erodible material is acceptable only if it meets all of the following five conditions:

i. The structure is essential to protect water dependent uses or heavily used public recreation beach areas in danger from tidal waters or erosion, or the structure is essential to protect existing structures and infrastructure in developed shorefront areas in danger from erosion, or the structure is essential to mitigate, through, for example, the construction of a retained earthen berm, the projected erosion in an erosion hazard area along a headland and provide erosion protection for a development that is otherwise acceptable under the Coastal Zone Management rules;

ii. The structure will not cause significant adverse impacts on local shoreline sand supply;

iii. The structure will not create net adverse shoreline sand movement downdrift, including erosion or shoaling;

iv. The structure will cause minimum feasible adverse impact to living marine and estuarine resources;

v. The structure is consistent with the State's Shore Protection Master Plan;

vi. If the proposed project requires filling of a water area it must be consistent with the General Water Area rule for Filling (N.J.A.C. 7:7E-4.10) and all other relevant coastal rules.

2. Maintenance or construction of an existing bulkhead is conditionally acceptable provided that it meets (e)2i, ii or iii below. All measurements shall be made from the waterward face of the original bulkhead alignment of the existing bulkhead to the waterward face of the replacement bulkhead.

- i. The replacement bulkhead is located within 18 inches outshore of the existing bulkhead, except in accordance with (e)2ii or iii below;
  - ii. The replacement bulkhead is located no more than 24 inches outshore of the existing bulkhead when the replacement bulkhead is constructed of a corrugated material, and the replacement bulkhead is located as close as possible to the face of the existing bulkhead; or
  - iii. Maintenance or reconstruction of an existing bulkhead which does not meet (e)2i or ii above shall be considered new construction, unless it can be demonstrated that the existing bulkhead cannot physically accommodate a replacement in accordance with (e)2i or ii above. In such case, the replacement bulkhead shall be as close as physically possible to the original bulkhead alignment.
3. Stone rip-rap and sloped concrete and gabion revetments which allow for growth of vegetation are the preferred form of retaining structures.
  4. Public access to the shore protection project is provided in accordance with the Lands and waters subject to public trust rights rule, N.J.A.C. 7:7E-3.50 and the Public trust rights rule, N.J.A.C. 7:7E-8.11.
  5. The construction of bulkheads subject to wave runup forces (V-Zones) must be designed and certified by a professional engineer to withstand the forces of wave runup, and must include a splash pad on the landward side. The splash pad must have a minimum width of 10 feet, and may be constructed of concrete, asphalt or other erosion resistant material. If a cobblestone or similar splash pad is utilized, appropriate subbase and filter cloth must be incorporated into the design. A provision for the use of rip-rap along the seaward toe of the bulkhead structure may be required on a case-by-case basis, as a means to limit the scour potential.
  6. Rationale: See the note at the beginning of this Chapter.

**7:7E-7.12 Dredged material placement on land**

(a) Dredged material placement is the disposal or beneficial use of sediments removed during dredging operations. Beneficial uses of dredged material include, but are not limited to, fill, topsoil, bricks and lightweight aggregate. This rule applies to the placement of dredged material landward of the spring high water line. The standards for dredged material disposal in Water Areas are found at N.J.A.C. 7:7E- 4.8.

(b) Dredged material placement on land is conditionally acceptable provided that the use is protective of human health, groundwater quality, and surface water quality, and manages ecological risks. Testing of the dredged material may be required as needed to determine the acceptability of the placement of the material on a particular site.

(c) Dredged material disposal is prohibited on wetlands unless the disposal satisfies the criteria found at N.J.A.C. 7:7E-3.27.

(d) The use of dredged material of appropriate quality and particle size for purposes such as restoring landscape, enhancing farming areas, capping and remediating landfills and brownfields, beach protection, creating marshes, capping contaminated dredged material disposal areas, and making new wildlife habitats is encouraged.

(e) Effects associated with the transfer of the dredged materials from the dredging site to the disposal site shall be minimized to the maximum extent feasible.

(f) Dredged material disposal in wet and dry borrow pits is conditionally acceptable (see N.J.A.C. 7:7E-3.14, and 3.35).

(g) If pre-dredging sediment analysis indicates contamination, then special precautions shall be imposed including but not necessarily limited to increasing retention time of water in the disposal site or rehandling basin through weir and dike design modifications, use of coagulants, ground water monitoring, or measures to prevent biological uptake by colonizing plants.

(h) All potential releases of water from confined (diked) disposal sites and rehandling basins shall meet existing State Surface Water Quality Standards (N.J.A.C. 7:9B) and State Groundwater Quality Standards (N.J.A.C. 7:9).

(i) The Department has prepared a dredging technical manual, titled "The Management and Regulation of Dredging Activities and Dredged Material Disposal in New Jersey's Tidal Waters," October 1997, which provides guidance on dredged material sampling, testing, transporting, processing, management, and placement. The manual is available from the Department's Office of Maps and Publications, PO Box 420, Trenton, New Jersey, 08625-0420, (609) 777-1038.

(j) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.13 National defense facilities use rule**

(a) A national defense facility is any building, group of buildings, marine terminal, or land area owned or operated by a defense agency (Army, Navy, Air Force, Marines, Coast Guard) and used for training, research, material support, or any other defense-related use.

(b) National defense facilities are conditionally acceptable provided the development meets either (b)1 or 2 below:

1. The proposed facility is consistent with all relevant Coastal Zone Management rules; or
2. The proposed facility is coastally dependent, will be constructed and operated with maximum possible consistency with Coastal Zone Management rules, and will result in minimal feasible degradation of the natural environment.

(c) The construction of new facilities or expansion of existing facilities on land not owned by a defense agency is discouraged, unless it can be shown that the facility cannot feasibly be accommodated on an existing base.

(d) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-7.14 High Rise Structures**

(a) High-rise structures are structures which are more than six stories or more than 60 feet in height as measured from existing preconstruction ground level.

(b) The standards for high-rise structures are as follows:

1. High-rise structures are encouraged to locate in an urban area of existing high density, high-rise and/or intense settlements;

2. High-rise structures within the view of coastal waters shall be separated from coastal waters by at least one public road or an equivalent area (at least 50 feet) physically and visually open to the public except as provided by N.J.A.C. 7:7E-3.48;

3. The longest lateral dimension of any high-rise structure must be oriented perpendicular to the beach or coastal waters, except for a high-rise structure that is located in the Redevelopment Zone of the City of Long Branch and authorized pursuant to the Long Branch Redevelopment Zone Permit at N.J.A.C. 7:7-7.4.

4. The proposed structure must not block the view of dunes, beaches, horizons, skylines, rivers, inlets, bays, or oceans that are currently enjoyed from existing residential structures, public roads or pathways, to the maximum extent practicable;

5. High-rise structures outside of the Hudson River waterfront special area as defined by N.J.A.C. 7:7E-3.48 shall not overshadow the dry sand beach between 10:00 A.M. and 4:00 P.M. between June 1 and September 20, and shall not overshadow waterfront parks year round;

6. The proposed structure must be in character with the surrounding transitional heights and residential densities, or be in character with a municipal comprehensive development scheme requiring an increase in height and density which is consistent with all applicable Coastal Zone Management rules;

7. The proposed structure must not have an adverse impact on air quality, traffic, and existing infrastructure; and

8. The proposed structure must be architecturally designed so as to not cause deflation of the beach and dune system or other coastal environmental waterward of the structure.

(c) The high-rise structures rule shall not apply to the following types of development:

1. Development in Atlantic City on existing ocean piers which meets the standards at N.J.A.C. 7:7E-3.49(c) or pedestrian bridges which meet the standards at N.J.A.C. 7:7E-3.49(i)1; or

2. Utility structures that have a demonstrated need.

(d) Rationale: See the note in the beginning of this Chapter.

## **SUBCHAPTER 8. RESOURCE RULES**

### **7:7E-8.1 Purpose and scope**

(a) In addition to satisfying the location and use rules, a proposed development must satisfy the requirements of this subchapter. This subchapter contains the standards the Department utilizes to analyze the proposed development in terms of its effects on various resources of the built and natural environment of the coastal zone, both at the proposed site as well as in its surrounding region.

**7:7E-8.2 Marine Fish and Fisheries**

(a) Marine fish are marine and estuarine animals other than marine mammals and birds. Marine fisheries means:

1. One or more stocks of marine fish which can be treated as a unit for the purposes of conservation and management and which are identified on the basis of geographical, scientific, technical, recreational and economic characteristics; and
2. The catching, taking or harvesting of marine fish.

(b) Any activity that would adversely impact on the natural functioning of marine fish, including the reproductive, spawning and migratory patterns or species abundance or diversity of marine fish, is discouraged. In addition, any activity that would adversely impact any New Jersey based marine fisheries or access thereto is discouraged, unless it complies with (c) below.

(c) The following coastal activities are conditionally acceptable provided that the activity complies with the appropriate general water area rule(s) at N.J.A.C 7:7E-4;

1. Construction of submerged cables and pipelines;
2. Sand and gravel mining to obtain material for beach nourishment, provided :
  - i. The beach nourishment project is in the public interest;
  - ii. There are no alternative borrow sites that would result in less impact to marine fish and fisheries;
  - iii. Any alteration of existing bathymetry within Prime Fishing areas, as defined at N.J.A.C. 7:7E-3.4, does not reduce the high fishery productivity of these areas; and
  - iv. Measures are implemented to minimize and compensate for impacts to marine fish and fisheries; and
3. The establishment of Aquaculture Development Zones in accordance with N.J.S.A. 4:27-1 et seq. and any regulations developed and adopted pursuant thereto.

(d) Rational: See the note at the beginning of this Chapter.

**7:7E-8.4 Water Quality**

(a) As required by Section 307(f) of the Federal Coastal Zone Management Act (P.L. 92-583), Federal, State and local water quality requirements established under the Clean Water Act (33 U.S.C. 1251) shall be the water resource standards of the coastal management program. These requirements include not only the minimum requirements imposed under the Clean Water Act but also the additional requirements adopted by states, localities, and interstate agencies pursuant to Section 510 of the Clean Water Act and such statutes as the New Jersey Water Pollution Control Act. In the Delaware River Basin, the requirements include the prevailing "Basin Regulations-Water Quality" adopted by the Delaware River Basin Commission as part of its Comprehensive Plan. In the waters under the jurisdiction of the Interstate Sanitation Commission in the New Jersey-New York metropolitan area, the requirements include the Interstate Sanitation Commission's Water Quality Regulations. Department rules related to water pollution control and applicable throughout the entire coastal zone include, for example, the Surface Water Quality Standards (N.J.A.C. 7:9-4), the rules concerning Wastewater Discharge Requirements (N.J.A.C. 7:9-5), the Ground-Water Quality Standards (N.J.A.C.

7:9-6), and the Regulations Concerning the New Jersey Pollutant Discharge Elimination System (N.J.A.C. 7:14A).

(b) Coastal development which would violate the Federal Clean Water Act, or State laws, rules and regulations enacted or promulgated pursuant thereto, is prohibited. In accordance with N.J.A.C. 7:15 concerning the Water Quality Management Planning and Implementation process, coastal development that is inconsistent with an approved Water Quality Management (208) Plan under the New Jersey Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., is prohibited.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-8.5 Surface water use**

(a) Surface water is water in lakes, ponds, streams, rivers, bogs, wetlands, bays, and ocean that is visible on land.

(b) Coastal development shall demonstrate that the anticipated surface water demand of the facility will not exceed the capacity, including phased planned increases, of the local potable water supply system or reserve capacity, and that construction of the facility will not cause unacceptable surface water disturbances, such as drawdown, bottom scour, or alteration of flow patterns.

1. Coastal development shall conform with all applicable Department and, in the Delaware River Area, Delaware River Basin Commission requirements for surface water diversions.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-8.6 Groundwater Use**

(a) Groundwater is all water within the soil and subsurface strata that is not at the surface of the land. It includes water that is within the earth that supplies wells and springs.

(b) Coastal development shall demonstrate, to the maximum extent practicable, that the anticipated groundwater withdrawal demand of the development, alone and in conjunction with other groundwater diversions proposed or existing in the region, will not cause salinity intrusions into the groundwaters of the zone, will not degrade groundwater quality, will not significantly lower the water table or piezometric surface, or significantly decrease the base flow of adjacent water sources. Groundwater withdrawals shall not exceed the aquifer's safe yield.

1. Coastal development shall conform with all applicable Department and, in the Delaware River Basin, Delaware River Basin Commission requirements for groundwater withdrawal and water diversion rights.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-8.7 Stormwater management**

If a project or activity meets the definition of “major development” at N.J.A.C. 7:8-1.2, then the project or activity shall comply with the Stormwater Management rules at N.J.A.C. 7:8.

**7:7E-8.8 Vegetation**

(a) Vegetation is the plant life or total plant cover that is found on a specific area, whether indigenous or introduced by humans.

(b) Coastal development shall preserve, to the maximum extent practicable, existing vegetation within a development site. Coastal development shall plant new vegetation, particularly appropriate coastal species native to New Jersey to the maximum extent practicable.

(c) Rationale: See the note at the beginning of this Chapter.

**7:7E-8.9 (Reserved)**

**7:7E-8.10 Air quality**

(a) The protection of air resources refers to the protection from air contaminants that injure human health, welfare or property, and the attainment and maintenance of State and Federal air quality goals and the prevention of degradation of current levels of air quality.

(b) Coastal development shall conform to all applicable State and Federal regulations, standards and guidelines and be consistent with the strategies of New Jersey's State Implementation Plan (SIP). See N.J.A.C. 7:27 and New Jersey SIP for ozone, particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, lead, and visibility.

(c) Coastal development shall be located and designed to take full advantage of existing or planned mass transportation infrastructures and shall be managed to promote mass transportation services, in accordance with the Traffic rule, N.J.A.C. 7:7E-8.14.

(d) Rationale: See the note at the beginning of this Chapter.

**7:7E-8.11 Public trust rights**

(a) Public trust rights to tidal waterways and their shores (public trust rights) established by the Public Trust Doctrine include public access which is the ability of the public to pass physically and visually to, from and along lands and waters subject to public trust rights as defined at N.J.A.C. 7:7E-3.50, and to use these lands and waters for activities such as swimming, sunbathing, fishing, surfing, sport diving, bird watching, walking and boating. Public trust rights also include the right to perpendicular and linear access. Public accessways and public access areas provide a means for the public to pass along and use lands and waters subject to public trust rights.

(b) When used in this section, the following words and terms have the following meanings, unless the context clearly indicates otherwise:

“Green Acres funding” means a loan or matching grant, or both, to a local government unit, or a matching grant to a nonprofit, for the acquisition of land or the development of outdoor recreation and conservation facility(ies) provided by the Department’s Green Acres Program in accordance with N.J.A.C. 7:36.

“Held” when used with reference to land means owned, leased, or otherwise controlled.

“Natural area” means an area that has retained its natural character, as evidenced by the presence of woody vegetation (trees, saplings, scrub-shrub vegetation) or rare or endangered plants. A disturbed area may be considered a natural area if such vegetation is present. A natural area does not include maintained lawns or areas landscaped with non-native herbaceous plants.

“Paper street” means the street shown on a recorded plan but never built.

“Public accessway” means a route that provides a means for the public to reach, pass along, and/or use lands and waters subject to public trust rights. Public accessways include streets, paths, trails, walkways, easements, paper streets, dune walkovers/walkways, piers and other rights-of-way.

“Shore Protection Program funding” means monies from the Shore Protection Fund established by N.J.S.A. 13:19-16 and any other Department money provided for shore protection projects associated with the protection, stabilization, restoration or maintenance of the shore and adjacent land, including beach nourishment projects and land acquisitions. A State Aid Agreement is the means by which a municipality participates in Shore Protection Program funding.

“State Aid Agreement” means a cost sharing agreement entered into by the Department and a municipality for the construction of a shore protection or beach nourishment project. The State Aid Agreement shall describe the project and project area for purposes of compliance with (p)7ii through vi and (p)8ii through v below in recognition of the phasing of a large-scale or multi-phase shore protection or beach nourishment project.

(c) (Reserved)

(d) Except as otherwise provided at (f) below, development on or adjacent to all tidal waterways and their shores shall provide on-site, permanent, unobstructed public access to the tidal waterway and its shores at all times, including both visual and physical access. Specific requirements for sites located along the Arthur Kill, Kill Van Kull west of Bayonne Bridge, Newark Bay, Delaware River from the Trenton Makes Bridge to the CAFRA boundary, Elizabeth River, Hackensack River, Passaic River, Rahway River, Raritan River, Cohansey River in Bridgeton City, and Maurice River in Millville City are found at (e) below. Public accessways and public access areas shall:

1. Include perpendicular access and a linear area along the tidal waterway and its

entire shore; and

2. If located in a natural area of a tidal waterway, be designed to minimize the impacts to the natural area and tidal waterway including impacts to habitat value, vegetation and water quality.

(e) Except as provided in (f) below, in addition to the requirements of (d) above, the perpendicular access and linear area provided for sites located along the Arthur Kill, Kill Van Kull west of Bayonne Bridge, Newark Bay, Delaware River from the Trenton Makes Bridge to the CAFRA boundary, Elizabeth River, Hackensack River, Passaic River, Rahway River, Raritan River, Cohansey River in Bridgeton City, and Maurice River in Millville City, shall comply with the following. The standards for public access along the Hudson River Waterfront Area are set forth at N.J.A.C. 7:7E-3.48.

1. The linear area shall consist of a walkway that meets the following:
  - i. The minimum width of walkway free of obstruction shall be 16 feet; and
  - ii. An area a minimum of 30 feet wide, including the walkway area, shall be permanently protected by a conservation restriction; and
2. The perpendicular access shall consist of a walkway that meets the following:
  - i. The minimum width of the walkway free of obstruction shall be 10 feet;
  - ii. An area a minimum of 20 feet wide, including the walkway area shall be permanently protected by a conservation restriction; and
  - iii. The linear distance between perpendicular accessways shall not exceed one-half mile as measured generally parallel to the waterway; and
3. The Department may reduce the walkway width requirements at (e)1i and 2i above, as necessary to protect endangered and threatened wildlife or vegetation species habitat, critical wildlife habitat as defined at N.J.A.C. 7:7-3.39, natural areas or existing infrastructure.

(f) The permanent on-site public access required at (d) and (e) above may be modified in the following circumstances. However, in no case shall such modification constitute permanent relinquishment of public trust rights of access to and use of tidal waterways and their shores.

1. Public access to tidal waterways and their shores shall be available at all times. However, the Department may allow closure of an area otherwise available for public access during specified late night hours upon documentation of unique circumstances, other than the risk associated with tidal waterways, that threaten public safety and warrant such closure. In no case shall physical barriers be used to close public access. This exception does not apply to the Hudson River Waterfront Area or to the waterways listed in (e) above;

2. The Department may allow, require or impose temporary restrictions to public access, including closure of an area otherwise subject to public access, when it determines:

- i. Exigent circumstances of public safety or security, or repair, maintenance, or construction relating to any public access infrastructure such as a walkway or boardwalk exist, with such closure to terminate immediately when such exigent circumstances cease to exist;

ii. Restrictions are necessary to protect endangered or threatened wildlife or plant species from disturbance or destruction; or

iii. Restrictions are necessary to protect other critical wildlife resources such as seasonal assemblages of wildlife in areas that provide critical feeding, roosting, resting or staging habitat;

3. Where development of a new or at an existing energy facility, industrial use, port use, airport, railroad, or military facility is proposed and the Department determines that perpendicular access and/or a linear area along the entire shore of the tidal waterway is not practicable based on the risk of injury from existing or proposed hazardous operations, or substantial existing and permanent obstructions, and no measures can be taken to avert these risks:

i. The linear public access that would be required in accordance with (d) on site shall be reconfigured and enhanced to accommodate such structures and address such risks; or

ii. If public access on site is not practicable in accordance with i above, alternate public access of comparable use to the public shall be provided at a nearby off site location;

4. Where development of a new or at an existing two-unit (excluding duplexes) or three- unit residential development, or associated accessory development or associated shore protection structure is proposed, the Department may allow the provision of alternate public access on-site or at a nearby offsite location based on an evaluation of the size of the site, the character of the waterway, and the availability and type of public access in the vicinity, provided i through iii below are met. This paragraph does not apply to the Hudson River Waterfront Area and the waterways listed at (e) above. Public access requirements may be imposed as a condition of Shore Protection Program funding, pursuant to (p) below.

i. The development does not result in the development of more than three residential units either solely or in conjunction with a previous development as defined at N.J.A.C. 7:7-2.1(b)8;

ii. No beach and dune maintenance activities are proposed; and

iii. The site is not located on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores;

5. Where development of a new or at an existing two- unit or three- unit (excluding duplexes) residential development, or associated accessory development, or associated shore protection structure is proposed that meets (f)4i above and is located on a site that is located along the Arthur Kill, Kill Van Kull west of Bayonne Bridge, Newark Bay, Delaware River from the Trenton Makes Bridge to the CAFRA boundary, Elizabeth River, Hackensack River, Passaic River, Rahway River, Raritan River, Cohansey River in Bridgeton City, and Maurice River in Millville City, linear and perpendicular public access shall be provided in accordance with the following:

i. The linear area shall consist of a walkway, that meets the following:

(1) The minimum width of walkway free of obstruction shall be 10 feet; and

(2) An area a minimum of 20 feet wide, including the walkway area shall be

permanently protected by a conservation restriction; and

ii. The perpendicular access shall consist of a walkway that meets the following:

(1) The minimum width of the walkway free of obstruction shall be 10 feet;

(2) An area a minimum of 10 feet wide, including the walkway area shall be permanently protected by a conservation restriction;

6. Except as provided in (f)7 below, the Department shall not require public access where development of a new or at an existing single family home, duplex, or associated accessory development or associated shore protection structure is proposed, provided (f)6i through iii below are met. Public access requirements may be imposed as a condition of Shore Protection Program funding, pursuant to (p) below. This paragraph does not apply to the Hudson River Waterfront Area at N.J.A.C. 7:7E-3.48.

i. The development does not result in the development of more than one single family home or duplex either solely or in conjunction with a previous development as defined at N.J.A.C. 7:7-2.1(b)8;

ii. No beach and dune maintenance activities are proposed; and

iii. The site does not include a beach on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores; or

7. Where development of a new or at an existing single family home, duplex, or associated accessory development, or associated shore protection structure is proposed that meets (f)6i above and is located on a site that includes a beach on which beach and dune maintenance activities are proposed or a beach on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores, public access along and use of the beach and the shore shall be provided. Additional requirements may be imposed as a condition of Shore Protection Program funding, pursuant to (p) below.

(g) Public access must be available on a nondiscriminatory basis. All establishments, including municipalities, counties, marinas, condominium associations, homeowner associations and beach clubs, which control access to tidal waterways and their shores shall comply with the Law Against Discrimination, N.J.S.A. 10:5-1 et seq.

(h) Public access to tidal waterways and their shores shall be clearly marked. Department approved public access signs shall be installed at each public accessway, public access area and/or public parking area at the development site and maintained in perpetuity by the permittee and its successors in title and interest,. N.J.A.C. 7:7E-8.11(p) contains the standards for signs for municipalities that participate in Shore Protection Program funding. Subsection (q) below contains the standards for signs for municipalities, counties and nonprofits that receive Green Acres funding for a Green Acres project site.

(i) Activities that have the effect of discouraging or preventing the exercise of public trust rights are prohibited. These activities include, but are not limited to, requiring photographic identification, requiring a liability waiver, requiring the purchase of drinks or food from a specific vendor, or prohibiting bringing beach equipment such as blankets or beach chairs.

(j) Parking shall be provided for the public to access tidal waterways and their shores, except where public access is not required in accordance with (f)6 above or the project is limited in scope in accordance with (f)7. Subsection (p) below contains the parking standards for municipalities that participate in Shore Protection Program funding.

Subsection (q) below contains the parking standards for municipalities, counties and nonprofits that receive Green Acres funding for a Green Acres project site. All other development shall provide parking as follows:

1. For developments which propose to reduce existing on-street or off-street parking that is used by the public for access to tidal waterways and their shores, mitigation for the loss of these public parking areas shall be required at a minimum creation to loss ratio of 1:1. This mitigation shall occur through the creation of new parking spaces within the proposed development site or at another location within 250 feet of the proposed development site;

2. The area set aside for off-street parking shall be dedicated for public access parking through the recording of a conservation restriction maintaining the parking spaces in perpetuity; and

3. The area set aside for on-street parking shall be dedicated for public access parking through municipal ordinance.

(k) Development on or adjacent to tidal waterways and their shores shall provide barrier free access where feasible and warranted by the character of the site.

(l) Development on or adjacent to tidal waterways and their shores shall incorporate fishing access and associated amenities to the maximum extent practicable within the area provided for public access. In the case of a beach, fishing access shall not be required in areas designated for swimming during hours designated for swimming.

(m) A fee for use of bathing and recreational facilities and safeguards, such as lifeguards, toilets, showers, and parking, at publicly or privately owned beach or waterfront areas, may be charged in accordance with (m)1 through 6 below. However, no fees shall be charged solely for access to or use of tidal waterways and their shores. The fee schedule and documentation of compliance with this paragraph shall be submitted to the Department by the permittee, Shore Protection Program participant or recipient of Green Acres funding for a Green Acres project site, and its successors in title and interest upon request.

1. Fees shall be no greater than that which is required to operate and maintain the facility, taking into consideration basic support amenities provided, such as lifeguards, restroom/shower facilities and trash pickup. This requirement applies to facilities and services directly associated with using the tidal waterways and their shores and does not apply to additional amenities such as cabanas, pools, or restaurants;

2. Fees shall not discriminate between residents and non-residents or on any other basis, except as allowed by this rule or other law;

3. Fees shall not be charged for children under the age of 12 years;

4. Badges or passes must be available for sale at times and places that are reasonably convenient for the public. Badges and passes shall be offered for sale in person at the beach or waterfront area during the hours that the beach is staffed. In addition, if the entity that owns or operates the beach or waterfront area offers private memberships, public badges or passes must be offered for sale to the public in the same manner, times and places as private memberships;

5. Weekly, monthly or seasonal badges or passes shall be transferable at the

discretion of the badge or pass holder; and

6. Public access to and use of tidal waterways and their shores may not be conditioned upon providing identification or signing or otherwise agreeing to any waiver or similar disclaimer of rights.

(n) The areas set aside for public access to tidal waterways and their shores shall be permanently dedicated for public use through the recording of a Department approved conservation restriction under the New Jersey Conservation Restriction and Historic Preservation Restriction Act, N.J.S.A. 13:8B-1 et seq., maintaining the publicly dedicated areas in perpetuity. Subsection (p) below contains the conservation restriction standards for municipalities that participate in Shore Protection Program funding. Subsection (q) below contains the conservation restriction standards for municipalities, counties and nonprofits that receive Green Acres funding for a Green Acres project site. N.J.A.C. 7:7E-8A.4 contains the recording requirements for all conservation restrictions.

(o) No authorization or approval under this chapter shall be deemed to relinquish public rights of access to and use of lands and waters subject to public trust rights.

(p) Municipalities that participate in Shore Protection Program funding through a State Aid Agreement shall:

1. Submit the following to the Department for approval prior to issuance of a coastal permit:

i. A draft public access plan that meets the requirements of N.J.A.C. 7:7E-8A.2 and 8A.3 and a draft ordinance adopting the public access plan; and

ii. A draft Public Access Instrument that meets the requirements of N.J.A.C. 7:7E-8A.5;

2. Comply with (c) through (m) above, as applicable for municipally held lands on or adjacent to tidal waterways and their shores. Compliance with (e) above will be required only at a shore protection or beach nourishment project proposed along one of the waterways listed at (e) above and not for other municipally held lands;

3. Prior to commencement of construction or nourishment, provide public access to all tidal waterways and their shores on or adjacent to lands held by the municipality;

4. Prior to commencement of construction or nourishment, adopt the ordinance and record the Public Access Instrument approved by the Department pursuant to (p)1 above;

5. Prior to commencement of construction or nourishment, repeal any ordinance that limits access to or use of tidal waterways and their shores or is in conflict with the Public Trust Doctrine;

6. Not enact or adopt ordinances or engage in activities in conflict with public access to or use of tidal waterways and their shores, such as the placing of signs, structures, vegetation, parking restrictions or any other means, that limit access to or use of tidal waterways and their shores;

7. For shore protection and beach nourishment projects described in the State Aid Agreement and located on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores:

i. Prior to commencement of construction or nourishment, record in accordance with N.J.A.C. 7:7E-8A.4, a Department-approved conservation restriction that maintains

the following areas for public access in perpetuity:

(1) The entire project, except those portions of jetties and groins on which public access is not required in accordance with ii below, and all beaches within the municipality along the waterway on which the project occurs. If a municipality cannot obtain the required conservation restriction for all privately held beaches outside of the project area within the municipality along the waterway on which the project occurs, the shore protection or beach nourishment project can proceed only if the municipality or State has entered into condemnation or other legal proceedings to diligently obtain the necessary easements;

(2) The public accessways held by the municipality that lead to or provide access to tidal waterways and their shores and are not listed in the Public Access Instrument approved by the Department pursuant to (p)1 above, including paths, trails, dune walkovers/walkways, and piers, and public accessways proposed pursuant to (p)7iii below; and

(3) All parking areas identified in (p)7v below;

ii. Immediately upon completion of project construction, provide public access to the entire project and to all beaches within the municipality along the waterway on which the project occurs. Public access is not required to those portions of jetties and groins where it is demonstrated that access poses an extraordinary risk of injury;

iii. Immediately upon completion of project construction, provide public accessways to the project and to all beaches within the municipality along the waterway on which the project occurs. The linear distance between public accessways shall not exceed one-quarter mile as measured generally parallel to the beach/shore, except as provided at (p)7iii(1) below. In areas where existing public accessways, including, but not limited to, streets, roads, paper streets, paths, trails, easements, dune walkovers/walkways, piers and other dedicated public rights-of-way are closer than one-quarter mile apart, the number of existing access points shall not be reduced;

(1) The linear distance between public accessways can exceed one-quarter mile provided:

(A) The average interval between public accessways within the municipality along the waterway on which the project occurs is one-quarter mile; and

(B) In no case is the interval between public accessways greater than three-eighths mile;

iv. Immediately upon completion of project construction, the public restroom facilities that are identified in the approved public access plan required in accordance with (p)1 above and located within the project area and within one-quarter mile of the project area, as measured generally parallel to the beach/shore, shall be open to the public for use. The restroom facilities shall be open to the public for use from the beginning of Memorial Day weekend through September 30, at minimum.

v. Immediately upon completion of project construction, provide parking sufficient to accommodate public demand to access the project and the beach capacity of all beaches within the municipality along that portion of the waterway on which the project occurs. The Department may allow a reduction in the number of parking spaces required upon documentation that the municipality has exhausted all possibilities to provide the required number of parking spaces. Alternative methods of providing adequate parking that must be considered include land acquisition, restriping or reconfiguring parking,

removing existing parking restrictions and providing remote/offsite parking with shuttle service; and

vi. Immediately upon completion of project construction, install Department approved public access signs. Signs shall be maintained in perpetuity by the participant in Shore Protection Project funding at each public accessway and/or public access area along the waterway on which the project occurs;

8. For shore protection and beach nourishment projects described in the State Aid Agreement and located on or adjacent to waterways other than the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores:

i. Prior to commencement of project construction, record in accordance with N.J.A.C. 7:7E-8A.4, a Department-approved conservation restriction that maintains the following for public access in perpetuity:

(1) The entire shore protection project or nourished beach, except for those portions of jetties and groins on which public access is not required in accordance with (p)8ii below;

(2) The public accessways held by the municipality that lead to or provide access to the shore protection project or nourished beach and are not listed in the Public Access Instrument approved by the Department pursuant to (p)1 above, including paths, trails, dune walkovers/walkways, and piers, and public accessways proposed pursuant to iii below; and

(3) All parking areas identified in (p)8iv below;

ii. Immediately upon completion of project construction, permit public access to the entire project. Public access is not required to those portions of jetties and groins where it is demonstrated that access poses an extraordinary risk of injury;

iii. Immediately upon completion of project construction, provide accessways along a linear shore protection or beach nourishment project of one-half mile or more in length at an interval not to exceed one-quarter mile as measured parallel to the project structure;

iv. Immediately upon completion of project construction, provide parking sufficient to accommodate public demand to access the entire project, taking into account the availability of existing public parking; and

v. Immediately upon completion of project construction, install Department approved public access signs. Signs shall be maintained in perpetuity by the participant in Shore Protection Project funding at the site of the project, except at jetties and groins that are not designed for public use;

9. Within 180 days of completion of an emergency shore protection or beach nourishment project, comply with (p)1 through 8 above; and

10. Any municipality that participates in Shore Protection Program funding after December 17, 2007 {the effective date of this rule}, that undertakes any action that is determined by the Department to be in conflict with this section or the Public Trust Doctrine, will be required to take corrective action within 30 days of notification by the Department of the conflict with this regulation or the Public Trust Doctrine. If the Shore Protection Program funding participant does not take corrective action, or if the corrective action taken is not adequate, then the Department may:

i. Withhold Shore Protection Program funding;

ii. Terminate the State Aid Agreement;

iii. Demand immediate repayment to the Shore Protection Fund of all Shore

Protection Program funding for the project(s) in which the municipality participated; and/or

iv. Pursue any other specific remedies in the State Aid Agreement.

(q) To be eligible for Green Acres funding for a Green Acres project site, a municipality, county, or nonprofit organization shall comply with (q)1 through 4 below. For the purposes of this subsection, the "Green Acres project site" is the land that is the subject of an application for Green Acres funding that contains or is adjacent to tidal waterways and their shores. Applicants for Green Acres funding for a Green Acres project site shall:

1. Submit to the Department for approval, prior to application for Green Acres funding for a Green Acres project site, a public access plan that meets the requirements at N.J.A.C. 7:7E-8A.2 and 8A.3.

i. An applicant that is a municipality or county shall also submit a draft ordinance adopting the public access plan;

2. Comply with (c) through (m) above, as applicable. Compliance with (e) above will be required only where the project site is located along one of the waterways listed at (e) above.

3. Provide public access to all tidal waterways and their shores on or adjacent to lands held by the applicant;

4. Not enact or adopt ordinances or engage in activities in conflict with the Public Trust Doctrine, such as the placing of signs, structures, vegetation, parking restrictions or any other means, that limit access to or use of tidal waterways and their shores.

5. In addition to complying with (q)1 through 4 above, an applicant that is a municipality shall:

i. Prior to application for Green Acres funding for a Green Acres project site, submit to the Department for approval, a draft Public Access Instrument that meets the requirements of N.J.A.C. 7:7E-8A.5;

ii. Prior to disbursement of Green Acres funding for a Green Acres project site, repeal any ordinance that limits access to and use of tidal waterways and their shores or is in conflict with the Public Trust Doctrine; and

iii. Prior to disbursement of Green Acres funding for a Green Acres project site, adopt the ordinance and record the Public Access Instrument approved by the Department pursuant to (q)1i and 5i above, respectively;

6. In addition to complying with (q)1 through 4 above, prior to disbursement of Green Acres funding for a Green Acres project site, an applicant that is a county shall adopt an ordinance adopting the public access plan approved by the Department pursuant to (q)1 above;

7. Immediately upon disbursement of Green Acres funding for a Green Acres project site, provide public access along the tidal waterway and its entire shore at the Green Acres project site;

8. Immediately upon disbursement of Green Acres funding for a Green Acres project site, provide at least one accessway to the tidal waterway, its shore and the project site across land held by the recipient of Green Acres funding. Additional accessways shall be provided as necessary given the size, location, and proposed use of the site;

9. Immediately upon disbursement of Green Acres funding for a Green Acres

project site, install and maintain in perpetuity Department approved public access signs at each public accessway and/or public access area at the project site;

10. Immediately upon disbursement of Green Acres funding for a Green Acres project site, record a Department-approved conservation restriction maintaining the following areas for public access in perpetuity. All lands held by the municipality or county for recreation and conservation purposes also must be listed on the Recreation and Open Space Inventory for the municipality and county, respectively, as required by Green Acres as a condition of funding pursuant to N.J.A.C. 7:36.

- i. The project site;
- ii. The public accessways held by the municipality that lead to or provide access to tidal waterways and their shores and are not listed in the Public Access Instrument, including paths, trails, dune walkovers/walkways, and piers and public accessways pursuant to 8 above; and
- iii. All parking areas identified in (q)11 below;

11. Within 10 days of completion of a Green Acres funded development for a Green Acres project site or within 180 days of disbursement of Green Acres funding for acquisition for a Green Acres project site, provide public restrooms and parking for the project site as directed by the Department based on the proposed use of the project site and the nature and extent of public demand; and

12. Any Green Acres funding recipient for a Green Acres project site that, after December 17, 2007, undertakes any action that is determined by the Department to be in conflict with the Public Trust Doctrine, will be required to take corrective action within 30 days of notification by the Department of the conflict with the Public Trust Doctrine. If the Green Acres funding for a Green Acres project site recipient does not take corrective action, or if the corrective action taken is not adequate, then the Department may:

- i. Withhold Green Acres funding;
- ii. Terminate the Green Acres Project Agreement executed pursuant to N.J.A.C. 7:36; and/or
- iii. Demand immediate repayment of all Green Acres funding that has been disbursed to funding recipient.

(r) Rationale: See the note at the beginning of this Chapter.

## **SUBCHAPTER 8A INFORMATION REQUIRED TO DEMONSTRATE COMPLIANCE WITH THE PUBLIC TRUST RIGHTS RULE, N.J.A.C. 7:7E-8.11; CONSERVATION RESTRICTIONS AND PUBLIC ACCESS INSTRUMENTS**

### **7:7E-8A.1 Purpose and scope**

(a) This subchapter sets forth information that shall be included in the public access plan developed in accordance with subsections (p) and (q) of the public trust rights rule. N.J.A.C. 7:7E-8A.2 sets forth the information requirements for the public access plan that is required for municipalities to participate in Shore Protection Program funding or to be eligible for Green Acres funding. N.J.A.C. 7:7E-8A.3 sets forth the information

requirements for the public access plan that is required for counties and nonprofit organizations to be eligible for Green Acres funding. N.J.A.C. 7:7E-8A.4 sets forth the requirements for the form and recording of conservation restrictions required pursuant to the N.J.A.C. 7:7E-8.11(n), (p) and (q). N.J.A.C. 7:7E-8A.5 sets forth the requirements for Public Access Instruments required pursuant to the N.J.A.C. 7:7E-8.11(p) and (q).

(b) When used in this section, the following words and terms have the following meanings, unless the context clearly indicates otherwise:

“Green Acres project site” means the land that is the subject to an application for Green Acres funding that contains or is adjacent to tidal waterways and their shores.

“Held” when used with reference to land means owned, leased or otherwise controlled.

“Paper street” means the street shown on a recorded plan but never built.

**7:7E-8A.2 Information requirements for public access plans submitted by municipalities to participate in Shore Protection Program funding or be eligible for Green Acres funding.**

(a) A public access plan is required pursuant to N.J.A.C. 7:7E-8.11(p)1 and (q)1 for a municipality to participate in Shore Protection Program funding or be eligible for Green Acres funding. A public access plan demonstrates how compliance with N.J.A.C. 7:7E-8.11(p) and (q) will be achieved. A public access plan shall not be modified or repealed without prior approval of the Department.

(b) A public access plan shall include the following:

1. A current tax map identifying:
  - i. All tidal waterways and their shores within the municipality and all lands held by the municipality adjacent thereto;
  - ii. All existing and proposed public accessways to tidal waterways and their shores including streets, roads, paths, trails, easements, paper streets, dune walkovers/walkways, piers, and other public dedicated rights-of way held by the municipality;
2. Copies of all existing and proposed conservation restrictions required pursuant to N.J.A.C. 7:7E-8.11 (p)7i and 8i, and (q)10;
3. A draft Public Access Instrument as described at N.J.A.C. 7:7E-8A.5 and required pursuant to N.J.A.C. 7:7E-8.11(p)1ii and (q)5i;
4. A fee schedule for use of bathing and recreational facilities and safeguards, at tidal waterways and their shores held by the municipality if fees are charged.
  - i. For shore protection and beach nourishment projects, a fee schedule shall also be provided for lands subject to a conservation restriction at N.J.A.C. 7:7E-8.11(p)7i(1) and 8i, if a fee is charged;
5. Draft ordinances required pursuant to N.J.A.C. 7:7E-8.11(p)1i or (q)1i as applicable. The ordinances shall provide that they may not be modified or repealed without prior approval of the Department;
6. Copies of all ordinances addressing use of the beach, tidal waterways and their shores and parking proximity to tidal waterways and their shores; and

7. A compliance statement, including supplemental documents as needed, demonstrating how the municipality and the proposed project comply with N.J.A.C. 7:7E-8.11 (p) or (q) as applicable.

(c) In addition to the information required in (b) above, a public access plan required pursuant to N.J.A.C. 7:7E-8.11(p) shall include the following:

1. Copies of prior State Aid Agreements;  
2. For shore protection and beach nourishment projects located on or adjacent to the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores, a current tax map identifying:

i. All existing and proposed public restrooms within the municipality located within one-quarter mile of the landward edge of the beach or dune along the waterway on which the project occurs. The plan shall provide that:

(1) There is at least one restroom facility every one-half mile within the municipality as measured generally parallel to the beach except in accordance with (c)2i(4) below;

(2) A restroom facility shall be located within one-quarter-mile of each municipal boundary. The one-quarter mile from the municipal boundary can be increased provided the one-quarter mile maximum distance from the landward edge of the beach or dune to the restroom is reduced by the amount the one quarter mile is increased and the distance from the municipal boundary is no greater than three-eighths mile;

(3) Each restroom facility shall be located within one-quarter mile of the landward edge of the beach or dune; and

(4) The one-half mile interval between restrooms required at (c)2i(1) above can be increased provided:

(A) The average interval between restrooms within the municipality is one-half mile, as measured generally parallel to the beach;

(B) The one-half mile maximum distance from the landward edge of the beach or dune to the restroom is reduced by the amount the distance between restrooms is increased; and

(C) In no case is the interval between restrooms greater than five-eighths mile, as measured generally parallel to the beach; and

ii. All existing and proposed parking for the public to access the project and the beach along the waterway on which the project occurs; and

3. For shore protection and beach nourishment projects located on or adjacent to waterways other than the Atlantic Ocean, Sandy Hook Bay, Raritan Bay or Delaware Bay and their shores, a site plan identifying all existing and proposed parking for the public to access the entire shore protection project and/or nourished beach.

(d) In addition to the information required in (b) above, a public access plan required pursuant to N.J.A.C. 7:7E-8.11(q) shall also include a site plan for the Green Acres project site identifying:

1. All tidal waterways and their shores located on or adjacent to the Green Acres project site;

2. All existing and proposed public accessways to tidal waterways and their shores including streets, roads, paths, trails, easements, paper streets, dune walkovers/walkways,

piers and other dedicated public rights-of-way located on the site, and municipally held public accessways within one-quarter mile of the Green Acres project site; and

3. All existing and proposed restrooms and parking held by the municipality for the public to access tidal waterways and their shores on and within one-quarter mile of the Green Acres project site.

**7:7E-8A.3 Information requirements for public access plans submitted by counties or nonprofit organizations to be eligible for Green Acres funding**

(a) A public access plan is required pursuant to N.J.A.C. 7:7E-8.11(q) for a county or nonprofit organization to be eligible for Green Acres funding. A public access plan demonstrates how compliance with N.J.A.C. 7:7E-8.11(q) will be achieved. A public access plan shall not be modified or repealed without prior approval of the Department.

(b) A public access plan under this section shall include the following:

1. A site plan of the Green Acres project site identifying:

i. All tidal waterways and their shores located on or adjacent to the Green Acres project site;

ii. All existing and proposed public accessways to tidal waterways and their shores including streets, paths, trails, easements, paper streets, dune walkovers/walkways, piers and other dedicated public rights-of-way located on the Green Acres project site;

iii. All existing and proposed restrooms and parking for the public to access tidal waterways and their shores on the Green Acres project site;

2. Copies of all existing and proposed conservation restrictions required pursuant to N.J.A.C. 7:7E-8.11(q)10;

3. For an applicant that is a county, a draft ordinance required pursuant to N.J.A.C. 7:7E-8.11(q)1; and

4. A compliance statement demonstrating how the county or nonprofit organization and the proposed project comply with N.J.A.C. 7:7E-8.11(q).

**7:7E-8A.4 Conservation restriction form and recording requirements**

(a) A conservation restriction required at N.J.A.C. 7:7E-8.11(n), (p) or (q) shall be recorded in the chain of title for all properties affected by the restriction.

(b) A conservation restriction shall:

1. Be in the appropriate form and terms as specified and approved by the Department and in accordance with the New Jersey Conservation Restriction and Historic Preservation Restriction Act, N.J.S.A. 13:8B-1 et seq.,

2. Be recorded in accordance with the New Jersey Recording Act, N.J.S.A. 46:15-1.1 et seq., and

3. Run with the property and be binding upon the property owner and the successors in interest in the property or in any part thereof.

(c) A conservation restriction required pursuant to N.J.A.C. 7:7E-8.11(n), (p) and (q) shall be recorded within the time frames specified therein and prior to any Department permit becoming effective.

(d) Proof that a conservation restriction required in (c) above has been recorded in the office of the clerk of the county or the registrar of deeds and mortgages of the county in which the development, project, or project site is located shall be submitted to the Department prior to the commencement of site preparation or construction, or permit effectiveness except as provided at (d)1 and (d)2 below:

1. For developments receiving Green Acres funding that do not require a coastal permit, proof that the conservation restriction has been recorded shall be submitted within 90 days of the disbursement of Green Acres funding; and

2. For acquisitions receiving Green Acres funding, proof that the conservation restriction has been recorded shall be submitted within 90 days of the disbursement of Green Acres funding.

(e) Authorizations and approvals issued by the Department shall not be valid authority to begin site preparation or construction until the Department approved conservation restriction is recorded, except as provided at (d)1 above.

#### **7:7E-8A.5 Public Access Instrument requirements**

(a) A Public Access Instrument required pursuant to N.J.A.C. 7:7E-8.11(p)1i and (q)5i is a conservation restriction recorded by a municipality that transfers to the Department the municipality's right to vacate, dispose of, or divert the lands listed and identified in (b) below to a use that precludes public access to tidal waterways and their shores at those lands.

(b) The Public Access Instrument shall list and identify by name all streets, roads, paper streets, easements, or other dedicated public rights-of-way held by the municipality that lead to tidal waterways and their shores. These shall be listed by block, lot and property owner on which the street, road, paper street, easement, or other dedicated public right-of-way is located and the lot, block and property owner of the lots that abut the street, road, paper street, easement, or other dedicated public right-of-way.

1. The portion of the street, road, paper street, easement, or other dedicated public right-of-way subject to the Public Access Instrument is:

i. Where a beach or dune is present:

(1) The portion of a street, road, paper street, easement, or other dedicated public right-of-way located on the beach or dune; and

(2) The portion of a street, road, paper street, easement, or other dedicated public right-of-way extending landward of the beach or dune to the first cross street or for a distance of one-quarter mile whichever is less; or

ii. Where no beach or dune is present:

(1) The portion of a street, road, paper street, easement, or other dedicated public right-of-way extending landward of the mean high water line to the first cross street or for a distance of one-quarter mile whichever is less.

2. To be eligible for Green Acres funding, all lands held by a municipality for recreation and conservation purposes also must be listed on the Recreation and Open Space Inventory required by Green Acres as a condition of funding pursuant to N.J.A.C. 7:36.

(c) The Public Access Instrument is a conservation restriction and shall comply with N.J.A.C. 7:7E-8A.4.

#### **7:7E-8.12 Scenic Resources and Design**

(a) Scenic resources include the views of the natural and/or built landscape.

(b) Large-scale elements of building and site design are defined as the elements that compose the developed landscape such as size, geometry, massing, height and bulk structures.

(c) New coastal development that is visually compatible with its surroundings in terms of building and site design, and enhances scenic resources is encouraged. New coastal development that is not visually compatible with existing scenic resources in terms of large-scale elements of building and site design is discouraged.

(d) In all areas, except the Northern Waterfront region, the Delaware River Region and Atlantic City, new coastal development adjacent to a bay or ocean or bayfront or oceanfront, beach, dune or boardwalk and higher than 15 feet in height measured from the existing grade of the site or boardwalk shall:

1. Provide an open view corridor perpendicular to the water's edge in the amount of 30 percent of the frontage along the waterfront where an open view currently exists; and

2. Be separated from either the beach, dune, boardwalk, or waterfront, whichever is further inland, by a distance of equal to two times the height of the structure. However, exceptions may be made for infill sites within existing commercial areas along a public boardwalk where the proposed use is commercial and where the set-back requirement is visually incompatible with the existing character of the area.

(e) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-8.13 Buffers and Compatibility of Uses**

(a) Buffers are natural or man-made areas, structures, or objects that serve to separate distinct uses or areas. Compatibility of uses is the ability for uses to exist together without aesthetic or functional conflicts.

(b) Development shall be compatible with adjacent land uses to the maximum extent practicable.

1. Development that is likely to adversely affect adjacent areas, particularly Special Areas N.J.A.C. 7:7E-3, or residential or recreation uses, is prohibited unless the impact is mitigated by an adequate buffer. The purpose, width and type of the required buffer shall vary depending upon the type and degree of impact and the type of adjacent area to be affected by the development, and shall be determined on a case-by-case basis.

2. The standards for wetland buffers are found at N.J.A.C. 7:7E-3.28.

3. The following apply to buffer treatment:

i. All buffer areas shall be planted with appropriate vegetative species, either through primary planting or supplemental planting. This landscaping shall include use of mixed,

native vegetative species, with sufficient size and density to create a solid visual screen within five years from the date of planting.

ii. Buffer areas which are forested may require supplemental vegetative plantings to ensure that acceptable visual and physical separation is achieved.

iii. Buffer areas which are non-forested will require dense vegetative plantings with mixed evergreen and deciduous trees and shrubs. Evergreens must be at least eight feet tall at time of planting; deciduous trees must be at least three inches caliper, balled and burlapped; shrubs must be at least three to four feet in height.

(c) Rationale: See the note at the beginning of this Chapter.

#### **7:7E-8.14 Traffic**

(a) Traffic is the movement of vehicles, pedestrians or ships along a route.

(b) Coastal development shall be designed, located and operated in a manner to cause the least possible disturbance to traffic systems.

1. Alternative means of transportation, that is, public and private mass transportation facilities and services, shall be considered and, where feasible, incorporated into the design and management of a proposed development, to reduce the number of individual vehicle trips generated as a result of the facility. Examples of alternative means of transportation include: van pooling, staggered working hours and installation of ancillary public transportation facilities such as bus shelters.

(c) When the level of service of traffic systems is disturbed by approved development, the necessary design modifications or funding contribution toward an area wide traffic improvement shall be prepared and implemented in conjunction with the coastal development, the satisfaction of the New Jersey Department of Transportation and any regional agencies.

(d) Any development that causes a location on a roadway to operate in excess of capacity Level D is discouraged. A developer shall undertake mitigation or other corrective measures as may be necessary so that the traffic levels at any affected intersection remain at capacity Level D or better. A developer may, by incorporating design modification or by contributing to the cost of traffic improvements, be able to address traffic problems resulting from the development, in which case development would be conditionally acceptable. Determinations of traffic levels which will be generated will be made by the New Jersey Department of Transportation.

(e) Coastal development located in municipalities which border the Atlantic Ocean, except as excluded under (e) 1, 2 or 3 below, shall provide sufficient on-site and/or off-site parking for its own use at a ration of two spaces per residential unit. In general, on street parking spaces along public roads cannot be credited as part of off-site parking provided for a project. All off-site parking facilities must be located either in areas within reasonable walking distance to the development or areas identified by any local or regional transportation plans as suitable locations. All off-site parking facilities must also comply with N.J.A.C. 7:7E-7.5(d), the parking facility rule, where applicable.

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1. The non-oceanfront portions of the following municipalities which border the Atlantic Ocean are excluded from the parking requirement at (e) above:
  - i. Neptune Township, Monmouth County: Those portions of this municipality which are west of State Highway 71;
  - ii. Brick, Dover and Berkeley Townships, Ocean County: Those portions of these municipalities which are not located between Barnegat Bay and the Atlantic Ocean;
  - iii. Upper Township, Cape May County: Those portions of this municipality which are not located between Whale Creek and the Atlantic Ocean and/or Strathmere Bay and the Atlantic Ocean; and
  - iv. Lower Township, Cape May County: Those portions of this municipality which are not between Lower Thorofare and the Atlantic Ocean and/or Jarvis Sound and the Atlantic Ocean;
2. The department shall reduce the parking requirement for developments restricted to senior citizen housing that is, restricted to persons at least 62 years of age or those persons meeting the definition of "senior citizen tenant" pursuant to the Senior Citizens and Disabled Protected Tenancy Act, N.J.S.A. 2A:18-61, upon documentation that the parking needs of the development are less than two spaces per unit; or
3. Nursing homes and assisted living facilities are excluded from the parking requirement at (e) above.

(f) Rationale: See the note at the beginning of this Chapter.

**7:7E-8.15 (Reserved)**

**7:7E-8.16 (Reserved)**

**7:7E-8.17 (Reserved)**

**7:7E-8.18 (Reserved)**

**7:7E-8.19 (Reserved)**

**7:7E-8.20 (Reserved)**

**7:7E-8.21 Subsurface sewage disposal systems**

(a) Subsurface sewage disposal system means a system for disposal of sanitary sewage into the ground which is designed and constructed to treat sanitary sewage in a manner that will retain most of the settleable solids in a septic tank and to discharge the liquid effluent to a disposal field.

(b) Acceptability conditions for subsurface sewage disposal systems are as follows:

1. Construction of the subsurface sewage disposal system is acceptable provided it meets all the provisions of the standards for Individual Subsurface Sewage Disposal Systems (N.J.A.C. 7:9A) and receives approval from the appropriate administrative authority;

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2. For areas subject to tidal flooding, the bottom elevation of the disposal bed must be at or above the 10 year flood elevation as determined by the Federal Emergency Management Agency Flood Insurance Study Reports;

3. Construction of subsurface sewage disposal systems must comply with flood hazard areas rule at N.J.A.C. 7:7E-3.25.

(c) Rationale: See the note at the beginning of this Chapter.

**7:7E-8.22 Solid and hazardous waste**

(a) Solid waste means any garbage, refuse, sludge or other waste material, including solid, liquid, semi-solid or contained gaseous material. A material is a solid waste if it is "disposed of" by being discharged, deposited, injected, dumped, spilled, leaked or placed into or on any land or water so that such material or any constituent thereof may enter the environment or be emitted into the air or discharged into ground or surface waters. Solid waste becomes a hazardous waste when it exhibits any of the characteristics which are specified in the Federal Regulations on Identification and Listing of Hazardous Waste (40 C.F.R. 261). The general characteristics of hazardous waste include, but are not limited to, characteristics of ignitibility, characteristics of corrosivity, characteristics of reactivity and characteristics of toxicity.

1. Solid waste shall not include the following:

i. Source separated food waste collected by livestock producers approved by the State's Department of Agriculture who collect, prepare and feed such wastes to livestock on their own farms, or recyclable materials that are exempt from regulation pursuant to N.J.A.C. 7:26A;

ii. Materials approved for beneficial use or categorically approved for beneficial use pursuant to N.J.A.C. 7:26;

iii. Spent sulfuric acid which is used to produce virgin sulfuric acid, provided at least 75 percent of the amount accumulated is recycled in one year;

(b) Coastal development shall conform with all applicable State and Federal regulations, standards and guidelines for the handling and disposal of solid and hazardous wastes, including the Solid Waste Management Act, N.J.S.A. 13:1E-1 et seq., the Solid Waste Management rules, N.J.A.C. 7:26, the Recycling rules, N.J.A.C. 7:26A, and the Hazardous Waste rules, N.J.A.C. 7:26G.

(c) Rationale: See the note at the beginning of this Chapter.

**APPENDIX 2 (RESERVED)**

**APPENDIX 3  
BOUNDARIES OF NON-MAINLAND COASTAL CENTERS IN THE CAFRA  
AREA**

For purposes of N.J.A.C. 7:7E-5 and 5B, this appendix sets forth the boundaries of the non-mainland coastal centers in the CAFRA area. The boundaries of the mainland coastal centers are set forth in Appendix 2 and the boundaries of coastal centers that expired on February 7, 2005 are set forth in Appendix 4.

In accordance with N.J.A.C. 7:7E-5.3(c), the impervious cover allowed on a site within a Department-delineated coastal center must be placed on the net land area of the site, as determined under N.J.A.C. 7:7E-5.3(d). The placement of impervious cover on a site in a coastal center may be further restricted by other provisions of this chapter, including the Special Area rules at N.J.A.C. 7:7E-3.

The appendix is organized as follows: Counties are listed alphabetically. Within each county, the municipalities are listed alphabetically. Within each municipality, the non-mainland coastal centers are listed alphabetically.

## **I. Atlantic County coastal centers on barrier islands, spits, and peninsulas**

### **A. Brigantine coastal town**

1. The coastal town boundary follows the municipal boundary of the City of Brigantine, but does not include any bay islands or the Absecon Wildlife Management Area.

## **II. Cape May County coastal centers on barrier islands, spits and peninsulas**

### **A. Lower Township coastal centers**

#### **1. Diamond Beach coastal town**

a. The coastal town boundary extends from the intersection of the Wildwood Crest/Lower Township municipal boundary and Park Boulevard thence southwest on Park Boulevard to North Station Avenue, thence southeast on North Station Avenue to Ocean Drive (County route 621), thence southwest on Ocean Drive (County route 621) to Madison Avenue, thence southeast on Madison Avenue to its end, thence southeast on the same bearing to the water's edge, thence northeast along the water's edge to the municipal boundary, and thence northwest along the municipal boundary to Park Boulevard.

### **B. Ocean City coastal regional center**

1. The coastal regional center boundary follows the municipal boundary of Ocean City, but does not include any bay islands or Corson's Inlet State Park.

### **C. Sea Isle City coastal town**

1. The coastal town boundary follows the municipal boundary of Sea Isle City, but does not include the area north of a line that extends along 22nd Street and along the same bearing from either end of 22nd Street to the mean high water line.

## **III. Monmouth County coastal centers on barrier islands, spits and peninsulas**

### **A. Monmouth Beach coastal town**

1. The coastal town boundary follows the municipal boundary of the Borough of Monmouth Beach, but does not include any bay islands.

**B. Sea Bright coastal town**

1. The coastal town boundary follows the municipal boundary of the Borough of Sea Bright, but does not include any bay islands.

**IV. Ocean County coastal centers on barrier islands, spits and peninsulas**

**A. Barnegat Light coastal village**

1. The coastal village boundary follows the municipal boundary of Barnegat Light Borough, but does not include any bay islands or Barnegat Light State Park.

**B. Bay Head coastal town**

1. The coastal town boundary follows the municipal boundary of Bay Head Borough.

**C. Beach Haven Borough coastal town**

1. The coastal town boundary follows the municipal boundary of Beach Haven Borough, but does not include any bay islands.

**D. Berkeley Township coastal town**

1. The coastal town boundary circumscribes that part of Berkeley Township that is east of Barnegat Bay, north of Island Beach State Park and south of Seaside Park Borough.

**E. Brick Township coastal centers**

**1. South Mantoloking coastal village**

a. The coastal village boundary circumscribes that part of Brick Township that is east of Barnegat Bay, north of Toms River Township, and south of Mantoloking Borough, but does not include any bay islands.

**F. Toms River Township coastal centers**

**1. Normandy Beach/Chadwick coastal town**

a. The coastal town boundary circumscribes that part of Toms River Township that is east of Barnegat Bay, north of Lavallette Borough and south of Brick Township, but does not include any bay islands.

**2. Ortleigh Beach coastal town**

a. The coastal town boundary circumscribes that part of Toms River Township that is east of Barnegat Bay, north of Seaside Heights Borough, and south of Lavallette Borough, but does not include any bay islands.

**G. Harvey Cedars coastal town**

1. The coastal town boundary follows the municipal boundary of Harvey Cedars Borough, but does not include any bay islands.

**H. Lavallette coastal town**

1. The coastal town boundary follows the municipal boundary of Lavallette Borough, but does not include any bay islands.

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**I. Long Beach coastal town**

1. The coastal town boundary circumscribes those non-contiguous parts of Long Beach Township that are east of Barnegat Bay, but does not include any bay islands or the Holgate Unit of the Edwin B. Forsythe National Wildlife Refuge.

**J. Mantoloking coastal village**

1. The coastal town boundary follows the municipal boundary of Mantoloking Borough, but does not include any bay islands.

**K. Seaside Heights coastal town**

1. The coastal town boundary follows the municipal boundary of Seaside Heights Borough, but does not include any bay islands.

**L. Seaside Park coastal town**

1. The coastal town boundary follows the municipal boundary of Seaside Park Borough, but does not include any bay islands.

**M. Ship Bottom coastal town**

1. The coastal town boundary follows the municipal boundary of Ship Bottom Borough, but does not include any bay islands.

**N. Surf City coastal village**

1. The coastal village boundary follows the municipal boundary of Surf City, but does not include any bay islands.

**APPENDIX 4 (RESERVED)**

**APPENDIX 5  
CAFRA CENTERS, CAFRA Cores and CAFRA Nodes**

This non-regulatory appendix contains the list of CAFRA centers, CAFRA cores and CAFRA nodes the boundaries of which have been accepted by the Department under N.J.A.C. 7:7E-5B.3(b), and which are incorporated into and shown on the CAFRA Planning Map. As required under N.J.A.C. 7:7E-5B.4(b), an applicant shall refer to the CAFRA Planning Map in order to determine the location of a site for the purposes of determining the applicable impervious cover limits under this chapter.

The Department will update the list of CAFRA centers, CAFRA cores and CAFRA nodes in this Appendix by notice of administrative change as part of the New Jersey Register notice required in N.J.A.C. 7:7E-5B.3(b). The appendix is organized as follows: Counties are listed alphabetically. Within each county, the municipalities are listed alphabetically. Within each municipality, the CAFRA centers, CAFRA cores and CAFRA nodes are listed alphabetically.

**I. Atlantic County CAFRA centers**

**A. Atlantic City**

1. Atlantic City CAFRA urban center

**B. Galloway Township CAFRA centers and CAFRA cores**

1. Galloway Downtown CAFRA core
2. Oceanville CAFRA village
3. Smithville CAFRA core
4. Smithville CAFRA town
5. Wrangleboro CAFRA town

**II. Cape May County CAFRA centers**

**A. Avalon Borough**

1. Avalon Borough CAFRA town

**B. Cape May City**

1. Cape May City CAFRA town

**C. Cape May Point Borough**

1. Cape May Point CAFRA village

**D. Stone Harbor Borough**

1. Stone Harbor Borough CAFRA town

**E. Wildwood City/North Wildwood City/Wildwood Crest Borough/West Wildwood Borough**

1. The Wildwoods CAFRA regional center

**III. Cumberland County CAFRA centers**

**A. Bridgeton City**

1. Bridgeton CAFRA regional center

**B. Commercial Township CAFRA centers**

1. Laurel Lake CAFRA village
2. Mauricetown-Haleyville CAFRA village
3. Port Norris CAFRA village

**C. Lawrence Township**

1. Cedarville CAFRA Village

**D. Maurice River Township**

1. Delmont CAFRA village
2. Dorchester-Leesburg CAFRA village
3. Heislerville CAFRA village
4. Port Elizabeth Bricksboro CAFRA village

5. Mauricetown Station CAFRA hamlet

**E. Millville City/Vineland City**

1. Millville-Vineland CAFRA regional center

**IV. Monmouth County CAFRA centers**

**A. Asbury Park City**

1. Asbury Park CAFRA urban center

**B. Atlantic Highlands Borough**

1. Atlantic Highlands Borough CAFRA town

**C. Long Branch City**

1. Long Branch CAFRA regional center

**D. Manasquan Borough**

1. Manasquan Borough CAFRA town

**E. Red Bank Borough**

1. Red Bank CAFRA regional center

**V. Ocean County CAFRA centers**

**A. Little Egg Harbor Township**

1. Mystic Island CAFRA town
2. Parkertown CAFRA village

**B. Little Egg Harbor Township/Tuckerton Borough**

1. Tuckerton CAFRA town

**C. Ocean Township**

1. Waretown CAFRA town center

**D. Seaside Heights Borough**

1. Seaside Heights CAFRA Town

**E. Stafford Township**

1. Stafford/Manahawkin CAFRA regional center

**VI. Salem County CAFRA centers and CAFRA nodes**

**A. Lower Alloways Township CAFRA centers**

1. PSE&G Energy Facility node

**B. Salem City**

1. Salem City CAFRA regional center

# **Appendix C – 3**

## **State Legal Authorities**

### **Freshwater Wetlands Protection Act Rules**

NJDEP Freshwater Wetlands Rules N.J.A.C. 7:7A Effective 10/20/03

Note: this is a courtesy copy of the freshwater wetlands rules. The official version is in the New Jersey Administrative Code (N.J.A.C.). Should there be any discrepancies between this courtesy copy and the official version, the official version will govern.

## **New Jersey Department of Environmental Protection Freshwater Wetlands Protection Act Rules N.J.A.C. 7:7A**

*For more information about NJDEP's freshwater wetlands program, see  
[www.state.nj.us/dep/landuse](http://www.state.nj.us/dep/landuse)*

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## SUBCHAPTER 1 GENERAL INFORMATION

### 7:7A-1.1 Scope and authority

This chapter constitutes the rules governing the implementation of the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.; and the New Jersey Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq. Certain violations of the New Jersey Water Pollution Control Act are also subject to enforcement provisions at N.J.A.C. 7:14.

### 7:7A-1.2 Construction of this chapter

This chapter shall be liberally construed to allow the Department to implement fully its statutory functions pursuant to the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq., and pursuant to the Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.

### 7:7A-1.3 Forms and information, internet web site

Forms or other information related to this chapter may be obtained from the Land Use Regulation Program as follows:

1. Through the Land Use Regulation Program website at [www.state.nj.us/dep/landuse](http://www.state.nj.us/dep/landuse); or by contacting the Land Use Regulation Program at:

Land Use Regulation Program  
New Jersey Department of Environmental Protection  
P.O. Box 439  
Trenton, New Jersey 08625 - 0439  
(609) 292-0060  
Fax: (609) 292-8115

- (b) Applications, fees, and correspondence shall be submitted to the address in (a) above, except that courier and hand deliveries shall be delivered to:

Land Use Regulation Program  
New Jersey Department of Environmental Protection  
5 Station Plaza  
501 East State Street  
Trenton, New Jersey 08609

- (c) Applications or other materials sent or delivered to a Department address other than those in (a) and (b) shall not be deemed to have been received for the purposes of calculating application review deadlines or other time periods under this chapter.
- (d) Other sources of information referred to in this chapter are available on the Land Use Regulation Program website at [www.state.nj.us/dep/landuse](http://www.state.nj.us/dep/landuse), or from the Office of Maps and Publications, located at 428 State Street, Trenton, New Jersey 08625, (609) 777-1038.

#### 7:7A-1.4 Definitions

The following words and terms, when used in this chapter, shall have the following meanings unless the context clearly indicates otherwise. Additional definitions specifically applicable to N.J.A.C. 7:7A-15, Mitigation, are set forth at N.J.A.C. 7:7A-15.1.

"Abandoned" means, with respect to an agricultural field, including a blueberry field or a cranberry bog, that the field was used for agriculture, but has not been used to produce a crop or product for five years or more. If an agricultural field has been abandoned for 40 or more years, it shall no longer be considered an abandoned agricultural field.

"ACOE" or "Corps" means the United States Army Corps of Engineers.

"Acid producing soils" means soils that contain geologic deposits of iron sulfide minerals (pyrite or marcasite) which, when exposed to oxygen from the air or from surface waters, oxidize to produce sulfuric acid. Acid producing soils, upon excavation, generally have a pH of 4.0 or lower. After exposure to oxygen, these soils generally have a pH of 3.0 or lower. Information regarding the location of acid producing soils in New Jersey can be obtained from local Soil Conservation District offices.

"Agency of the State" means each of the principal departments in the executive branch of the State Government, and all boards, divisions, commissions, agencies, departments, councils, authorities, offices or officers within any such departments.

"Applicant" means a person who submits an application for a permit, waiver, or any other Department decision pursuant to N.J.A.C. 7:7A.

"Aquatic ecosystem" means waters of the United States, including wetlands, that serve as habitat for interrelated and interacting communities and populations of plants and animals.

"Atlantic white-cedar wetlands" means a type of forested freshwater wetlands where Atlantic white-cedar tree is the dominant vegetation, as described in the Federal Manual.

"Best Management Practices" or "BMPs" means methods, measures, designs, performance standards, maintenance procedures, and other management practices which prevent or reduce adverse impacts upon or pollution of freshwater wetlands, State open waters, and adjacent aquatic habitats, which facilitate compliance with the Federal Section 404(b)(1) guidelines (40 C.F.R. Part 230), New Jersey Department of Environmental Protection Flood Hazard Area Control rules, N.J.A.C. 7:13; the Department's Storm Water Management Regulations, N.J.A.C. 7:8; the Standards for Soil Erosion and Sediment Control in New Jersey, promulgated by the New Jersey State Soil Conservation Committee at N.J.A.C. 2:90; and effluent limitations or prohibitions under Section 307(a) of the Federal Act and the Department's Surface Water Quality Standards, N.J.A.C. 7:9B. Examples include practices found at 33 C.F.R. 330.6, 40 C.F.R. 233.35(a)6, the Department's Technical Manual for Stream Encroachment, and "A Manual of Freshwater Wetland Management Practices for Mosquito Control in New Jersey". The manuals included in this definition are only a partial listing, and interested persons should contact the Department for the most up to date list.

"Category one waters" means waters designated as category one waters in the Department's Surface Water Quality Standards at N.J.A.C. 7:9B. As of September 4, 2001, N.J.A.C. 7:9B-1.15 defines category one waters as those waters designated in the tables in

N.J.A.C. 7:9B-1.15(c) through (h), for purposes of implementing the antidegradation policies set forth at N.J.A.C. 7:9B-1.5(d), for protection from measurable changes in water quality characteristics because of their clarity, color, scenic setting, other characteristics of aesthetic value, exceptional ecological significance, exceptional recreational significance, exceptional water supply significance, or exceptional fisheries resource(s). These waters may include, but are not limited to:

1. Waters originating wholly within Federal, interstate, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings that have not been designated as FW1 at N.J.A.C. 7:9B-1.15(h) Table 6;
2. Waters classified at N.J.A.C. 7:9B-1.15(c) through (g) as FW2 trout production waters and their tributaries;
3. Surface waters classified in this subchapter as FW2 trout maintenance or FW2 nontrout that are upstream of waters classified in this subchapter as FW2 trout production;
4. Shellfish waters of exceptional resource value; or
5. Other waters and their tributaries that flow through, or border, Federal, State, county, or municipal parks, forests, fish and wildlife lands, and other special holdings.

"Commissioner" means the Commissioner of the Department of Environmental Protection.

"Compelling public need" means that based on specific facts, the proposed regulated activity will serve an essential health or safety need of the municipality in which the proposed regulated activity is located, that the public health and safety benefit from the proposed use and that the proposed use is required to serve existing needs of the residents of the State, and that there is no other means available to meet the established public need.

"Conservation restriction" means a restriction, easement, covenant, or condition, in any deed, will or other instrument, other than a lease, executed by or on behalf of the owner of the land, appropriate to retaining land or water areas predominantly in their natural, scenic or open or wooded conditions, or for conservation of soil or wildlife, or for outdoor recreation or park use, or as suitable habitat for fish or wildlife, to forbid or limit any or all:

1. Construction or placing of buildings, roads, signs, billboards or other advertising, or other structures on or above the ground;
2. Dumping or placing of soil or other substance or material as landfill, or dumping or placing of trash, waste or unsightly or offensive materials;
3. Removal or destruction of trees, shrubs or other vegetation;
4. Excavation, dredging or removal of loam, peat, gravel, soil, rock or other mineral substance;
5. Surface use except for purposes permitting the land or water area to remain predominantly in its natural condition;

6. Activities detrimental to drainage, flood control, water conservation, erosion control or soil conservation, or fish and wildlife habitat preservation;
7. Other acts or uses detrimental to the retention of land or water areas according to the purposes of this chapter.

"Contiguous" means adjacent properties, even if they are separated by human-made barriers or structures or legal boundaries. Contiguous properties shall include, but are not limited to, land areas which directly abut or are separated by a general access roadway or other right-of-way, including waterways; and properties which are part of a subdivision that was under common ownership on July 1, 1988.

"Council" means the Wetlands Mitigation Council established pursuant to Section 14 of the Act.

"Critical habitat for fauna or flora" means:

1. For fauna, areas which serve an essential role in maintaining commercially and recreationally important wildlife, particularly for wintering, breeding, spawning and migrating activities;
2. For flora, areas supporting rare or unique plant species or uncommon vegetational communities in New Jersey.

"Cultivating" means physical methods of soil treatment, employed upon planted farm, ranch or forest crops to aid and improve the growth, quality or yield of the crops.

"Degraded wetland" means a wetland in which there is impaired surface water flow or groundwater hydrology, or excessive drainage; a wetland which has been partially filled or excavated, contaminated with hazardous substances, or which has an ecological value substantially less than that of undisturbed wetlands in the region.

"Delegable waters" means all waters of the United States, as defined in this section, within New Jersey, except waters which are presently used, or are susceptible to use in their natural condition or by reasonable improvement, as a means to transport interstate or foreign commerce, shoreward to their ordinary high water mark. This term includes all waters which are subject to the ebb and flow of the tide, shoreward to their mean high water mark, including wetlands that are partially or entirely located within 1000 feet of their ordinary high water mark or mean high tide. Waters that are not delegable waters include, but are not limited to:

1. The entire length of the Delaware River within the State of New Jersey;
2. Waters of the United States under the jurisdiction of the Hackensack Meadowlands Development Commission; and
3. Greenwood Lake.

"Department" means the Department of Environmental Protection.

"Detention basin" or "detention facility" means a human-made impoundment area made by constructing an embankment, or excavating a pit, or both, for the purpose of temporarily storing stormwater.

"Developable upland" means an upland area that could be developed under the laws that apply to the site.

"Discharge of dredged material" means any addition of dredged material into State open waters or freshwater wetlands. The term includes the addition of dredged material into State open waters or freshwater wetlands and the runoff or overflow from a contained land or water dredge material disposal area. Discharges of pollutants into State open waters resulting from the subsequent onshore processing of dredged material are not included within this term. Such discharges of pollutants may, however, be subject to the New Jersey Pollutant Discharge Elimination System (NJPDES) rules at N.J.A.C. 7:14A.

"Discharge of fill material" means the addition of fill into State open waters or freshwater wetlands. The term includes, but is not limited to, the following activities:

1. Placement of fill that is necessary for the construction of any structure;
2. The building of any structure or impoundment requiring rock, sand, dirt, or other materials for its construction;
3. Site-development fill for recreational, industrial, commercial, residential, and other uses;
4. Causeways or road fills;
5. Dams and dikes;
6. Artificial islands;
7. Property protection or reclamation devices, or both, such as rip-rap, groins, seawalls, breakwaters, and revetments;
8. Beach nourishment;
9. Levees;
10. Fill for structures such as sewage treatment facilities, intake and outfall pipes associated with power plants and underground utility lines; and
11. Artificial reefs.

"Ditch" means a linear topographic depression with bed and banks of human construction, which conveys water to or from a site, which is surrounded by uplands and which is not located within a wetland. This does not include channelized or redirected natural water courses.

"Documented habitat for threatened or endangered species" means areas for which:

1. There is recorded evidence of past use by a threatened or endangered species of flora or fauna for breeding, resting, or feeding. Evidence of past use by a species may include, but is not limited to, sightings of the species, or of its sign (for example, skin, scat, shell, track, nest, herbarium records, etc.), as well as identification of its call; and
2. The Department makes the finding that the area remains suitable for use by the specific documented threatened or endangered species during the normal period(s) the species would use the habitat.

"Drainage" means active or passive methods for changing the hydrologic conditions of wetlands or State open water, such as lowering groundwater or surface water levels through pumping, ditching, or otherwise altering water flow patterns.

"Dredging" means removal of wetlands or State open water soils or sediments through use of mechanical, hydraulic, or pneumatic tools or other means.

"Dredged material" means material that is excavated or dredged from waters of the United States.

"Dumping" means the discharge, placement or abandonment of solid, semi-solid or liquid materials.

"Environmental commission" means a municipal advisory body created pursuant to N.J.S.A. 40:56A-1 et seq.

"EPA priority wetlands" means wetlands which are designated as priority wetlands by EPA, and are listed on the "Priority Wetlands List for the State of New Jersey," which is available from the Department's Office of Maps and Publications at the address listed at N.J.A.C. 7:7A-1.3.

"Established, ongoing farming, ranching or silviculture operation" means activities on areas subject to a farming, ranching, or silviculture use as of June 30, 1988, which use has been pursued continuously since June 30, 1988. Activities on areas lying fallow as part of a conventional rotational cycle that does not exceed five years are part of an established operation. Activities which bring an area into farming, silviculture, or ranching use are not part of an established operation. An operation ceases to be established when the area on which it was conducted has been converted to another use or has lain idle for so long that modifications to the hydrological regime are necessary to resume operations, or for more than five years, whichever is shorter.

"Farmed wetland" means a freshwater wetland, as defined in this section, which was both manipulated and cropped before December 23, 1985, and has been in active agricultural use continuously since then. This term also includes a wetland that was manipulated and used for pasture or hayland before December 23, 1985, which has been in active use for pasture or hayland continuously since then. An area that lies fallow as part of a conventional rotational cycle that does not exceed five years is considered to be in active agricultural use.

"Federal act" means the Federal Water Pollution Control Act, 33 U.S.C. §§1251 et seq., including any amendments and supplements, and implementing regulations. This statute is sometimes referred to as the Federal Clean Water Act.

"Excavation" means to dig or remove soil, rocks, etc., resulting in a change in site elevation.

"Federal 404 program" means the program regulating the discharge of dredged or fill materials pursuant to Section 404 of the Federal Act.

"Fill" means the deposition or placement of material such as soil, sand, earth, rock, concrete, pavement, or solid material of any kind; so as to change the ground elevation in relation to surface water or groundwater level. "Fill" also means the material deposited.

"Forested" means that tree species with an average height greater than 20 feet are the predominant vegetation present.

"FW" means the general surface water classification applied to fresh waters in the Department's Surface Water Quality Standards, N.J.A.C. 7:9B.

"FW1 waters" means waters designated as FW1 waters in the Department's Surface Water Quality Standards, N.J.A.C. 7:9B. As of September 4, 2001, N.J.A.C. 7:9B-1.15 defines FW1 waters as those fresh waters wholly within Federal or State lands or special holdings, that are preserved for posterity, and are not subject to wastewater discharges of human origin.

"FW2 waters" means waters designated as FW2 waters in the Department's Surface Water Quality Standards, N.J.A.C. 7:9B.

"Freshwater wetland" or "wetland" means an area that is inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophytic vegetation; provided, however, that the Department, in designating a wetland, shall use the three-parameter approach (that is, hydrology, soils and vegetation) enumerated in the 1989 Federal Manual as defined in this section. These include tidally influenced wetlands which have not been included on a promulgated map pursuant to the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq.

"Freshwater wetlands permit" means a permit to engage in a regulated activity in a freshwater wetland issued pursuant to the Freshwater Wetlands Protection Act and this chapter.

"Gabion" means a shore or stream bank protection structure, that is made of wire mesh basket(s) or mattress(es) filled with rocks and usually used in multiples as a structural unit installed to withstand the forces of waves and currents.

"General permit" means a permit, adopted as a rule, under which the Department issues authorizations. A general permit may authorize regulated activities in freshwater wetlands, State open waters, and/or transition areas. An authorization issued under a general permit satisfies the requirement for a freshwater wetlands permit, open water fill permit, and/or transition area waiver, as applicable.

"Government agency" means any department, division, authority, board, commission, office, bureau, agency, committee or other instrumentality of the United States, or of the State or any political subdivision thereof.

"Harvesting" means physical measures employed directly upon farm, forest, or ranch crops within established agricultural and silvicultural lands to bring about their removal from farm, forest, or ranch land, but does not include the construction of farm, forest, or ranch roads or other engineering practices such as drainage which would alter the existing character of the farm, forest or ranch land.

"HUC 11" or "hydrologic unit code 11" means an area within which water drains to a particular receiving surface water body, which area is identified by an eleven digit hydrologic unit boundary designation, as shown on the map included in the United States Geological Survey, Water Resources Investigations Report 95-4134, 1995, entitled "Development of a 14-digit Hydrologic Coding Scheme and Boundary Data Set for New Jersey." The HUC codes for New Jersey can be downloaded from [www.njgeodata.state.nj.us](http://www.njgeodata.state.nj.us). The HUC 11 data is entitled "subwatersheds." Software designed for use with Geographic Information Systems (GIS) will be required to view the downloaded data.

"Hydric soil" means a soil that in its undrained condition is saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions that favor the growth and regeneration of hydrophytic vegetation. These soils may be described in several places, including New Jersey's Official List of Hydric Soils, developed by the Natural Resources Conservation Service; the National Wetlands Inventory, entitled "The Wetlands of New Jersey", published in 1985 by the United States Fish and Wildlife Service; or in the 1989 Federal manual. Alluvial land, as mapped on soil surveys, or other soils exhibiting hydric characteristics identified through field investigation as described in Part III of the 1989 Federal manual may also be considered a hydric soil for the purposes of wetland classification. Also, wet phases of somewhat poorly drained soils not on New Jersey's Official List of Hydric Soils may be associated with a wetland and therefore for the purposes of this chapter shall be considered a hydric soil.

"Hydrophyte" means plant life adapted to growth and reproduction under periodically saturated root zone conditions during at least a portion of the growing season. A listing of these plants can be found in the "National List of Plant Species that Occur in Wetlands: 1988-New Jersey" and amendments thereto, compiled by the USFWS, ACOE, EPA and the Natural Resources Conservation Service.

"Impervious surface" means any structure or surface which prevents absorption of stormwater into land. Examples of impervious surfaces are pavement, rooftops, sidewalks, driveways, tennis courts and swimming pools.

"Individual permit" means a freshwater wetlands permit or open water fill permit that is issued by the Department after an alternatives test and other site-specific and project-specific reviews required at N.J.A.C. 7:7A-7.

"Individual transition area waiver" means a transition area waiver issued by the Department under N.J.A.C. 7:7A-6, which is not granted as part of a general permit authorization. The following are the types of individual transition area waivers: an averaging plan transition area waiver, a special activity transition area waiver, a matrix type width reduction transition area waiver, a hardship transition area waiver, and an access transition area waiver.

"Intermittent stream" means surface water drainage channels with definite bed and banks in which there is not a permanent flow of water. Most intermittent streams are shown on Soil Conservation Service county soil surveys.

"Isolated wetlands " means a freshwater wetland that is not "part of a surface water tributary system," as defined in this section.

"Lake, pond, or reservoir" means any impoundment of water, whether naturally occurring or created in whole or in part by the building of structures for the retention of surface water.

"Letter of interpretation" or "LOI" means the document issued by the Department under N.J.A.C. 7:7A-3, indicating the presence or absence of wetlands, State open waters, or transition areas; verifying or delineating the boundaries of freshwater wetlands, State open waters, and/or transition areas; or assigning a wetland a resource value classification.

"Linear development" means land uses such as roads, drives, railroads, sewerage and stormwater management pipes, gas and water pipelines, electric, telephone and other transmission lines and the rights-of-way therefor, the basic function of which is to connect two points. Linear development shall not mean residential, commercial, office, or industrial buildings, improvements within a development such as utility lines or pipes, or internal circulation roads.

"Major discharge" means a discharge or activity that the Department must transmit to EPA for review in accordance with the Department's 1993 MOA with EPA regarding assumption of the Federal 404 program. Provisions regarding EPA review of major discharges are found at N.J.A.C. 7:7A-12.2. The following are major discharges:

1. A draft general permit;
2. A discharge with reasonable potential to affect Federally listed or proposed endangered or threatened species as determined by the U.S. Fish and Wildlife Service;
3. A discharge of dredged or fill material which has the potential for adverse impacts on the waters of a state other than New Jersey;
4. A discharge known or suspected to contain:
  - i. Toxic pollutants as identified by Section 307(a)(1) of the Federal act;
  - ii. Hazardous substances identified pursuant to Section 311 of the Federal act and Section 101(14) of the Comprehensive Environmental Response Compensation and Liability Act, 42 U.S.C. §§9601 et seq.;
  - iii. Toxic substances as defined by Section 3 of the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; or
  - iv. Hazardous waste as defined by Section 1004(5) of the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq.;
5. A discharge located in the proximity of a public water supply intake;

6. A discharge within a critical area established under State or Federal law, including but not limited to a National or State park; fish or wildlife sanctuary or refuge; National or historical monument; wilderness area or preserve; a site identified or proposed under the National Historic Preservation Act; or a component of the National Wild and Scenic Rivers system;
7. The filling of five or more acres of freshwater wetlands and/or State open waters;
8. Any regulated activity that results in a significant reduction in the ecological, commercial, or recreational values of five or more acres of freshwater wetlands or State open waters;
9. A culvert enclosure longer than 100 feet; or
10. Channelization of more than 500 feet of a river or stream.

"Maximum extent practicable" means to the maximum extent after weighing, evaluating and interpreting alternatives to protect the ecological integrity of a wetland or State open water.

"Mitigation" means activities carried out pursuant to N.J.A.C. 7:7A-15 in order to compensate for freshwater wetlands or State open waters loss or disturbance caused by regulated activities.

"Natural Resources Conservation Service" or "NRCS" means the arm of the U.S. Department of Agriculture (USDA) that provides technical assistance with USDA conservation programs associated with soil, water, and other related natural resources. The Natural Resources Conservation Service was previously known as the Soil Conservation Service.

"1989 Federal Manual" means the Federal Manual for Identifying and Delineating Jurisdictional Wetlands, published in 1989 by the EPA, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, and the U.S. Department of Agriculture's Natural Resources Conservation Service (formerly the Soil Conservation Service), as amended and/or supplemented, which Manual is incorporated herein by reference.

"Non-delegable waters" mean waters that are not delegable waters.

"Normal rainfall year" means a 12 month period in which the precipitation at a location is within 10% of the average annual precipitation for that location, calculated using the standard averaging period for "normals," established by the World Meteorological Organization, except that the Department may determine normal rainfall on a case-by-case basis in unusual situations, such as where the sampling period begins immediately following prolonged drought conditions. As of September 4, 2001, the World Meteorological Organization has defined the standard averaging period as 1961 through 1990. Information regarding the standard averaging period can be found in the USDA's Natural Resources Conservation Service website at [www.nrcs.usda.gov/water/climate](http://www.nrcs.usda.gov/water/climate).

"Offsite" means the area not onsite.

"Onsite" means the area located within the site, as defined in this section.

"Open water fill permit" means the type of New Jersey Pollution Discharge Elimination System permit issued pursuant to this chapter and N.J.S.A. 58:10A-1 et seq., which governs the discharge of dredged or fill material into State open waters.

"Ordinary high water mark" means that line on the shore established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.

"Palustrine emergent" means a wetlands vegetation pattern in which persistent and non-persistent grasses, rushes, sedges, forbs and other herbaceous or grass-like plants are the dominant vegetation.

"Part of a surface water tributary system" means connected to a surface water that discharges into a lake, pond, river, stream or other surface water feature. The connection may be through any surface water feature, whether regulated or not, including a stormwater or drainage pipe. The connection may be through a secondary flow channel or other feature. However, the connection may be through overland flow only if there is evidence of scouring, erosion, or concentrated flows. The connection may not be through groundwater alone. Wetlands adjacent to a surface water are connected to the surface water and are part of the surface water tributary system.

"Permit" means an approval to engage in a regulated activity in a freshwater wetland, State open water, or transition area, issued by the Department under this chapter. The Department issues the following permits under this chapter:

1. Freshwater wetlands permits including general permit authorizations;
2. Open water fill permits; and
3. Transition area waivers.

"Permittee" means a person to whom the Department has issued a permit or a waiver under this chapter.

"Person" means an individual, corporation, partnership, association, the Federal government, the State, municipality, commission or political subdivision of the State or any interstate body.

"Pilings" means timber, metal, concrete or other similar structures driven, dropped, poured, or placed to support a vertical load.

"Plowing" means all forms of primary tillage, including moldboard, chisel, or wide-blade, plowing, discing, harrowing, and similar physical means utilized on farm, forest or ranch land for the breaking up, cutting, turning over, or stirring of soil to prepare it for the planting of crops. The term does not include the redistribution of dredged material, rock, sand, or other surface materials in a manner which changes any area of wetlands to dry land. For example, the redistribution of surface materials by blading, grading, or other means to fill in wetland areas is not plowing. Rock crushing activities which result in the loss of natural drainage characteristics, the reduction of water storage and recharge capabilities, or the overburden of natural water filtration capacities do not constitute plowing. Plowing will never involve a discharge of material.

"Practicable alternative" means other choices available and capable of being carried out after taking into consideration cost, existing technology, and logistics in light of overall project purposes, and may require an area not owned by the applicant which could reasonably have been or be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity.

"Preliminary approval" means the conferral of certain rights pursuant to N.J.S.A. 40:55D-46, 48 and 49 prior to final approval after specific elements of a development plan have been agreed upon by the planning board and the applicant.

"Project" means the following:

1. For the purpose of a transition area exemption under N.J.A.C. 7:7A-2.8(f) based on the application for or the grant of a preliminary site plan approval:
  1. All buildings, structures, pavements, and other improvements specifically depicted on the site plans referenced in the resolution approving the site plan; and
  2. For the purpose of a transition area exemption under N.J.A.C. 7:7A-2.8(f) based on the application for or the grant of a preliminary subdivision approval:
    - i. Where subdivision approval is the last stage of municipal review before the owner/applicant may apply for a building permit to begin construction, the "project" is the development of the subdivision consistent with the lot coverage, use, and density restrictions of the zoning ordinance in effect at the time of the subdivision approval; or
    - ii. Where site plan approval is required prior to construction, "project" means the proposed economic development, whether commercial, industrial or residential, intended to be constructed on that portion of a tract of land that is the focus of the qualifying approval. Although "project" is not limited to specific structures shown on the subdivision plans, it is limited to development on those portions of a tract of land that were the focus of the qualifying subdivision application or approval. Development on other lands, such as development on the remainder of a larger tract or on a contiguous property in common ownership, are not included within a "project."

In order to determine if an applicant qualifies for an exemption under this definition, the Department will determine the existence of a proposed economic development at the time of the subdivision application. Because the purpose of the exemption is to protect that degree of investment in planning and development that the preliminary site plan or subdivision application normally represents, where the subdivision is merely a division of land and no substantial investment was made in planning or development, there can be no exempted project. Therefore, an application for the subdivision of lands simply for future development, yet to be planned, or simply for resale shall not qualify for an exemption. To determine the existence of a proposed economic development and to determine which portion of a tract was the focus of subdivision approval or application, the Department will examine the resolution granting approval and any documentation submitted with the application, including, but not limited to, drainage, engineering, traffic, utility, landscaping, soil and environmental plans and reports as well as the subdivision plan. In cases where the above information is unclear, the Department may consider money spent or obligated on engineering and design in the preparation of the subdivision application to

determine if a substantial investment has been made in an economic development. Money spent or obligated for the initial purchase, carrying costs, or legal services will not be considered in determining the existence of a proposed economic development.

- iii. The following are examples of how the Department will determine the "project" exempted on the basis of the application for or grant of preliminary subdivision approval:
  - (1) Where a project was to be developed in three sections but a complete application for preliminary approval was submitted, accepted and subsequently approved for only one section, only the development planned for that section is exempt and the development envisioned for sections two and three is not exempt. This is not altered by the fact that some depiction of that future development on the remainder of the parcel might be required by a local planning board in concept or sketch form;
  - (2) Where an entire parcel is subdivided into five conforming residential lots, the residential development planned on all five lots is exempt. However, where the focus of the subdivision application and approval is on less than the entire tract of land, which lesser portion is divided into five single family house lots, and the remainder of the tract is left as a bulk parcel for further subdivision or other planning board approval, only development on the five lots is exempt. It is irrelevant that the configuration of the remainder lot has been changed by the subdivision or that the remainder lot has been renumbered;
  - (3) Where the land to be divided for a commercial industrial park straddles two townships and the developer received approval to subdivide the land in township A and sold the unsubdivided portion in township B to another developer, only the development on the land in township A could be considered the subject of township A's subdivision approval. Therefore, only the development on the land in township A is exempt. It is irrelevant that the original developer had, from the start, contemplated a commercial industrial park for the property in both townships or that the office building contemplated on the land in township B did not require further subdivision;
  - (4) Where land is divided for the sole purpose of bequeathing it sometime in the future to one's children to be developed as they wish, no economic development was contemplated when the application was made or approval granted. After the land passes to the children and one of them decides to build, that development is not exempt. The purpose of the exemption is to protect that degree of investment in planning and development that the preliminary site plan or subdivision application normally represents. Where the subdivision is merely a division of land and no investment was made in the planning or development, there can be no exempted project; and
  - (5) Where land is subdivided but requires further subdivision, other than de minimis changes for road right of ways or other infrastructure, before the applicant can proceed to the next step of municipal approval (either building permits or site plan approvals), there is no evidence of intended economic development at the time of initial subdivision application or approval, because the proposed economic development only comes into being with the subsequent, untimely subdivision. Therefore, there is no basis for exemption.

"Property as a whole" means all property assembled as one investment or to further one development plan. The property as a whole may include more than one municipal tax block or lot. The property as a whole may also include blocks or lots that were previously sold or developed, if those blocks or lots and the remaining unsold or undeveloped blocks or lots were part of one.

"Public hearing" means an administrative non-adversarial type hearing before a representative or representatives of the Department providing the opportunity for public comment, but does not include cross-examination.

"Redevelopment" means the construction of structures or improvements on or below impervious surfaces, as defined in this section, or other significantly disturbed area.

"Regulated activity" means any of the activities described at N.J.A.C. 7:7A-2.2 or at N.J.A.C. 7:7A-2.6.

"Residential development project" means the construction of a new structure for residential use and the area within 20 feet of the structure on all sides, measured outward from the outside edge of the foundation of the structure. An addition to an existing residence is a residential development project if the addition has a foundation. A residential development project may include construction of one or more single family home(s) or multi-unit residential building(s).

"Seeding" means the sowing of seed and placement of seedlings to produce farm, ranch, or forest crops and includes the placement of soil beds for seeds or seedlings on established farm and forest lands.

"Silviculture" means the art and science of controlling the establishment, growth, composition, health, and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis. The normal harvesting of forest products is a part of some silviculture operations.

"Site" means the area within the legal boundary of the property(ies) or right-of-way for which a letter of interpretation is requested, or upon which a regulated activity is proposed, is occurring, or has occurred, plus any contiguous land owned or controlled by the same person(s). This term also includes an area which is the subject of an application for a letter of interpretation or which is the location of a proposed mitigation bank. For the purposes of this definition, the legal boundary of a property or right-of-way shall be the boundary as it existed on July 1, 1988, except that if additional contiguous lots and/or blocks were acquired after July 1, 1988, or if lots were merged after July 1, 1988, these lots are included in the site, and the legal boundary of the property or right-of-way shall be the boundary of all contiguous land owned or controlled by the same person(s), as it exists on the date an application is submitted under this chapter. The legal boundary of a property is set forth in the deed(s) for the property or other legally binding document that sets forth a boundary. The legal boundary of a right-of-way is set forth in the document creating the right-of-way.

"Soil Conservation District" means a local subdivision of the New Jersey Department of Agriculture (NJDA), established pursuant to N.J.S.A. 4:24-1 et seq. Generally, each Soil Conservation District administers NJDA programs for a single county, although some administer programs for more than one county. The Soil Conservation Districts are overseen by the New Jersey State Soil Conservation Committee in the NJDA, which promulgates the Standards for Soil Erosion and Sediment Control in New Jersey, N.J.A.C. 2:90.

"Special aquatic site" means a site described in subpart E of the 404(b)1 guidelines (40 C.F.R. 230 et seq.), except freshwater wetlands which, for the purposes of this chapter, shall not be considered special aquatic sites. In general, special aquatic sites are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted functions and values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region. As of September 4, 2001, the following special aquatic sites are described in subpart E of the 404(b)1 guidelines (40 C.F.R. 230 et seq.): sanctuaries and refuges, wetlands (note: while freshwater wetlands are excluded from the definition of a special aquatic site for purposes of this chapter, other wetlands, such as most coastal wetlands, would be considered special aquatic sites), mud flats, vegetated shallows, coral reefs, and riffle and pool complexes.

"State Forester" means the chief forester employed by the Department.

"State open waters" means all waters of the State as defined in this section, including waters of the United States as defined in this section, but excluding ground water as defined at N.J.A.C. 7:14A, and excluding freshwater wetlands as defined in this section. The following waters will generally not be considered State open waters for the purposes of this chapter. However, the Department shall determine, on a case-by-case basis, if a particular watercourse or water body listed below is a State open water:

1. Non-tidal drainage and irrigation ditches excavated on dry land;
2. Artificially irrigated areas which would revert to upland if the irrigation ceased;
3. Artificial lakes or ponds created by excavating and/or diking dry land to collect and retain water and which are used exclusively for such purposes as stock watering, irrigation, settling basins, or rice growing;
4. Artificial reflecting or swimming pools or other small ornamental bodies of water created by excavating and/or diking dry land to retain water for primarily aesthetic reasons;
5. Water-filled depressions created in dry land incidental to construction or remediation activity and pits excavated in dry land for the purpose of obtaining fill, sand, or gravel unless and until the construction or excavation operation is abandoned and the resulting body of water meets the definition of "waters of the United States";
6. Waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of the Federal act (other than cooling ponds);
7. Erosional channels less than two feet wide and six inches deep in upland areas resulting from poor soil management practices; and
8. Stormwater management facilities created in uplands.

"Stormwater management facility" means a facility which receives, stores, conveys or discharges stormwater runoff and is designed in accordance with applicable local, county and State regulations. These facilities may include retention basins, detention basins, infiltration structures, grassed swales, rip-rap channels and/or stormwater outfalls.

"Swale" means a linear topographic depression, either naturally occurring or of human construction, which meets all of the following criteria:

1. It is surrounded by uplands except where runoff flows out of it. A depression is not a swale if it is located within a larger wetland or if it is merely an undulation in a wetland boundary;
2. It has formed or was constructed in uplands to convey surface water runoff from the surrounding upland areas;
3. It drains less than 50 acres;
4. It is not a seep or spring;
5. It is not an intermittent stream;
6. It has no definite bed and banks; and
7. At its widest point, it is generally 50 feet wide or narrower.

"Temporary disturbance" means a disturbance caused by permitted regulated activities that are permanently discontinued within six months after they are begun.

"Threatened or endangered species" means a species identified pursuant to the Endangered and Nongame Species Conservation Act, N.J.S.A. 23:2A-1 et seq., or those identified pursuant to the Endangered Species Act of 1973, 16 U.S.C. §§1531 et seq., and subsequent amendments thereto.

"Tidal waters" means fresh or saline waters under tidal influence, up to the head of the tide.

"Transition area" means an area of upland adjacent to a freshwater wetland which minimizes adverse impacts on the wetland or serves as an integral component of the wetlands ecosystem.

"Transition area waiver" or "waiver" means a waiver issued by the Department under this chapter, authorizing any of the regulated activities enumerated at N.J.A.C. 7:7A-2.6 in a transition area.

"Tree" means a woody plant which is five inches or greater in diameter at a height of four and one half feet above the ground.

"Trout production waters" means waters designated in the Department's Surface Water Quality Standards, N.J.A.C. 7:9B, for use by trout for spawning or nursery purposes during their first summer.

"USEPA" or "EPA" means the United States Environmental Protection Agency.

"USFWS" means the United States Department of the Interior, Fish and Wildlife Service.

"USGS" means the United States Geological Survey.

"USGS quad map" means a topographic quadrangle map issued by the USGS, 7.5 minute series, drawn at a scale of 1:24,000, available from the Department's Maps and Publications Office at the address listed in N.J.A.C. 7:7A-1.3.

"Utility line" means a pipe, cable, line, conduit, or wire for the transport or transmission of gases, liquids, electrical energy or communications. This term includes a tower or pole required to support a utility line, but does not include a tower or pole that only transmits waves through the air, such as for radio, television, or telephone transmission. The term "utility line" does not include a stormwater pipe, or a pipe that drains a wetland or State open water, such as a drainage tile.

"Vernal habitat" means a wetland or water that meets all of the criteria at 1 through 4 below. Evidence of breeding by an obligate species under 2i below creates a rebuttable presumption that the criteria at 3 and 4 below are met:

1. Occurs in a confined basin depression without a permanent flowing outlet;
2. Features evidence of breeding by one or more species of fauna adapted to reproduce in ephemeral aquatic conditions, identified in N.J.A.C. 7:7A, Appendix 1. The following shall constitute evidence of breeding by such a species:
  - i. One or more obligate species listed in Appendix 1, or evidence of such a species, is found in the area of ponded water; or
  - ii. Two or more facultative species listed in Appendix 1, or evidence of the presence of such a species, are found in the area of ponded water;
3. Maintains ponded water for at least two continuous months between March and September of a normal rainfall year; and
4. Is free of fish throughout the year, or dries up at some time during a normal rainfall year.

"Water-dependent activity" means an activity that cannot physically function without direct access to the body of water along which it is proposed. An activity that can function on a site not adjacent to the water is not considered water dependent regardless of the economic advantages that may be gained from a waterfront location.

"Water Pollution Control Act" means the New Jersey Water Pollution Control Act, N.J.S.A. 58:10A-1 et seq.

"Waters of the State" means the ocean and its estuaries, all springs, streams, wetlands, and bodies of surface or ground water, whether natural or artificial, within the boundaries of the State of New Jersey or subject to its jurisdiction.

"Waters of the United States" means:

1. All waters which are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;
2. All interstate waters including interstate wetlands;
3. All other waters such as intrastate lakes, rivers, streams (including intermittent streams), wetlands, mudflats, sand flats, sloughs, wet meadows, or natural ponds the use, degradation, or destruction of which would affect or could affect interstate or foreign commerce including any such waters:
  - i. Which are or could be used by interstate or foreign travelers for recreational or other purposes;
  - ii. From which fish or shellfish are or could be taken and sold in interstate or foreign commerce;
  - iii. Which are used or could be used for industrial purposes by industries in interstate commerce;
  - iv. Which are or would be used as habitat by birds protected by Migratory Bird Treaties;
  - v. Which are or would be used as habitat by other migratory birds which cross state lines;
  - vi. Which are or would be used as habitat for endangered and threatened species; or
  - vii. Which are used to irrigate crops sold in interstate commerce;
4. All impoundments of waters otherwise defined as waters of the United States under this definition;
5. Tributaries of waters identified in paragraphs 1 through 4 of this definition;
6. The territorial seas; and
7. Wetlands adjacent to waters identified in paragraphs 1 through 6 of this definition, other than those that are themselves wetlands.

"Water quality certificate" means a Department determination issued for a proposed activity which requires a Federal license or permit, pursuant to 33 U.S.C. §1341 of the Federal Act and N.J.S.A. 58:10A-1 et seq.

"Working day" means a day upon which the offices of the New Jersey Department of Environmental Protection are open for business.

#### 7:7A-1.5 Severability

If any subchapter, section, subsection, provision, clause, or portion of this chapter, or the application thereof to any person, is adjudged unconstitutional or invalid by a court of competent jurisdiction, such judgment shall be confined in its operation to the subchapter, section, subsection, provision, clause, portion, or application directly involved in the controversy in which the judgment was rendered and it shall not affect or impair the remainder of this chapter or the application thereof to other persons.

#### 7:7A-1.6 Other statutes and regulations

- (a) The powers, duties and functions vested in the Department under this chapter shall not limit in any manner the powers, duties and functions vested therein under any other law except as specifically set forth in this chapter.
- (b) The Freshwater Wetlands Protection Act, on and subsequent to July 1, 1988, shall supersede any law or ordinance enacted by any municipality, county, or political subdivision thereof, regulating freshwater wetlands or freshwater wetlands transition areas except that the Pinelands Commission may provide for more stringent regulation of activities in and around freshwater wetland areas within its jurisdiction. No municipality, county, or political subdivision thereof shall enact any law, ordinance, or rule or regulation requiring a transition area adjacent to a freshwater wetland, except that the Pinelands Commission may provide for more stringent regulation of activities in and around freshwater wetland areas within its jurisdiction.
- (c) This section shall not, however, preclude municipal advice to the Department concerning letters of interpretation or other matters.
- (d) This chapter shall not preempt State regulatory programs which affect regulated activities in freshwater wetlands, including but not limited to Coastal Area Facility Review Act (CAFRA), N.J.S.A. 13:19-1 et seq., the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., and State approved municipal water quality management plans. These programs will continue to regulate based on the concerns covered by their respective enabling statutes and rules, and may, through such regulation, have some impact on projects in freshwater wetlands. However, those programs will not use freshwater wetlands concerns as a basis for regulation, and any regulation by these programs of projects in freshwater wetlands will be limited to that based on other (for example, flood danger) concerns.
- (e) If a proposed project does not involve a freshwater wetland or State open water, does not constitute a regulated activity, or is exempt under this chapter, the final decision on the application shall be based solely on the requirements of other applicable permit programs.

#### 7:7A-1.7 Hearings and appeals

- (a) Subject to the limits on third party hearings at (k) below, a person may request an administrative hearing to contest a decision under this chapter on any of the following actions:
  - 1. An exemption letter request;

2. An application for a letter of interpretation;
  3. An application for authorization to act under a general permit;
  4. An application for a transition area waiver;
  5. An application for an individual freshwater wetlands permit;
  6. An application for an individual open water fill permit; or
  7. An application for a modification or extension of any Department issued document.
- (b) A person seeking to contest an administrative order or a penalty assessment arising from an enforcement matter under this chapter shall do so under N.J.A.C. 7:7A-16.18.
- (c) A request for an administrative hearing shall:
1. Be in writing;
  2. Contain all information required by the administrative hearing request checklist, available from the Department at the address in N.J.A.C. 7:7A-1.3;
  3. Explain in what way the person submitting the request believes the Department has acted improperly;
  4. Explain what issues the person submitting the request will raise if a hearing is held; and
  5. Be submitted to the Department at the following address:  
  
Office of Legal Affairs  
Attention: Administrative Hearing Requests  
Department of Environmental Protection  
P.O. Box 402  
Trenton, New Jersey 08625-0402
- (d) To contest a decision listed at (a) above, a person shall submit a hearing request within 30 days after notice of the decision is published in the DEP Bulletin. If a person submits the hearing request after this time, the Department shall deny the request. The DEP bulletin is available through the Department's website at [www.state.nj.us/dep](http://www.state.nj.us/dep).
- (e) As part of a request for an administrative hearing, a person may request that the Department determine whether the matter for which the administrative hearing is requested is suitable for mediation by the Department's Office of Dispute Resolution. The Department shall promptly notify the person who submitted the request of its determination. If the Department determines the matter is suitable for mediation, it shall also notify the person who submitted the request of the procedures and schedule for mediation.
- (f) A request by a permittee for a hearing shall automatically stay operation of a permit, including a transition area waiver or general permit authorization, unless the permittee

shows good cause why the permit should continue in effect while being contested. If a hearing is requested by a permittee, all permitted activities shall stop upon the date the hearing request is submitted, and shall not be started again until the matter is resolved, unless the Department grants an exception in writing. If a person other than the permittee requests a hearing, the requester may also request a stay of the permit. The Department shall grant the request for a stay of the permit if the requester shows good cause why the permit should be stayed.

- (g) When the Department receives an administrative hearing request, the Commissioner may refer the matter to the Office of Administrative Law for an administrative hearing in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., and the Uniform Administrative Procedure rules, N.J.A.C. 1:1, or may deny the request for a hearing. If the Commissioner refers the matter to the Office of Administrative Law, the Department shall so notify the person who submitted the request and the applicant.
- (h) If the Department agrees to settle a matter for which a hearing request has been submitted under this section, and the settlement will result in Department approval of a regulated activity, public notice of the settlement shall be provided as follows:
  - 1. The person who requested the hearing shall send by certified mail a notice of intent to settle the matter. A form for the notice may be obtained from the Department at the address in N.J.A.C. 7:7A-1.3. The notice shall be sent to:
    - i. Each person provided notice of the application for the permit or approval which is the subject of the appeal; and
    - ii. Each person who commented on the application;
  - 2. The Department shall publish a notice of intent to settle in the DEP Bulletin, and shall accept comments on the notice for at least 30 days;
  - 3. After the 30 day comment period provided for in (h)2 above, the person who requested the hearing shall send by certified mail a notice of settlement. A form for the notice may be obtained from the Department at the address in N.J.A.C. 7:7A-1.3. The notice shall be sent to:
    - i. Each person provided notice of intent to settle under (h)1 above; and
    - ii. Each person who commented on the notice of intent to settle provided under (h)2 above; and
  - 4. The Department shall publish a notice of the final settlement in the DEP Bulletin.
    - (i) After a hearing, the administrative law judge will submit an initial decision to the Commissioner. Within forty five days of receiving the initial decision, the Commissioner shall affirm, reject, or modify the decision, in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., and the Uniform Administrative Procedure rules, N.J.A.C. 1:1.

- (j) The Commissioner's action under (i) above shall be considered final agency action for the purposes of the Administrative Procedure Act, and shall be subject only to judicial review in the Appellate Division of the Superior Court, as provided in the Rules of Court.
- (k) Nothing in this section shall be construed to provide a right to an administrative hearing in contravention of the Administrative Procedure Act, N.J.S.A. 52:14B-3.1 through 3.3.

## SUBCHAPTER 2 APPLICABILITY

### 7:7A-2.1 Jurisdiction; permit or waiver requirement

- (a) A person proposing to engage in a regulated activity, as described at N.J.A.C. 7:7A-2.2, shall first obtain a general permit authorization or an Individual freshwater wetlands or open water fill permit. A person proposing to engage in a prohibited activity, as described at N.J.A.C. 7:7A-2.6, in a transition area shall first obtain approval from the Department through a transition area waiver or general permit authorization. The discharge of dredged or fill material in a State open water or wetland may also require a stream encroachment permit pursuant to the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq.
- (b) An agency of the State proposing to engage in a regulated activity shall first obtain a freshwater wetlands and/or open water fill permit, and/or a transition area waiver, but shall not be required to pay an application fee.
- (c) On March 2, 1994, the Department assumed responsibility for administering the Federal wetlands program (also known as the 404 program) in delegable waters, as defined at N.J.A.C. 7:7A-1.4. In non-delegable waters, the ACOE retains jurisdiction under Federal law, and both Federal and State requirements apply. A project in non-delegable waters requires two permits, one from the Department under this chapter and one from the ACOE under the Federal 404 program.
- (d) A permit issued under this chapter shall constitute the water quality certificate required under the Federal Act at 33 U.S.C. §1341 for any activity covered by this chapter. If a discharge of dredged or fill material into waters of the United States, as defined at N.J.A.C. 7:7A-1.4, does not require a permit under this chapter but does require a water quality certificate, the Department shall use the standards and procedures in this chapter to determine whether to issue the water quality certificate, except in the New Jersey Coastal zone, as described at N.J.A.C. 7:7E-1.2(b). For a discharge of dredged or fill material in the Coastal zone, the Department shall use the standards and procedures in the Coastal Permit Program rules and the Coastal Zone Management rules, N.J.A.C. 7:7 and 7:7E, respectively, to determine whether to issue a water quality certificate.
- (e) A permittee shall be solely responsible for ensuring that the permitted project complies with all requirements in this chapter, regardless of whether others manage, oversee or work on the project.
- (f) Only an activity specifically identified as authorized in a permit, including a transition area waiver or general permit authorization, shall be authorized under that permit.

7:7A-2.2 Regulated activities in freshwater wetlands and State open waters

- (a) The following activities are regulated under this chapter when performed in a freshwater wetland unless excluded under (c) below:
1. The removal, excavation, disturbance or dredging of soil, sand, gravel, or aggregate material of any kind;
  2. The drainage or disturbance of the water level or water table so as to alter the existing elevation of groundwater or surface water, regardless of the duration of such alteration, by:
    - i. Adding or impounding a sufficient quantity of stormwater or other water to modify the existing vegetation, values or functions of the wetland; or
    - ii. Draining, ditching or otherwise causing the depletion of the existing groundwater or surface water so as to modify the existing vegetation, values or functions of the wetland;
  3. The dumping, discharging or filling with any materials;
  4. The driving of pilings;
  5. The placing of obstructions, including depositing, constructing, installing or otherwise situating any obstacle which will affect the values or functions of a freshwater wetland;
  6. The destruction of plant life which would alter the character of a freshwater wetland, including killing vegetation by applying herbicides or by other means, the physical removal of wetland vegetation, and/or the cutting of trees; and
  7. Placement of any portion of a residential development project, as defined at N.J.A.C. 7:7A-1.4.
- (b) The term "regulated activity" shall also mean the discharge of dredged or fill material into State open waters, except for a discharge into a non-delegable State open water which is subject to the Waterfront Development Law, N.J.S.A. 12:5-3.
- (c) Notwithstanding (a) above, the following activities are not regulated activities:
1. Surveying or wetlands investigation activities, for the purpose of establishing or reestablishing a boundary line or points, which use only hand held equipment and do not involve the use of motorized vehicles to either clear vegetation or extract soil borings. The clearing of vegetation along the survey line or around the survey points shall not exceed three feet in width or diameter respectively and shall not be kept clear or maintained once the survey or delineation is completed;
  2. The placement of temporary structures ( such as observation blinds, waterfowl blinds, artificial nesting structures, or sign posts) for observing, managing, or harvesting fish or wildlife, provided the structures:

- i. Do not have permanent foundations;
  - ii. Do not require the deposition of fill material; and
  - iii. Have a footprint no larger than 32 square feet;
3. Placement of one or more small guy anchors that screw into the ground to secure a guy wire supporting a utility pole, provided that the area of disturbance caused by each guy anchor is no more than 15 inches in diameter;
  4. Hand trimming of trees or other vegetation, provided the trimming does not alter the character of the freshwater wetland; and
  5. The driving of one or more pilings in a State open water, if the pilings are not regulated by the ACOE under the Federal 404 program. The ACOE regulates the placement of pilings if the placement would have the effect of a discharge of fill material. Examples of activities that are and are not regulated by the ACOE are:
    - i. Activities that generally do not have the effect of a discharge of fill material and thus are not regulated are:
      - (A) Placing pilings for linear projects, such as bridges, elevated walkways, and utility line structures; and
      - (B) Placement of pilings for piers or docks;
    - ii. Activities that generally do have the effect of a discharge of fill material and thus are regulated include, but are not limited to:
      - (A) Projects where the pilings are so closely spaced that sedimentation rates would be increased;
      - (B) Projects in which the pilings themselves effectively would replace the bottom of a water body;
      - (C) Projects involving the placement of pilings that would reduce the reach or impair the flow or circulation of waters of the United States;
      - (D) Projects involving the placement of pilings which would result in the adverse alteration or elimination of aquatic functions; and
      - (E) Projects where the pilings are intended to be used for structural support of a building such as a commercial or residential structure.

7:7A-2.3 Identifying freshwater wetlands

- (a) Freshwater wetlands shall be identified and delineated using the three-parameter approach (that is, hydrology, soils and vegetation) enumerated in the 1989 Federal manual, as defined at N.J.A.C. 7:7A-1.4.

- (b) To aid in determining the presence or absence of freshwater wetlands, the Department may refer to any of the following sources of information:
1. New Jersey Freshwater Wetlands maps prepared by the Department and available as indicated in (f) below;
  2. United States Department of Agriculture Soil Surveys;
  3. United States Fish and Wildlife Service National Wetlands Inventory (NWI) Maps;
    - i. NWI maps shall be used to indicate the approximate location of some freshwater wetlands;
    - ii. NWI maps have been determined to be unreliable for the purposes of locating the actual wetlands boundary;
  4. USGS quad maps;
  5. Letters submitted by applicants containing site specific data;
  6. Comments filed by municipal and county governments and interested citizens; and
  7. Comments filed by State or Federal agencies.
- (c) Vegetative species classified as hydrophytes and indicative of freshwater wetlands shall include, but not be limited to, those plants listed in "National List of Plant Species that Occur in Wetlands: 1988-New Jersey," compiled by the United States Fish and Wildlife Service in cooperation with the ACOE, USEPA, and the United States Soil Conservation Service, and any subsequent amendments thereto.
- (d) To obtain a determination from the Department of the presence, absence, or boundaries of freshwater wetlands on a particular site, a person may apply to the Department for a letter of interpretation under N.J.A.C. 7:7A-3.
- (e) The Department has developed freshwater wetlands maps at a scale of 1:12000 to provide guidance and for general informational purposes. These freshwater wetlands maps can help to determine the approximate extent and location of wetlands. However, these maps are for guidance only and do not take the place of nor supersede a wetland delineation that the Department has approved through a letter of interpretation issued for a particular site.
- (f) The Department has provided the New Jersey freshwater wetlands maps to the following offices for public inspection:
1. The county clerk or registrar of deeds and mortgages in each county;
  2. The municipal clerk of each municipality; and
  3. The Department's Maps and Publications Sales Office, located at the address listed in N.J.A.C. 7:7A-1.3.

7:7A-2.4 Classification of freshwater wetlands by resource value

- (a) Freshwater wetlands shall be divided into three classifications based on resource value. The Department shall consider the resource value classification of a wetland in, among other things, evaluating alternatives to the proposed regulated activity, in determining the size of the transition area, and in determining the amount and/or type of mitigation required.
- (b) A freshwater wetland of exceptional resource value, or exceptional resource value wetland, is a freshwater wetland which:
  - 1. Discharges into FW1 or FW2 trout production waters or their tributaries;
  - 2. Is a present habitat for threatened or endangered species; or
  - 3. Is a documented habitat for threatened or endangered species, and which remains suitable for breeding, resting, or feeding by these species during the normal period these species would use the habitat.
- (c) The Department identifies present or documented habitat for threatened or endangered species for purposes of (b) above using the Landscape Project method, which focuses on habitat areas required to support local populations of threatened or endangered wildlife species. The details of this method are described in the Land Use Regulation Program's freshwater wetlands technical manual, available from the Department's Office of Maps and Publications at the address in N.J.A.C. 7:7A-1.3. An applicant may request that a documented habitat not result in the classification of a freshwater wetland as a freshwater wetland of exceptional resource value. Such a request shall include a demonstration of the long-term loss of one or more habitat requirements of the specific documented threatened or endangered species, including, but not limited to, wetlands size or overall habitat size, water quality, or vegetation density or diversity. Upon such a request, the Department shall review all available information, and shall make a final classification of the wetland.
- (d) A freshwater wetland of ordinary resource value, or an ordinary resource value wetland, is a freshwater wetland which does not exhibit any of the characteristics in (b) above, and which is:
  - 1. An isolated wetland, as defined at N.J.A.C. 7:7A-1.4, which:
    - i. Is smaller than 5,000 square feet; and
    - ii. Has the uses listed below covering more than 50 percent of the area within 50 feet of the wetland boundary. In calculating the area covered by a use, the Department will only consider a use that was legally existing in that location prior to July 1, 1988, or was permitted under this chapter since that date:
      - (1) Lawns;
      - (2) Maintained landscaping;
      - (3) Impervious surfaces;

- (4) Active railroad rights-of-way; and
    - (5) Graveled or stoned parking/storage areas and roads;
  - 2. A drainage ditch;
  - 3. A swale; or
  - 4. A detention facility created by humans in an area that was upland at the time the facility was created.
- (e) A freshwater wetland of intermediate resource value, or intermediate resource value wetland, is any freshwater wetland not defined as exceptional or ordinary.
- (f) The classification system established under this section shall not restrict the Department's authority to require the creation or restoration of freshwater wetlands under N.J.A.C. 7:7A-15.
- (g) To obtain a Department determination of the resource value classification for a particular wetland, an applicant may obtain a letter of interpretation from the Department under N.J.A.C. 7:7A-3.

#### 7:7A-2.5 General transition area provisions

- (a) A transition area serves as:
- 1. An ecological transition zone from uplands to freshwater wetlands which is an integral portion of the freshwater wetlands ecosystem, providing temporary refuge for freshwater wetlands fauna during high water episodes, critical habitat for animals dependent upon but not resident in freshwater wetlands, and slight variations of freshwater wetland boundaries over time due to hydrologic or climatologic effects; and
  - 2. A sediment and storm water control zone to reduce the impacts of development upon freshwater wetlands and freshwater wetlands species.
- (b) Acts or acts of omission in a transition area that adversely affect a transition area's ability to serve as any of the areas described below at (b)1 to 7 shall be deemed inconsistent with (a) above:
- 1. A temporary refuge for freshwater wetlands fauna during high water episodes;
  - 2. A habitat area for activities such as breeding, spawning, nesting and wintering for migrating, endangered, commercially and recreationally important wildlife;
  - 3. An area to accommodate slight variations in freshwater wetland boundaries over time due to hydrologic or climatologic effects;

4. A remediation and filtration area to remove and store nutrients, sediments, petrochemicals, pesticides, debris and other pollutants as they move from the upland towards the freshwater wetlands;
  5. A buffer area to keep human activities at a distance from freshwater wetlands, thus reducing the impact of noise, traffic, and other direct and indirect human impacts on freshwater wetlands species;
  6. A corridor area which facilitates the movement of wildlife to and from freshwater wetlands and from and to uplands, streams and other waterways; and
  7. A sediment and storm water control area to reduce the adverse effects of development or disturbance upon freshwater wetlands, flora and fauna, and nearby waterways.
- (c) A transition area is required adjacent to a freshwater wetland of exceptional resource value and of intermediate resource value as classified in N.J.A.C. 7:7A-2.4. A transition area is not required adjacent to a freshwater wetland of ordinary resource value or adjacent to a State open water.
- (d) The standard width of a transition area adjacent to a freshwater wetland of exceptional resource value shall be 150 feet. This standard width shall only be modified through the issuance of a transition area waiver. The types of transition area waivers are listed at N.J.A.C. 7:7A-6.1(a).
- (e) The standard width of a transition area adjacent to a freshwater wetland of intermediate resource value shall be 50 feet. This standard width shall only be modified through the issuance of a transition area waiver. The types of transition area waivers are listed at N.J.A.C. 7:7A-6.1(a).
- (f) A person shall not engage in regulated activities, as described at N.J.A.C. 7:7A-2.6, in a transition area except pursuant to a transition area waiver.
- (g) A transition area shall be measured outward from a freshwater wetland boundary line on a horizontal scale perpendicular to the freshwater wetlands boundary line as shown in N.J.A.C. 7:7A-6, Appendix A, which is incorporated by reference in this chapter. The outside boundary line of a transition area shall parallel, that is, be equidistant from, the freshwater wetlands boundary line, unless the Department issues a transition area waiver. The width of the transition area shall be measured as the minimum distance between the freshwater wetlands boundary and the outside transition area boundary.

#### Figure 1 - Transition Area

Example of a transition area adjacent to a freshwater wetland. Depicted are a plan and elevation view. (See figure 1 in the New Jersey Administrative Code.)

#### 7:7A-2.6 Regulated activities in transition areas

- (a) Except as provided in (b) and (c) below, the following are regulated activities when they occur in transition areas:
1. Removal, excavation, or disturbance of the soil;

2. Dumping or filling with any materials;
  3. Erection of structures;
  4. Placement of pavements;
  5. Destruction of plant life which would alter the existing pattern of vegetation; and
  6. Placement of any portion of a residential development project, as defined at N.J.A.C. 7:7A-1.4.
- (b) Notwithstanding (a) above, the following activities are not regulated in transition areas and do not require Department approval under this chapter, provided that the activities are performed in a manner that minimizes adverse effects to the transition area and adjacent freshwater wetlands:
1. Normal property maintenance;
    - i. For the purposes of this paragraph, "normal property maintenance" means activities required to maintain lawfully existing artificial and natural features, landscaping and gardening. These activities include:
      - (1) Mowing of existing fields or lawns;
      - (2) Pruning of trees and shrubs;
      - (3) Selective cutting of trees;
      - (4) Replacement of existing non-native plants with either native or non-native species;
      - (5) Limited supplemental planting of non-native plant species that will not significantly change the character of the existing vegetational community of the transition area. The creation of a lawn is not considered supplemental planting;
      - (6) Planting of native species, that is, plants naturally occurring in transition areas in the local region, (the county agricultural agent may be consulted to obtain information regarding these species);
      - (7) Continued cultivation of existing gardens and the development of new gardens no larger than one quarter acre in size; and
      - (8) Maintenance of artificial features including the repair, rehabilitation, replacement, maintenance or reconstruction of any previously authorized, currently serviceable structure, lawfully existing prior to July 1, 1989, or permitted under this chapter, provided such activities do not result in additional disturbance of the transition area upon completion of the activity. Minor deviations from the existing structure due to changes in materials or construction techniques and

which are necessary to make repairs, rehabilitation or replacements are allowed provided such changes do not result in disturbance of additional transition area upon completion of the activity.

- ii. Any activity which involves or causes the substantial alteration or change of the existing characteristics of a transition area shall not be considered normal property maintenance. Activities which involve or cause substantial alteration or change of the transition area include, but are not limited to, extensive removal or destruction of vegetation by clear cutting, cutting, mowing (except as described in (b)1i above), burning or application of herbicides, planting of ornamental plants or lawns for landscaping purposes (except as described in (b)1i above), regrading or significant changes in the existing surface contours and the placement of fill, pavement or other impervious surfaces.
2. Minor and temporary disturbances of the transition area resulting from, and necessary for, normal construction activities on land adjacent to the transition area, provided the activities do not result in adverse environmental effects on the transition area or on the adjacent freshwater wetlands, and do not continue for more than six months. For the purposes of this paragraph, minor and temporary disturbances include, but are not limited to, the placement of scaffolds or ladders, the removal of human-made debris by non-mechanized means which does not destroy woody vegetation, the placement of temporary construction supports, and the placement of utility lines over or under a previously authorized, currently serviceable paved roadway surface;
  3. The erection of one or more temporary structures covering a combined total of 150 square feet or less of the transition area. For the purposes of this paragraph, a "temporary structure" means a shed or fence without a foundation, or a structure that remains in the transition area for no more than six months.
- (c) Certain regulated activities are exempt from transition area requirements under N.J.A.C. 7:7A-2.8(f). In addition, an activity that is exempt from freshwater wetlands permit requirements under N.J.A.C. 7:7A-2.8(c) for farming activities, or N.J.A.C. 7:7A-2.8(d) for forestry activities, is also exempt from transition area requirements, subject to the limits on freshwater wetlands exemptions at N.J.A.C. 7:7A-2.8. A person may request an exemption letter confirming the exemption status of an activity by using the procedures at N.J.A.C. 7:7A-2.10.

#### 7:7A-2.7 Transition areas due to freshwater wetlands on adjacent property

- (a) The outside boundary of a transition area is determined solely by reference to the freshwater wetlands boundary and is not affected by property lines. Therefore, a property within 150 feet of a freshwater wetlands may contain a transition area that arises from a freshwater wetlands on another property. Every property containing a transition area is subject to this chapter, even if the freshwater wetland that causes the transition area is located on another property.
- (b) To determine whether a site has transition areas on it caused by wetlands on another property:

1. Determine whether there are any wetlands on any property within 150 feet of the site's property line. If not, there are no transition areas on the site due to wetlands on nearby properties;
  2. If there are freshwater wetlands on another property within 150 feet of the site's property line, determine the resource value classification of the wetlands on the nearby property. For a Department-issued resource value classification of the wetlands, obtain an LOI under N.J.A.C. 7:7A-3;
  3. If all of the freshwater wetlands on nearby properties within 150 feet of the site's property line are ordinary resource value wetlands, there is no transition area on the site arising from wetlands on other properties;
  4. If any of the freshwater wetlands on nearby properties within 150 feet of the site's property line cannot be classified as ordinary resource value wetlands, determine the transition area on the site as follows:
    - i. If any wetlands on nearby properties are intermediate resource value wetlands, and are within 50 feet of the site's property line, there is at least some transition area on the site arising from these wetlands. In order to determine the size and shape of the transition area, obtain a delineation of the wetlands on the nearby properties and determine the transition area for each under N.J.A.C. 7:7A-2.5(e); and
    - ii. If any wetlands on nearby properties are exceptional resource value wetlands, and are within 150 feet of the site's property line, there is at least some transition area on the site arising from these wetlands. In order to determine the size and shape of the transition area, obtain a delineation of the wetlands on the nearby properties and determine the transition area for each under N.J.A.C. 7:7A-2.5(d); and
  5. To avoid obtaining an LOI and/or delineating wetlands under (b)3 and 4 above, a person can ensure compliance with transition area requirements arising from wetlands on other properties by assuming that there are exceptional resource value wetlands on all adjacent properties and refraining from any regulated activities within 150 feet of the site's property line.
- (c) It may be necessary to obtain written permission from adjacent property owners to investigate their land within 150 feet of the site's boundary.

#### 7:7A-2.8 Activities exempted from permit and/or waiver requirement

- (a) This section sets forth certain activities that are exempt from certain permit requirements in this chapter. However, even if an activity is exempt under this chapter, it may still require a permit from the Army Corps of Engineers under the Federal wetlands program, and/or a water quality certificate issued by the Department.
- (b) The farming, ranching, and silviculture exemptions in (c) and (d) below are subject to the following limits:

1. The exemptions shall not apply to any discharge of dredged or fill material into freshwater wetlands or State open water incidental to any activity which involves bringing an area of freshwater wetlands or State open waters into a use to which it was not previously subject, where the flow or circulation patterns of the freshwater wetlands or waters may be impaired, or the extent or values and functions of freshwater wetlands or State open waters is reduced;
  2. The exemptions apply only as long as the area is used for the exempted activity. Therefore, if the area stops being used for farming, ranching, or silviculture, the exemption no longer applies;
  3. The exemptions apply only to the portion of the property which meets all requirements for the exemption. For example, if half of a 20 acre property has been actively farmed and half has not, the half that has not been actively farmed would not be considered to be part of an established, ongoing farming operation and would therefore not be eligible for the farming exemption;
  4. Clear cutting of a non-cultivated, wooded wetland area is not covered by the exemptions unless it is part of the normal harvesting of forest products performed in accordance with a written approval from the State Forester; and
  5. If an area with hydric soils has been drained for farming purposes through the use of drainage structures such as tiles or ditches, the Department shall presume that the area has wetlands hydrology for the purpose of identifying a freshwater wetland under N.J.A.C. 7:7A-2.3. To rebut this presumption of wetlands hydrology, all drainage structures shall be removed or completely disabled and the area shall be left undisturbed for at least one normal rainfall year, after which the presence or absence of wetlands hydrology shall be determined through use of technical criteria, field indicators, and other information, in accordance with the 1989 Federal manual.
- (c) Subject to the limitations of this section, the following activities, when part of an established, ongoing farming, ranching or silviculture operation, on properties which have received or are eligible for a farmland assessment under the New Jersey Farmland Assessment Act, N.J.S.A. 54:4-23.1 et seq., are exempt from the requirement of a freshwater wetlands or open water fill permit, or transition area waiver:
1. Normal farming, silviculture, and ranching activities such as plowing, seeding, cultivating, minor drainage, harvesting for the production of food and fiber, or soil and water conservation practices. For the purposes of this paragraph, "minor drainage" means:
    - i. The discharge of material incidental to connecting upland drainage facilities to adjacent wetlands, adequate to effect the removal of excess soil moisture from upland croplands;
    - ii. The discharge of material for the purpose of installing ditching or other such water control facilities incidental to planting, cultivating, protecting, or harvesting of rice, cranberries or other wetland crop species, where these

activities and the discharge occur in waters which are in established use for such agricultural and silvicultural wetlands crop production;

- iii. The discharge of material for the purpose of manipulating the water levels of, or regulating the flow or distribution of water within, existing impoundments which have been constructed in accordance with applicable requirements of the Federal Act and which are in established use for the production of rice, cranberries, or other wetland crop species;
  - iv. The discharge of material incidental to the emergency removal of sandbars, gravel bars, or other similar blockages which are formed during flood flows or other events, where such blockages close or constrict previously existing drainageways and, if not properly removed, would result in damage to or loss of existing crops on land in established use for crop production. Such removal does not include enlarging or extending the dimensions of, or changing the bottom elevations of, the affected drainageway as it existed prior to the formation of the blockage. Removal must be accomplished within one year of formation of such blockages in order to be eligible for exemption under this paragraph; and
  - v. Minor drainage in wetlands is limited to drainage within areas that are part of an established farming or silvicultural operation. It includes maintenance of existing drainage tile or other drainage structures. It does not include drainage associated with the immediate or gradual conversion of a wetland to a non-wetland (for example, wetlands species to upland species not typically adapted to life in saturated soil conditions), or conversion from one wetland use to another (for example, silviculture to farming). In addition, minor drainage does not include the construction of any new canal, ditch, dike or other waterway or structure. Any discharge of dredged or fill material into the wetlands or State open waters incidental to the construction of any such structure or waterway requires a freshwater wetlands or State open water permit, and will not be considered minor drainage;
2. Construction or maintenance of farm or stock ponds or irrigation ditches, or the maintenance of drainage ditches, provided that such facilities are for farming, ranching or silvicultural purposes and do not constitute a change in use. Any dredged material from pond construction or maintenance must be placed outside the freshwater wetlands unless it is needed for the structural or environmental integrity of the pond; and
  3. Construction or maintenance of farm roads or forest roads constructed and maintained in accordance with best management practices (BMPs) to assure that flow and circulation patterns and chemical and biological characteristics of freshwater wetlands and State open waters are not impaired and that any adverse effect on the aquatic environment will be minimized. Where the proposed discharge will result in significant discernible alterations to flow or circulation, the presumption is that flow or circulation may be impaired by such alteration. Roads constructed for forestry and silviculture purposes shall be constructed using temporary mats whenever practicable. All roads employing the placement of fill shall be removed once the land use changes from forestry to another use.

- (d) Normal harvesting of forest products in accordance with a forest management plan approved by the State Forester is exempt from the requirement of a freshwater wetlands permit, transition area waiver, or open water fill permit, subject to the limitations of this section. However, the removal of stumps results in a discharge of dredged or fill material, and a change in use and an impairment of flow or circulation. Therefore, under (b)1 above, the removal of stumps is not exempt.
- (e) Until March 2, 1994, when the Department assumed responsibility for the Federal 404 program, the Department issued certain exemptions based on prior local approvals. However, as of March 2, 1994, these exemptions are void as they apply to freshwater wetlands permit and open water fill requirements. The exemptions continue to apply to transition area requirements, and are described at (f) below.
- (f) Subject to the limitations of this section including (g) below, the following projects, as defined at N.J.A.C. 7:7A-1.4, are exempt from transition area requirements, but are subject to freshwater wetlands and State open water requirements:
1. A project for which a preliminary site plan or subdivision application received formal preliminary approvals from local authorities pursuant to the Municipal Land Use Law, N.J.S.A. 40:55D-1 et seq., prior to July 1, 1989, provided those approvals remain valid under the Municipal Land Use Law. This excludes approvals which were given prior to the August 1, 1976 effective date of the Municipal Land Use Law; and
  2. A project for which a preliminary site plan or subdivision application, as defined in N.J.S.A. 40:55D-1 et seq., was submitted to the local authorities prior to June 8, 1987 and was subsequently approved. To qualify for an exemption under this paragraph, an application for preliminary approval must have been in proper form, must have been accompanied by all plans, data and information called for by the local land use ordinance and by statute, and thus must have been in fact complete prior to June 8, 1987.
- (g) The following limits apply to the transition area exemptions at (f) above:
1. To be eligible for a transition area exemption under (f) above, a project must have preliminary site plan or subdivision approval. The exemptions do not apply to an application for, or grant of, any other approval under the Municipal Land Use Law, such as a sketch plat approval, general development plan, classification determination, building permit, variance, or conditional use approval;
  2. A project listed in (f) above shall no longer be exempt from transition area requirements if significant changes are made to the approved site or subdivision plan. A significant change will be deemed to have been made if either of the following criteria is met:
    - i. The change would void the preliminary approval; or
    - ii. The change would require submittal to or approval of a new or amended application from the local authorities and either of the following criteria is met:

- (1) The change would result in a change in land use on the project site, for example, from single family houses to multi-family units or a golf course; or
  - (2) The change would increase impacts to freshwater wetlands, State open waters, or transition areas;
- 3. A project listed in (f) above shall no longer be exempt if the municipal approval upon which the exemption was based becomes invalid for any reason; and
- 4. For all development determined to be exempt by the Department, once the development is constructed, the exempted "project" has been built. If, for example, the owner of a commercial building decides afterward that it is necessary to construct an addition, and goes back to the municipal authority for a new or amended site plan or subdivision approval, the exemption has been "used up" and the addition is subject to the permitting requirements of this chapter. Similarly, for residential approvals, once the houses and any accessory structures planned along with the house (for example, detached garages, barns, storage sheds, pools) are constructed, the exemption has been exhausted and any later additions or structural improvements are subject to the permitting requirements of this chapter. If there is an interruption of more than one year before construction of an accessory structure claimed to have been planned along with the house, there is a rebuttable presumption that the structure constitutes a later addition and will require a permit.
- (h) If any discharge of dredged or fill material resulting from the activities exempted by this section contains any toxic pollutant listed under section 307 of the Federal Act, such discharge shall be subject to any applicable toxic effluent standard or prohibition, and shall require a freshwater wetlands or open water fill permit.
- (i) A project covered by an individual permit issued by the U.S. Army Corps of Engineers prior to July 1, 1988 shall be governed only by the Federal Act, and shall not be subject to additional or inconsistent substantive requirements of this chapter. However, when the ACOE permit expires, any application for an extension shall be made to the Department under N.J.A.C. 7:7A-14.6. The Department shall not require a transition area as a condition of any extension of an ACOE permit issued prior to July 1, 1988.

7:7A-2.9 Geographic areas exempted from permit and/or waiver requirement

- (a) Regulated activities in areas under the jurisdiction of the Hackensack Meadowlands Development Commission under N.J.S.A. 13:17-1 et seq. do not require a permit under this chapter, but may require other State and/or Federal wetlands approvals, such as a Federal 404 permit from the ACOE, and/or a Water Quality Certificate issued by the Department, and/or a Federal Consistency Determination issued under the Federal Coastal Zone Management Act, 16 U.S.C. ?? 1451 et seq.
- (b) The discharge of dredged or fill material in a freshwater wetlands or State open water under the jurisdiction of the Pinelands Commission is subject to freshwater wetlands and open water fill permit requirements under this chapter. However, regulated activities in areas under the jurisdiction of the Pinelands Commission, other than the discharge of dredged or fill material, are not subject to this chapter. Transition areas are not regulated

under this chapter in areas under the jurisdiction of the Pinelands Commission. However, the Pinelands Commission may provide for more stringent regulation of activities in and around freshwater wetland areas within its jurisdiction, which include transition area regulations. For information on freshwater wetlands and transition areas in the Pinelands under this chapter and under the Pinelands Comprehensive Management Plan (CMP), contact the Pinelands Commission at (609) 894-7300 or through its website at [www.state.nj.us/pinelands](http://www.state.nj.us/pinelands).

- (c) An application for the discharge of dredged or fill material in areas under the jurisdiction of the Pinelands Commission shall be reviewed as follows:
  - 1. If the discharge is subject to the Pinelands CMP and is eligible for a general permit under this chapter, the Pinelands Commission shall review the discharge under the CMP and shall also review the application for a freshwater wetlands general permit using the standards in this chapter;
  - 2. If the discharge is subject to the Pinelands CMP and requires an individual permit under this chapter, the Pinelands Commission shall review the discharge under the CMP and the Department shall review the application for an individual freshwater wetlands permit using the standards in this chapter; and
  - 3. If the discharge is not subject to the Pinelands CMP but requires an individual or general permit under this chapter, the Department shall review the application for an individual or general freshwater wetlands permit using the standards in this chapter.
- (d) Regulated activities in tidally influenced wetlands which are defined as coastal wetlands pursuant to the Wetlands Act of 1970, N.J.S.A. 13:9A-1 et seq. are not subject to this chapter, but may require other State and/or Federal approvals.

#### 7:7A-2.10 Exemption letters

- (a) A person with a project or activity which qualifies for an exemption under this subchapter may obtain a letter from the Department certifying that an activity is exempt. The letter will be based on the information required by this section, and will be void if the information submitted is not complete and accurate, if the approval upon which it was based becomes invalid for any reason, or if the project or activity is not carried out as represented in the submittal(s) to the Department. This exemption will remain valid for the duration of the approval upon which it was based.
- (b) To apply for an exemption letter for a farming, silviculture or ranching exemption under N.J.A.C. 7:7A-2.8(c), an applicant shall submit the following:
  - 1. Certification of farmland assessment eligibility under the New Jersey Farmland Assessment Act, N.J.S.A. 54:4-23.1 et seq. The Department will accept a copy of the applicant's tax bill showing farmland assessment to document this requirement;
  - 2. A description of the activities for which the exemption is requested, including the total area covered, the types of farming, silviculture, or ranching, best management

practices currently employed or to be employed and the length of time the operation has been ongoing;

3. The fee specified in N.J.A.C. 7:7A-11; and
  4. Any other information reasonably necessary for the Department to determine if the applicant is eligible for the exemption, as listed in the Department's application checklist for the exemption letter.
- (c) To apply for an exemption letter for a forest products harvesting exemption pursuant to N.J.A.C. 7:7A-2.8(d), an applicant shall submit the following:
1. A copy of a forest management plan approved by the State Forester which includes the size of the site, the length of time required to complete the project, and a detailed description of the activities to take place in wetlands, transition areas, and/or State open waters, including the best management practices to be employed; and
  2. The fee specified in N.J.A.C. 7:7A-11; and
  3. Any other information reasonably necessary for the Department to determine if the applicant is eligible for the exemption, as listed in the Department's application checklist for the exemption letter.
- (d) To apply for an exemption letter for a transition area exemption pursuant to N.J.A.C. 7:7A-2.8(f), an applicant shall submit the following:
1. A folded copy of the preliminary local approval of the site plan or subdivision, including a copy of the site plan or subdivision itself and a copy of the resolution approving the site plan or subdivision;
  2. A letter from a municipal official with knowledge of and authority over the approval, including the following:
    - i. A statement that the site plan or subdivision approval is still within the period of protection from zoning changes provided for in the Municipal Land Use Law; or if the period of protection has expired, that there have been no changes to the municipal land use ordinances since the approval that would prohibit construction of the project; and
    - ii. A statement that the municipal approval that forms the basis for the exemption is still valid;
  3. The fee specified in N.J.A.C. 7:7A-11; and
  4. Any other information reasonably necessary for the Department to determine if the applicant is eligible for the exemption, as listed in the Department's application checklist for the exemption.

## SUBCHAPTER 3 LETTERS OF INTERPRETATION

### 7:7A-3.1 Basic LOI information

- (a) A letter of interpretation (LOI) provides the Department's official determination of one or more of the following:
  - 1. Whether there are any freshwater wetlands, transition areas, and/or State open waters present on a site or portion of a site;
  - 2. Where the boundaries of freshwater wetlands, transition areas and/or State open waters are located on a site; and/or
  - 3. What is the resource value classification, under N.J.A.C. 7:7A-2.4, of freshwater wetlands on a site.
- (b) A letter of interpretation does not grant approval to conduct any regulated activities. The sole function of a letter of interpretation is to provide or confirm information about the presence or absence, boundaries, and/or resource value classification of freshwater wetlands, transition areas, and/or State open waters.
- (c) The Department issues the following three types of LOIs:
  - 1. A presence/absence LOI, in which the Department determines whether any freshwater wetlands, transition areas, and/or State open waters exist on a site or on a portion of a site (also called a footprint of disturbance LOI). See N.J.A.C. 7:7A-3.2 for further details regarding presence/absence LOIs;
  - 2. A line delineation LOI, in which the Department delineates the boundary lines of freshwater wetlands, transition areas, and/or State open waters for an applicant. See N.J.A.C. 7:7A-3.3 for further details regarding line delineation LOIs; and
  - 3. A line verification LOI, in which the Department confirms or modifies a delineation proposed by the applicant. See N.J.A.C. 7:7A-3.4 for further details regarding line verification LOIs.
- (d) If an area with hydric soils has been drained for farming purposes through the use of drainage structures or features such as tiles or ditches, the Department shall presume that the area has wetlands hydrology for the purpose of identifying a freshwater wetland under N.J.A.C. 7:7A-2.3. To rebut this presumption of wetlands hydrology, all drainage structures shall be removed or completely disabled and the area shall be left undisturbed for at least one normal rainfall year, after which the presence or absence of wetlands hydrology shall be determined through use of technical criteria, field indicators, and other information, in accordance with the 1989 Federal manual.
- (e) Each LOI that indicates the presence of freshwater wetlands will state the resource value classification of the wetlands under N.J.A.C. 7:7A-2.4 and will specify the width of the transition area. However, in some cases, seasonal conditions make it difficult to determine the resource value classification of a wetland. For example, if there has been a past sighting of a bog turtle (an endangered species) in the area, and an LOI application is submitted in December when the early successional habitat needed by bog turtles may be

impossible to identify under snow cover, Department staff cannot determine if the habitat remains suitable for bog turtles until the snow melts. In such a case, the Department will notify the applicant that seasonal conditions do not permit an accurate assessment of resource value, shall provide an explanation of the seasonal conditions involved, and shall give the applicant the option to accept an exceptional resource value classification, or to wait for the LOI until the Department can determine the resource value of the wetland.

- (f) The Department shall issue an LOI within the applicable time period below. Average time periods from the Department's receipt of an application to a final decision on the application are set forth for all approvals at N.J.A.C. 7:7A-10.1(k):
1. If the Department does not request additional information regarding an LOI application under N.J.A.C. 7:7A-12.1(c)4, within 30 days after receiving the application;
  2. If the Department requests additional information regarding an LOI application under N.J.A.C. 7:7A-12.1(c)4, within 45 days after receipt of information sufficient to declare the application complete;
  3. If the applicant chooses to wait for a determination of resource value classification under (e) above, as soon as the Department determines that the resource classification of the wetlands can be definitively determined; and
  4. If the Department conducts a site inspection, the time set forth in this subsection for issuance of the letter of interpretation shall be extended by 45 days.
- (g) The Department will issue an LOI for a portion of a site, also called a footprint of disturbance, under N.J.A.C. 7:7A-3.2(c)2 or N.J.A.C. 7:7A-3.4(b)2. Special application requirements will apply to such an LOI, in order to ensure that the portion of the site is clearly marked on the plan and on the ground. These requirements are described at N.J.A.C. 7:7A-10.3(b) and (d)4.
- (h) The Department shall not issue an LOI if the Department determines that the information submitted in the application for the LOI is inaccurate. In such a case, the applicant may provide corrected information upon the Department's request, or may apply directly for a permit without obtaining an LOI. If the applicant applies for the permit without first obtaining an LOI, the permit application must include all information that would be necessary for the Department to issue an LOI for the site, in accordance with N.J.A.C. 7:7A-10.4(a)2, 10.5(a)1, or 10.6(a)2, as applicable. The Department will then review the submitted wetland delineation as part of the permit review process.
- (i) In order to ensure that a delineated wetlands boundary can be located in the future after the LOI is issued, an LOI applicant shall provide the Department with a survey of the approved delineated wetlands boundary line. The survey may be submitted as part of the LOI application, or if the applicant prefers, the survey may be submitted after the Department inspects the site and approves the delineation as marked on the site with flags or other markers. If the Department requires adjustments to the delineated wetlands boundary after the survey is submitted, the applicant shall re-survey the delineated boundary after the adjustments are made and the Department has approved the boundary. The issued LOI will reference the approved and surveyed boundary line. The Department shall waive the survey requirement if the applicant demonstrates that the extent of

wetlands on the site can be easily determined in the future without a survey, so that the expense of a survey is not warranted. For example, the Department may waive the survey requirement if an entire site is covered completely with freshwater wetlands.

- (j) If an LOI covers only a portion of a site in accordance with N.J.A.C. 7:7A-3.2(c)2 or 3.4(b)2, the applicant shall provide, in addition to the survey required at (i) above, a survey of the boundaries of the portion of the site that are covered by the LOI.
- (k) If a site is located in an area under the jurisdiction of the Pinelands Commission, the Department shall not issue a letter of interpretation. The lead agency in this area for determining the presence, absence, or extent of freshwater wetlands is the Pinelands Commission. However, in cases of disagreement, the Department and the Pinelands Commission retain authority to independently or jointly establish these boundaries.

#### 7:7A-3.2 Presence/absence LOI

- (a) A presence/absence LOI identifies whether any freshwater wetlands, State open waters or transition areas exist on a site, or on a portion of a site (footprint of disturbance). A presence/absence LOI also provides the resource value classification for any wetlands on the site.
- (b) A presence/absence LOI does not identify the boundaries or location of any freshwater wetlands, transition areas, and/or State open waters found within a site or portion thereof. To obtain an LOI indicating the location or the boundaries of freshwater wetlands, transition areas, and/or State open waters, an applicant must apply for a line delineation LOI under N.J.A.C. 7:7A-3.3, or a line verification LOI under N.J.A.C. 7:7A-3.4.
- (c) The Department shall issue a presence/absence LOI for either of the following:
  - 1. An entire site, as defined at N.J.A.C. 7:7A-1.4, regardless of its size; or
  - 2. A portion of a site, also known as a footprint of disturbance, provided the portion is no larger than one acre.
- (d) The Department shall issue a presence/absence LOI for more than one portion of a site, provided that:
  - 1. Each portion is no larger than one acre;
  - 2. The applicant submits a separate fee for each portion; and
  - 3. No more than three presence/absence LOIs shall be issued for a single site under this subsection.

#### 7:7A-3.3 Line delineation LOI

- (a) A line delineation LOI identifies the boundaries of any freshwater wetlands, transition areas, and/or State open waters on a site or a municipal tax lot that is one acre or smaller, and identifies the resource value classification of any freshwater wetlands on the site. For

a line delineation LOI, the applicant need not submit a delineation. Rather, the Department will inspect the site and delineate the boundary lines of any freshwater wetlands, transition areas, and/or State open waters.

- (b) The Department shall issue a line delineation LOI for a site, as defined at N.J.A.C. 7:7A-1.4, or for a municipal tax lot, that is one acre or smaller. The Department shall not issue a line delineation LOI for a site larger than one acre. The Department shall not issue a line delineation LOI for a portion of a site, unless the portion is a municipal tax lot.

#### 7:7A-3.4 Line verification LOI

- (a) A line verification LOI identifies the boundaries of any freshwater wetlands, transition areas, and/or State open waters on a site, and the resource value classification of any freshwater wetlands on the site. For a line verification LOI, the applicant must submit a proposed delineation of wetlands, transition areas, and/or State open waters, which the Department will confirm or modify.
- (b) The Department shall issue a line verification LOI for the following:
  - 1. A site, as defined at N.J.A.C. 7:7A-1.4, regardless of its size;
  - 2. A municipal tax lot no larger than the site; or
  - 3. A portion of a site, if all of the following criteria are met:
    - i. The site is publicly owned;
    - ii. The site is larger than 10 acres;
    - iii. The portion is one acre or smaller; and
    - iv. The portion is clearly marked on the plan and on the ground.

#### 7:7A-3.5 Application for a letter of interpretation

- (a) An applicant for a letter of interpretation shall follow all application procedures and information requirements at N.J.A.C. 7:7A-10, Application contents and procedures. However, if a site is located in an area under the jurisdiction of the Pinelands Commission, the applicant shall instead apply to the Pinelands Commission for a determination regarding the presence, absence, and/or extent of wetlands on the site; and the transition area for any wetlands on site.
- (b) The Department shall review an application for a letter of interpretation using the procedures at N.J.A.C. 7:7A-12, Department review of an application.
- (c) The Department, in reviewing an application for an LOI, shall consider comments filed by municipal and county governments and interested citizens. Comments should be submitted to the Department in writing within 15 days after the commenter receives notice of the LOI application, to ensure adequate time for the Department to fully consider them.

However, comments will be accepted until the Department makes a decision on the application.

#### 7:7A-3.6 Effect, duration, and extension of a letter of interpretation

- (a) A person who is issued a letter of interpretation pursuant to this subchapter shall be entitled to rely on the determination of the Department, concerning the presence or absence, or the extent of freshwater wetlands and/or State open waters, for a period of five years from its issuance, unless the letter of interpretation is determined to have been based on inaccurate or incomplete information, in which case the Department may void the original letter of interpretation and issue a new letter of interpretation reflecting the actual conditions on the site. For example, the LOI may be revised to reflect additional wetland areas identified after LOI issuance; or if a threatened or endangered species habitat is disclosed or discovered after the LOI was issued, the Department may correct the resource value classification.
- (b) The term of a letter of interpretation may be extended, provided that the information upon which the original letter was based remains valid, but shall not exceed five years from the original expiration date.
- (c) Requests for extensions shall be made in writing to the Department before the letter of interpretation has expired and shall be subject to the application requirements at N.J.A.C. 7:7A-10. Applicants will be required to submit a new application if an extension is not applied for prior to the expiration date of the letter of interpretation.

### SUBCHAPTER 4 GENERAL PROVISIONS FOR GENERAL PERMITS

#### 7:7A-4.1 Department issuance of general permits

- (a) This section details how the Department will adopt General permits except for general permits numbers 6 and 7. To adopt a general permit, the Department will publish a draft general permit as a rule proposal pursuant to the New Jersey Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq. In addition, the Department will send a copy of the draft general permit to USEPA, and will follow the procedures for EPA comment found at N.J.A.C. 7:7A-12.2.
- (b) The Department may adopt a general permit only if all of the following conditions are met:
  - 1. After conducting an environmental analysis, the Department determines that the regulated activities will cause only minimal adverse environmental impacts when performed separately, will have only minimal cumulative adverse impacts on the environment, and will cause only minor impacts on freshwater wetlands and State open waters;
  - 2. The Department determines that the activity will conform to the purposes of the Freshwater Wetlands Protection Act, and will not violate the Federal Act; and
  - 3. The Department provides public notice and opportunity for a public hearing.

- (c) In addition to the conditions required by this subchapter, each general permit shall contain limitations as necessary to comply with Federal regulations governing the Department's assumption of the Federal 404 program at 40 CFR §233.21(c) as follows:
1. A description of the activities which are authorized, including limits for any single project. At a minimum, these limits shall include:
    - i. The maximum quantity of material that may be discharged;
    - ii. The type(s) of material that may be discharged;
    - iii. The depth of fill permitted;
    - iv. The maximum extent to which an area may be modified; and
    - v. The size and type of structure that may be constructed; and
  2. A precise description of the geographic area to which the general permit applies, including, when appropriate, limits on the type(s) of water(s) or wetlands where activities may be conducted.
- (d) The Department may modify an adopted general permit as it applies to a particular project by adding special conditions which must be met in order to qualify for authorization under the general permit.
- (e) The Department may repeal an adopted general permit and thereafter require individual permits for activities previously covered by the general permit, if it finds that the general permit no longer meets the standards of the Freshwater Wetlands Protection Act and this chapter.
- (f) The Department shall review each general permit at least every five years. This review shall include public notice and opportunity for public hearing. Upon this review the Department shall modify, readopt or repeal each general permit.
- (g) If a general permit is not modified or readopted in accordance with (f) above within five years of publication of its adoption in the New Jersey Register, it shall automatically expire.

#### 7:7A-4.2 Using a general permit to authorize specific activities

- (a) To use a general permit to authorize regulated activities, an applicant shall submit an application for a general permit authorization, using the application procedures for all permits and waivers set forth at N.J.A.C. 7:7A-10, except in an area under the jurisdiction of the Pinelands Commission. In such an area, the application shall be submitted to the Pinelands Commission rather than to the Department, in accordance with the Pinelands Comprehensive Management Plan (CMP). For information on freshwater wetlands and transition areas in the Pinelands, contact the Pinelands Commission at (609) 894-7300 or through its website at [www.state.nj.us/pinelands](http://www.state.nj.us/pinelands).
- (b) Each general permit specifies whether it covers activities in freshwater wetlands, transition areas, State open waters, or a combination thereof. An authorization issued under a

general permit that covers activities in freshwater wetlands satisfies the requirement for a freshwater wetlands permit. An authorization issued under a general permit that covers activities in State open waters satisfies the requirement for an open water fill permit. An authorization issued under a general permit that covers activities in a transition area satisfies the requirement for a transition area waiver.

- (c) Each general permit authorization shall include a limited transition area waiver to allow access to the authorized activity, in accordance with N.J.A.C. 7:7A-6.1(a)6. No fee or application is required for this waiver and the disturbance authorized under this waiver is not counted in calculating the amount of disturbance under the general permit. An access transition area waiver allows regulated activities only:
  - 1. In that portion of the transition area bordering on that portion of the freshwater wetland in which the activity authorized by the general permit will take place; and
  - 2. For an activity that the Department determines is necessary to accomplish the activity authorized in the wetlands under the general permit. An activity not directly required in order to obtain access to the activity authorized in the wetlands under the general permit shall require a separate transition area waiver.
- (d) Usually, a general permit is the only wetlands approval required for activities in freshwater wetlands in New Jersey. However, if an activity is located in non-delegable waters, as defined at N.J.A.C. 7:7A-1.4, both a general permit authorization from the Department and a Federal 404 program approval from the ACOE may be required. In addition, if an activity is located in wetlands or transition areas in an area under the jurisdiction of the Pinelands Commission, approval may be required from the Pinelands Commission, in accordance with the Pinelands Comprehensive Management Plan (CMP). For information on freshwater wetlands and transition areas in the Pinelands, contact the Pinelands Commission at (609) 894-7300 or through its website at [www.state.nj.us/pinelands](http://www.state.nj.us/pinelands).
- (e) The Department shall deny an application for a general permit authorization and require an application for an individual permit if the Department finds that:
  - 1. Additional permit conditions added under N.J.A.C. 7:7A-4.1 and/or 13.2 would not be sufficient to ensure compliance with this chapter and other applicable laws; or
  - 2. Special circumstances make an individual permit necessary to ensure compliance with the Freshwater Wetlands Protection Act, this chapter, any permit or order issued pursuant thereto, or the Federal Act.
- (f) The limits on disturbance in each general permit apply to the entire site upon which activities authorized under the general permit occur. An applicant shall not segment a project or its impacts by applying for general permit authorization for one portion of the project and applying for an individual permit for another portion of the project. Similarly, an applicant shall not segment a project or its impacts by separately applying for general permit authorizations for different portions of the same project.
- (g) Unless otherwise specified, the limits on disturbance under a general permit apply to total disturbance, including both temporary and permanent disturbance.

- (h) If a regulated activity is not covered by any general permit or combination of general permits, an individual freshwater wetlands or open water fill permit must be obtained under N.J.A.C. 7:7A-7 in order to authorize the activity under this chapter. If a regulated activity in a transition area is not covered by any general permit or combination of general permits, an individual transition area waiver must be obtained under N.J.A.C. 7:7A-6 in order to authorize the activity under this chapter.

7:7A-4.3 Conditions that apply to all General Permit Authorizations

- (a) A person acting under the authority of a general permit shall comply with:
1. The conditions listed under the general permit itself;
  2. The standard conditions for all general permits set forth at (b) below;
  3. The conditions for all permits at N.J.A.C. 7:7A-13;
  4. The limits on the use of multiple general permits in N.J.A.C. 7:7A- 4.4; and
  5. If required under a particular general permit, mitigation pursuant to N.J.A.C. 7:7A-15.
- (b) The following conditions apply to all activities conducted under the authority of a general permit:
1. Activities performed under a general permit shall be associated with a proposed project. The Department shall not authorize activities under a general permit for the purpose of eliminating a natural resource in order to avoid regulation. For the purposes of this subsection, project shall mean the use and configuration of all buildings, pavements, roadways, storage areas and structures, and all associated activities;
  2. The regulated activity shall not occur in the proximity of a public water supply intake;
  3. The activities shall not destroy, jeopardize, or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize the continued existence of any local population of a threatened or endangered species;
  4. The activity will not occur in a component of either the Federal or State Wild and Scenic River System; nor in a river officially designated by Congress or the State Legislature as a "study river" for possible inclusion in either system while the river is in an official study status; except that the activity may occur in these waters if approved by the National Park Service in accordance with 40 CFR (233);
  5. The activity shall not adversely affect properties which are listed or are eligible for listing on the New Jersey or National Register of Historic Places unless the applicant demonstrates to the Department that the proposed activity avoids or minimizes impacts to the maximum extent practicable or the Department

determines that any impact to the affected property would not impact the property's ability to continue to meet the criteria for listing at N.J.A.C. 7:4-2.3 or otherwise negatively impact the integrity of the property or the characteristics of the property that led to the determination of listing or eligibility. The Department shall not issue a conditional permit if it finds that the mitigation proposed is inadequate to compensate for the adverse affect. Any permit for an activity which may adversely affect a property listed or eligible for listing on the New Jersey or National Register of Historic Places shall contain conditions to ensure that any impact to the property is minimized to the maximum extent practicable and any unavoidable impact is mitigated. If the permittee, before or during the work authorized, encounters a probable historic property that may be eligible for listing in the New Jersey or National Register, the permittee shall immediately notify the Department and proceed as directed;

6. Any discharge of dredged or fill material shall consist of clean, suitable material free from toxic pollutants (see 40 CFR 401) in toxic amounts, and shall comply with all applicable Department rules and specifications regarding use of dredged or fill material;
7. Any structure or fill authorized shall be maintained as specified in the construction plans;
8. During construction activities, all excavation must be monitored for the presence of acid-producing deposits. If any such deposits are encountered, the permittee shall implement the mitigation and disposal standards in the Flood Hazard Area Control Act Rules at N.J.A.C. 7:13 and shall establish an annual post-planting monitoring program to ensure the reestablishment of vegetation in temporarily disturbed areas. The plantings shall have a minimum 85 percent plant survival and coverage rate after two complete growing seasons. If the plantings fail to achieve this survival rate, the Department will require the permittee to implement additional corrective measures;
9. The activity will not result in a violation of the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 or implementing rules at N.J.A.C. 7:13;
10. If activities under the general permit will result in a 1/4 acre or greater increase in impervious surfaces, the stormwater resulting from the general permit activities shall be treated in accordance with the water quality requirements in the Department's Flood Hazard Area Control Act rules at N.J.A.C. 7:13-2.8;
11. If activities under the general permit involve excavation or dredging, the applicant shall use an acceptable disposal site for the excavated or dredged material. No material shall be deposited or dewatered in freshwater wetlands, transition areas, State open waters or other environmentally sensitive areas. The Department may require testing of dredged material if there is reason to suspect that the material is contaminated. If any dredged material is contaminated with toxic substances, the dredged material shall be removed and disposed of in accordance with Department-approved procedures;

12. The amount of rip-rap or other energy dissipating material shall not exceed the minimum necessary to prevent erosion, as calculated under the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90;
  13. Best management practices, as defined at N.J.A.C. 7:7A-1.4, shall be followed whenever applicable;
  14. If the general permit activities are subject to the Department's Water Quality Management Planning rules at N.J.A.C. 7:15, the activities shall be consistent with those rules and with the applicable approved Water Quality Management Plan (208 Plan) adopted under the New Jersey Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq.; and
  15. The timing requirements at (c) below shall be met; and
  16. Activities authorized under a general permit shall not take place in a vernal habitat, as defined at N.J.A.C. 7:7A-1.4, or in a transition area adjacent to a vernal habitat.
- (c) In order to protect the fishery resources and/or the spawning of the fish population, any activity which may introduce sediment into a stream or cause a stream to become turbid shall not be performed during the time periods listed in Table A below:

Table A<sup>1</sup> RESTRICTED TIME PERIODS FOR WATERS WITH FISHERY RESOURCES

Water body or water body classification - Time period (inclusive) during which activities shall not be performed.

|  |                               |
|--|-------------------------------|
| Brook trout production waters;<br>Brown trout production waters; and All other trout<br>production waters except Rainbow trout production waters | September 15 through March 15 |
|--|-------------------------------|

|                                 |                             |
|---------------------------------|-----------------------------|
| Rainbow trout production waters | February 1 through April 30 |
|---------------------------------|-----------------------------|

|  |                          |
|--|--------------------------|
| Trout-stocked waters;<br>Trout maintenance waters; and An area within one mile<br>upstream of a trout-stocked or a trout maintenance water | March 15 through June 15 |
|--|--------------------------|

|   |                    |
|---|--------------------|
| All unimpeded tidal waters open to the ocean, including:<br>Coastal bays; Delaware Bay and River up to any impassable<br>barrier; and Water bodies identified as anadromous migratory pathways. | April 1 to June 30 |
|---|--------------------|

|   |                 |
|---|-----------------|
| Water bodies that support general game fish | May 1 to June 3 |
|---|-----------------|

|                                    |                     |
|------------------------------------|---------------------|
| Water bodies that support pickerel | Ice out to April 30 |
|------------------------------------|---------------------|

|                                   |                   |
|-----------------------------------|-------------------|
| Water bodies that support walleye | March 1 to May 30 |
|-----------------------------------|-------------------|

Water bodies used by American Shad for migrations in the Delaware River:

- Mouth of Delaware Bay to Delaware Memorial Bridge; and March 1 through June 30; and  
- Tidal Maurice River. October 1 through November 30
- Delaware Memorial Bridge to Trenton; and March 1 through June 30; and  
- Tidal portions of Rancocas, Raccoon, and September 1 through November 30  
- Crosswicks Creeks.
- Delaware River from Trenton to New York State line. April 1 through June 30; and  
September 1 through November 30

**<sup>1</sup>Note that the Delaware River Basin Commission (DRBC) imposes additional timing restrictions on certain activities in waters under DRBC jurisdiction. Contact the U.S. Fish and Wildlife Service's River Basin Coordinator through the DRBC at (609)883-9500 for information on these additional timing restrictions.**

- (d) The Department may reduce, extend or otherwise modify the timing requirements listed at (c) above on a case-by-case basis provided:
  1. The applicant demonstrates that the impact to the fishery resource will be less if the regulated activities occur during the timing restriction rather than during an unrestricted period;
  2. The combined effects of the timing restrictions above would restrict activities to less than 183 calendar days per year. In such a case, the Department may allow regulated activities to occur for up to 183 calendar days if the applicant demonstrates to the Department that proper steps will be taken that will minimize the impact to the fishery resources;
  3. The Department determines that regulated activities must occur during periods when local schools are not in session in order to avoid increased risks or excessive delays to school buses or vans; or
  4. The Department determines that, due to the nature of the project or an unusual circumstance on site, the timing restriction must be modified or extended in order to prevent a substantial adverse impact to the fishery resource, to the aquatic environment, or to a threatened or endangered species or its habitat.
- (e) If an activity will take place in a non-delegable water, as defined at N.J.A.C. 7:7A-1.4, and the activity requires approval from the ACOE under the Federal 404 program, the activities authorized under the general permit shall not begin until the permittee obtains the required Federal 404 program approval.
- (f) No activity is authorized under a general permit without a written approval from the Department, except for the following, which are subject to the notice and application requirements set forth in the applicable provisions cited below:
  1. Maintenance of an off-stream stormwater management facility, as authorized under general permit 1 at N.J.A.C. 7:7A-5.1(d);

2. Repair of a malfunctioning septic system, as authorized under general permit 25 at N.J.A.C. 7:7A-5.25; and
3. Minor channel or stream cleaning activities, as authorized under general permit 26 at N.J.A.C. 7:7A-5.26.

7:7A-4.4 Use of multiple general permits

- (a) The Department may authorize activities under one or more general permits on a single site, provided that:
  1. The individual limits of each general permit are complied with. If activities under one general permit are conducted in more than one place on a site, the total disturbance caused by all activities at all locations onsite under that general permit shall be summed in order to determine if the limits in the general permit are met; and
  2. The total combined area of wetlands, State open waters, and transition areas disturbed or modified on the site under general permits 2, 6, 7, 8, 10A, 10B, 11, 12, 13, 14, 17, 18, 19, 21, 22, 24, 25, and 26 does not exceed one acre with the exception of the following:
    - i. Disturbance of State open waters as part of a lake dredging project under general permit 13 at N.J.A.C. 7:7A-5.13. However, disturbance of wetlands or transition area in the lake or for access to the dredging project shall be counted toward the one acre limit in this subsection;
    - ii. Disturbance of State open waters as part of a channel or stream cleaning project under general permit 26 at N.J.A.C. 7:7A-5.26. However, disturbance of wetlands or transition area in the channel or stream or for access to the channel or stream cleaning project shall be counted toward the one acre limit in this subsection;
    - iii. Disturbance of a transition area solely for access to a general permit activity performed in a wetland in accordance with N.J.A.C. 7:7A-4.2(c); and
    - iv. Disturbance authorized under general permit 17 on a publicly owned site.
- (b) The Department may authorize activities under a general permit more than once on the same site, and/or at different times on the same site. However, the total disturbance authorized on a site under general permits since July 1, 1988 shall meet the criteria for use of multiple general permits set forth at (a)1 and 2 above.
- (c) If a general permit is not listed at (a)2 above, any acreage disturbed under that general permit is not counted towards the one acre limit in (a)2 above, regardless of whether the general permit is used singly or in combination with other general permits, and regardless of whether the general permit is used once or repeatedly.
- (d) In addition to the limits above, the Department shall not authorize activities under general permit numbers 13, 15, or 18 more often than once every five years on a single site.

7:7A-4.5 Application for authorization to act under General Permits

- (a) An applicant for authorization to act under a general permit shall follow all application procedures and information requirements at N.J.A.C. 7:7A-10, Application contents and procedures, unless the activity is one of the following, in which case the application requirements are found in the general permit itself:
1. Maintenance of an off-stream stormwater management facility under N.J.A.C. 7:7A-5.1(d);
  2. Repair or modification of a malfunctioning individual subsurface sewage disposal system under N.J.A.C. 7:7A-5.25; or
  3. Minor channel or stream cleaning under N.J.A.C. 7:7A-5.26.

7:7A-4.6 Combined general permit authorization and flood hazard area permit

- (a) An applicant may obtain a combined freshwater wetlands general permit authorization and flood hazard area permit for an activity that is in a freshwater wetlands and also in an area regulated under the Department's Flood Hazard Area Control Act rules under the following provisions:
1. N.J.A.C. 7:7A-5.2A, authorizing an underground utility line;
  2. N.J.A.C. 7:7A-5.10C, authorizing a minor road crossing;
  3. N.J.A.C. 7:7A-5.11A, authorizing an intake or outfall structure;
  4. N.J.A.C. 7:7A-5.20A, authorizing bank stabilization activities; and
  5. N.J.A.C. 7:7A-5.26A, authorizing channel or stream cleaning activities.
- (b) The combined permit issued under this section shall constitute both the general permit authorization and the flood hazard area permit for the covered activities. However, if a project includes elements other than the activities covered by the combined general permit and flood hazard area permit, those elements may require a separate flood hazard area or freshwater wetlands approval.
- (c) Application requirements for combined permits are set forth at N.J.A.C. 7:7A-10.7.

SUBCHAPTER 5 ADOPTED GENERAL PERMITS

7:7A-5.1 General Permit 1 - Maintenance and repair of existing features

- (a) General permit 1 authorizes activities in freshwater wetlands and State open waters, required to carry out the repair, rehabilitation, replacement, maintenance or reconstruction of a previously authorized, currently serviceable structure, fill, roadway, utility line, active irrigation or drainage ditch, or stormwater management facility lawfully existing prior to July

1, 1988 or permitted under this chapter. General permit 1 does not cover transition areas because these activities are not regulated in transition areas under N.J.A.C. 7:7A-2.6 and thus may be performed in a transition area without Department approval under this chapter.

- (b) To be authorized under general permit 1, the previously authorized structure, fill, roadway, utility, ditch or facility shall not have been and will not be put to any use other than as specified in any permit authorizing its original construction. Activities under general permit 1 shall not expand, widen or deepen the previously authorized feature, and shall not deviate from any plans of the original activity, except that minor deviations due to changes in materials or construction techniques and which are necessary to make repairs, rehabilitation or replacements are allowed provided such changes do not result in disturbance of additional freshwater wetlands or State open waters upon completion of the activity.
- (c) If the activity is the ongoing maintenance of an off-stream stormwater management facility created in uplands, including a wetland constructed in uplands for stormwater management purposes after September 4, 2001, the following shall apply:
  - 1. The application for authorization shall be subject to the public notice requirements at N.J.A.C. 7:7A-10.9 but shall not be subject to the other application requirements in N.J.A.C. 7:7A-10;
  - 2. The application for authorization shall include the information required by the application checklist, including information identifying and describing the site and the project, and a copy of the permit, if any, authorizing the original construction of the stormwater management facility;
  - 3. The Department shall process the application for authorization using the procedures at (d) below; and
  - 4. For the purposes of this subsection, maintenance includes removal of sediment and debris and mowing of vegetation, as necessary to ensure that the stormwater management facility will function as it was originally designed and/or permitted. Maintenance does not include enlargement of a stormwater management structure, excavation below the original bottom of a structure, or any other change in its design.
- (d) Upon receipt of an application for authorization under (c) above, the Department shall process the application as follows:
  - 1. Within 20 days of the Department's receipt of the application, the Department shall notify the applicant if the application is not administratively complete (that is, if it does not include all of the information required under (c) above). If the Department so notifies the applicant, the time period in (d)2 below shall not begin to run. If the Department does not so notify the applicant, the application shall be deemed administratively complete 20 days after the Department receives it; and
  - 2. If the application is administratively complete, the Department shall have 30 days after receipt of the complete application to notify the applicant that the activities are not authorized under general permit 1, or that the activities may be authorized but

require a full application review under N.J.A.C. 7:7A-10. If the Department does not so notify the applicant, the application is automatically approved, to the extent that the activity does not violate other laws then in effect.

- (e) Activities under general permit 1 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.2 General Permit 2 - Underground utility lines

- (a) General permit 2 authorizes activities in freshwater wetlands, transition areas, and/or State open waters, necessary for the construction and/or maintenance of an underground utility line.
- (b) If a utility line is jacked or directionally drilled underground, so that there is no surface disturbance of any freshwater wetlands, transition areas, or State open waters and there is no draining or dewatering of freshwater wetlands, no Department approval is required under this chapter. Jacking or directional drilling is regulated under this chapter if any disturbance occurs to the ground surface in the freshwater wetlands, transition area, or State open water; for example, if the drilling is conducted from a pit located in a freshwater wetland or transition area.
- (c) Activities under general permit 2 shall comply with the following limits:
  1. Permanent above-ground disturbance of wetlands, transition area, and/or State open waters shall be no greater than one acre. Anything that changes the character of the existing wetland, even if only to a different wetland type, is permanent disturbance. For example, maintained clearing over a utility line is permanent disturbance;
  2. Permanently maintained clearing over the utility line shall be no wider than 20 feet unless a wider area is required by law;
  3. The trench into which the utility line is placed shall be no wider than necessary to comply with the United States Occupational Safety and Health Administration safety standards for excavations, set forth at 29 CFR Part 1926, Subpart P;
  4. Temporary disturbance, as defined at N.J.A.C. 7:7A-1.4, such as temporary construction clearing or temporary storage of dirt or equipment, shall be the minimum size necessary for compliance with applicable laws;
  5. The activities shall not cause any change in preconstruction elevation of a freshwater wetland transition area, or State open water; and
  6. Manholes and siphons for sewer lines shall be placed outside of wetlands, unless the Department's Municipal Finance and Construction Element determines under N.J.A.C. 7:22 and/or N.J.A.C. 14A-23 that there is no feasible alternative to placement in wetlands.
- (d) In order to minimize environmental impact, a permittee shall:
  1. Dispose of any excess soil or bedding material immediately upon completion of construction. This material shall be disposed of outside of freshwater wetlands,

transition areas, State open waters, and areas regulated under the Department's Flood Hazard Area Control Act rules;

2. Backfill the uppermost 18 inches of any excavation with the original topsoil material;
  3. Replant the disturbed area with indigenous wetlands plants;
  4. Stabilize the disturbed area in accordance with the requirements of the appropriate Soil Conservation District; and
  5. Ensure that the activities do not interfere with the natural hydraulic characteristics of the wetland, such as the flow characteristics of groundwater on the site.
- (e) Any pipes laid through wetlands, transition areas, or State open waters shall be:
1. Properly sealed so as to prevent leaking or infiltration;
  2. Designed so as not to form or provide a conduit for groundwater to be discharged or drained from the wetland; and
  3. Placed entirely beneath the pre-existing ground elevation in order to allow free passage of surface and ground water, unless the applicant shows that placing some or all of the pipe above ground would be more environmentally beneficial.
- (f) Activities under general permit 2 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.2A Combined general permit 2 and flood hazard area permit

- (a) If an activity authorized under general permit 2 also requires a flood hazard area permit under N.J.A.C. 7:13, the Department shall issue a combined flood hazard area permit and general permit 2 authorization for the activity if all of the following requirements are met:
1. The underground utility line meets the requirements for authorization under general permit 2 at N.J.A.C. 7:7A-5.2;
  2. The underground utility line meets the applicable requirements of the Department's Flood Hazard Area Rules at N.J.A.C. 7:7A-13; and
  3. Either of the following criteria is met:
    - i. The site is covered by a valid letter of interpretation showing the boundaries of any wetlands on the site, issued by the Department under N.J.A.C. 7:7A-3; or
    - ii. The activities will result in disturbance of State open waters only, and will not involve regulated activities in a freshwater wetland or transition area, as described at N.J.A.C. 7:7A-2.

- (b) The combined permit provided for under this section shall be subject to the conditions for combined permits found at N.J.A.C. 7:7A-4.6. An application for the combined general permit 2 and flood hazard area permit shall meet the application requirements at N.J.A.C. 7:7A-10.7.

7:7A-5.3 General Permit 3 - Discharge of return water

- (a) General permit 3 authorizes the discharge of return water from an upland, contained, dredged material disposal area into State open waters, and placement of a pipe above ground for the discharge through freshwater wetlands and/or transition areas. The dredging itself may also require other State and Federal permits.
- (b) Activities under general permit 3 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.4 General Permit 4 - Hazardous site investigation and cleanup

- (a) General permit 4 authorizes activities in freshwater wetlands, transition areas, and State open waters, which are undertaken by the Department or expressly approved in writing by the Department's Site Remediation Program, for the investigation, cleanup or removal of:
  - 1. Hazardous substances as defined in the Department's rules governing hazardous substances at N.J.A.C. 7:1E, Appendix A; or
  - 2. Pollutants, as defined in the New Jersey Water Pollution Control Act implementing rules at N.J.A.C. 7:14A.
- (b) There is no acreage limit on activities under general permit 4. However, disturbance shall be the minimum that is necessary for compliance with the Department's technical requirements for site remediation, N.J.A.C. 7:26E, and mitigation shall be performed for all disturbances of freshwater wetlands or State open waters caused by a cleanup authorized under this general permit except that mitigation is not required to compensate for disturbance of wetlands or State open waters that have formed as a direct result of the remediation activities. The mitigation shall meet the substantive and procedural requirements at N.J.A.C. 7:7A-15.
- (c) The mitigation proposal required under (b) above may be incorporated into the document by which the Department approves the cleanup and/or it may be submitted as part of the General Permit application. The Department shall not issue an authorization under general permit 4 until the mitigation proposal, or an equivalent document that ensures that the requirements of N.J.A.C. 7:7A-15 are met, is approved. Mitigation shall be performed prior to or concurrently with cleanup activities.
- (d) Activities under general permit 4 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.5 General Permit 5 - Landfill closures

- (a) General permit 5 authorizes activities in freshwater wetlands, transition areas and/or State open waters that are undertaken by the Department's Division of Solid and Hazardous Waste, or authorized through a solid waste facility closure and post-closure plan or disruption approval issued by the Department under N.J.A.C. 7:26-2A.9.
- (b) General permit 5 authorizes a disturbance authorized through a closure plan, post-closure plan, or disruption approval only if:
  - 1. The activities that will cause the disturbance are necessary to properly close the solid waste facility and to properly maintain and monitor it after closure. For example, an access road necessary for landfill closure may be authorized under general permit 5, but an access road that is not necessary for landfill closure, but that will facilitate development of the site, is not authorized under general permit 5; and
  - 2. The amount of disturbance is the minimum necessary in order to adequately close and/or maintain the landfill. For example, a disturbance for an access road through wetlands may be necessary to properly close the landfill in accordance with (b)2 above, but the road shall be the minimum size possible.
- (c) There is no acreage limit on activities under general permit 5. However, mitigation shall be performed to compensate for disturbance of freshwater wetlands and/or State open waters authorized under general permit 5, except that mitigation is not required for disturbance of wetlands located on top of the landfill, or on the intermediate or permanent cover of the landfill. The mitigation shall meet the procedural and substantive requirements at N.J.A.C. 7:7A-15.
- (d) The mitigation proposal required under (c) above may be incorporated into the closure and post-closure plan or disruption approval and/or it may be submitted as part of the general permit application.
- (e) The Department shall not issue an authorization under general permit 5 until the mitigation proposal is approved. Activities under general permit 5 shall not begin until the Department has approved the mitigation proposal. Mitigation shall be performed prior to or concurrently with closure or disruption activities.
- (f) Activities under general permit 5 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.6 General Permit 6 - Non-tributary wetlands

- (a) General permit 6 authorizes regulated activities in freshwater wetlands, transition areas adjacent to those wetlands, and/or State open waters, if the freshwater wetlands and/or State open waters are not part of a surface water tributary system discharging into an inland lake or pond, or a river or stream.
- (b) Activities under general permit 6 shall be limited as follows:

1. The activities shall disturb no more than one acre of a freshwater wetland and/or State open water, which is not a water of the United States, as defined at N.J.A.C. 7:7A-1.4;
  2. The activities shall disturb no more than one acre of a transition area; and
  3. The activities shall disturb no more than one-half acre of a freshwater wetland and/or State open water, which is a water of the United States, as defined at N.J.A.C. 7:7A-1.4.
- (c) Activities under general permit 6 shall not take place in any of the following, nor in a transition area adjacent to the following:
1. An exceptional resource value wetland, as described at N.J.A.C. 7:7A-2.4;
  2. A State open water that is a special aquatic site, as defined at N.J.A.C. 7:7A-1.4;
  3. USEPA priority wetlands;
  4. A State open water that is larger than one acre; or
  5. A vernal habitat, as defined at N.J.A.C. 7:7A-1.4.
- (d) Activities under general permit 6 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.7 General Permit 7 - Human-made ditches or swales in headwaters

- (a) General permit 7 authorizes activities in freshwater wetlands that are human-made ditches or in freshwater wetlands that are swales, provided the ditch or swale is located in a headwater. In accordance with the definition of a "swale" at N.J.A.C. 7:7A-1.4, a swale may be naturally occurring or of human construction.
- (b) For the purpose of this section, "headwater" means a water or wetland that is upstream of the point on a non-tidal stream where the average annual flow is less than five cubic feet per second. The Department may estimate this point from available data by using area annual precipitation, area drainage basin maps, and the average annual runoff coefficient, or by similar means. For a stream that is dry for long periods of the year, the Department may establish the downstream boundary of the headwater as that point in the stream where water flow exceeds five cubic feet per second at least 50 percent of the time. In general, the Department considers a water body with a drainage area of less than 50 acres to be a headwater.
- (c) Activities under general permit 7 shall not take place in the following:
1. A ditch or swale that is, or is located within, an exceptional resource value wetlands, as described at N.J.A.C. 7:7A- 2.4; or
  2. A ditch or swale that is, or is located within, a USEPA priority wetland, as defined at N.J.A.C. 7:7A-1.4.

- (d) Activities under general permit 7 shall not result in either of the following:
  - 1. The loss or substantial modification of more than one acre of freshwater wetlands; or
  - 2. A disruption of a surface water connection, resulting in the isolation of wetlands or State open waters which were not isolated at the time of the general permit application.
- (e) Activities under general permit 7 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.8 General Permit 8 - House additions

- (a) General permit 8 authorizes activities in freshwater wetlands and/or transition areas, necessary for the construction of additions or appurtenant improvements to residential dwellings lawfully existing prior to July 1, 1988, provided that the improvements or additions require less than a cumulative surface area of 750 square feet of fill and/or disturbance and will not result in new alterations to a freshwater wetlands outside of the 750 square foot area. General permit 8 does not authorize activities in State open waters.
- (b) To be authorized under general permit 8, an addition or improvement shall be located within 100 feet of the residential dwelling.
- (c) Activities under general permit 8 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.9 General permit 9 - Airport sight line clearing

- (a) General permit 9 authorizes the selective cutting of certain vegetation in freshwater wetlands and transition areas, at a public use aeronautical facility, as defined in the New Jersey Department of Transportation (NJDOT) rules at N.J.A.C. 16:54-1.3.
- (b) General permit 9 authorizes the cutting of vegetation only as necessary to comply with the protected air space provisions for a public use aeronautical facility, mandated by the Federal Aviation Administration (FAA) and set forth in the New Jersey Department of Transportation rules at N.J.A.C. 16:54-4.2.
- (c) General permit 9 covers only activities necessary to enable an aeronautical facility to comply with New Jersey Department of Transportation rules. The cutting of vegetation in wetlands and/or transition areas as part of a project that increases the area of pavement or buildings at an airport is not authorized under general permit 9, and would require an individual permit under this chapter.
- (d) In addition to meeting all applicable application requirements at N.J.A.C. 7:7A-10, an applicant for authorization under general permit 9 shall provide a certification from the Director of the Division of Aeronautics in the New Jersey Department of Transportation, containing:

1. A copy of the current license for the public use aeronautical facility;
  2. A description of the area that must be cleared to ensure compliance with New Jersey Department of Transportation rules, including descriptions and drawings of the required approach slopes, the airport layout, and/or other aspects of the facility, as applicable; and
  3. A statement citing the applicable regulation, and an explanation of why the proposed cutting of vegetation is necessary to bring existing operations into compliance with New Jersey Department of Transportation and FAA rules, or to maintain the compliance of existing operations with those rules.
- (e) The permittee shall minimize adverse environmental impacts as follows:
1. Activities shall be timed to minimize disturbance of threatened and endangered species. The Department will specify the required timing in the general permit authorization when issued;
  2. The permittee shall leave all tree stumps, brush stumps, and root systems in place;
  3. The permittee shall minimize disturbance of freshwater wetlands and transition areas through use of matting, equipment running on oversized tires, or other similar practices; and
  4. Cut vegetation shall be disposed of in a manner that will minimize adverse environmental impacts on wetlands and transition areas, taking into consideration State Forest Fire Service requirements at N.J.S.A. 13:9-23 and/or other applicable laws.
- (f) Activities under general permit 9 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.10A General Permit 10A - Very minor road crossings

- (a) General permit 10A authorizes the following activities in freshwater wetlands, transition areas, and/or State open waters:
1. Construction of one or more new road crossings, including attendant features such as shoulders, sidewalks and embankments;
  2. Expansion, widening, or upgrading of one or more existing paved or unpaved roads or drives; and
  3. Activities necessary to reduce horizontal curves in an existing paved road to comply with New Jersey Department of Transportation safety regulations.
- (b) The Department shall issue a general permit 10A authorization only if the activities comply with the limits in one of the following scenarios:

1. Short crossing scenario:
    - i. The disturbance of freshwater wetlands and/or State open waters is no longer than 100 feet for each crossing, as calculated under (e) below; and
    - ii. The total cumulative disturbance of freshwater wetlands, transition area, and State open waters onsite under general permit 10A is one quarter acre or less; or
  2. Long crossing scenario: The total cumulative disturbance of freshwater wetlands, transition area, and State open waters onsite under general permit 10A is one eighth acre or less. Under the long crossing scenario, the length of the crossing is not limited.
- (c) If a proposed road crossing skirts along the edge of a wetland or transition area or touches the wetland or transition area, without actually crossing through the wetland or transition area, the applicant shall, in addition to meeting the requirements at (b) above, demonstrate in accordance with N.J.A.C. 7:7A-5.10B(d) that there is no alternative onsite location and/or configuration for the road crossing that would provide access to the developable upland with less adverse environmental impact.
- (d) Activities under general permit 10A shall minimize environmental impact as follows:
1. The applicant shall design the crossing to ensure that fish passage is unimpeded during times when the water level is at its lowest, unless the applicant demonstrates that the water body is unsuitable for habitation by fish and will remain so for the foreseeable future. The applicant shall ensure fish passage by maintaining the existing gradient and bottom contours of the water body to the extent possible, and by using arches, culverts, or other structures that will ensure fish passage;
  2. The applicant shall install cross drains or other devices to ensure that the crossing does not alter the hydrology of the freshwater wetlands and/or State open waters on either side of the crossing; and
  3. The amount of rip-rap or other energy dissipating material used shall be the minimum necessary to prevent erosion, and shall not exceed 200 cubic yards of fill below the top of bank or high water mark, unless a larger amount is required in order to comply with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90.
- (e) The length limit at (b)1 above applies to each separate road crossing on the site. The following apply to the calculation of the length of disturbance caused by a road crossing:
1. The length of the disturbance resulting from a crossing is measured along its longest dimension;
  2. A crossing that connects more than two upland areas that are separated by the same wetland or State open water is considered one crossing. That is, a road that repeatedly traverses the same wetland or State open water is considered one crossing. Thus, the total length of disturbance is the sum of all the lengths of crossing that traverse that particular wetland or water. For example, if a road

crosses three arms of an irregularly shaped wetland, the total length of disturbance would be the sum of the lengths of all three crossings. See figures 2 and 3 below for an illustration of this; and

3. If the road crosses State open waters with adjacent wetlands, the total length of disturbance is the sum of the disturbances in both the State open waters and the adjacent wetlands.
- (f) Activities under general permit 10A shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

Figure 2  
One Road Crossing That Crosses Two Fingers Of One Freshwater Wetland

(See figure 2 in the New Jersey Administrative Code.)

Figure 3  
Two Road Crossings, Each Crossing A Different Freshwater Wetland

(See figure 3 in the New Jersey Administrative Code.)

N.J.A.C. 7:7A-5.10B General permit 10B - Minor road crossings

- (a) General permit 10B authorizes the following activities in freshwater wetlands, transition areas, and/or State open waters:
1. Construction of one or more new road crossings, including attendant features such as shoulders, sidewalks and embankments;
  2. Expansion, widening, or upgrading of one or more existing paved or unpaved roads, including attendant features such as shoulders, sidewalks and embankments; and
  3. Activities necessary to reduce horizontal curves in an existing paved road to comply with New Jersey Department of Transportation safety regulations.
- (b) The Department shall issue a general permit 10B authorization only if all of the following criteria are met:
1. The applicant demonstrates in accordance with (d) below that there is no alternative onsite location and/or configuration for the road crossing that would provide access to the developable upland with less adverse environmental impact; and
  2. The total area of freshwater wetlands, transition areas, and/or State open waters disturbed under general permit 10B shall not exceed one quarter of an acre.

- (c) Activities under general permit 10B shall minimize environmental impact as follows:
1. The applicant shall design the crossing to ensure that fish passage is unimpeded during times when the water level is at its lowest, unless the applicant demonstrates that the water body is unsuitable for habitation by fish and will remain so for the foreseeable future. The applicant shall ensure fish passage by maintaining the existing gradient and bottom contours of the water body to the extent possible, and by using arches, culverts, or other structures that will ensure fish passage;
  2. The applicant shall install cross drains or other devices to ensure that the crossing does not alter the hydrology of the freshwater wetlands and/or State open waters on either side of the crossing;
  3. The amount of rip-rap or other energy dissipating material used shall be the minimum necessary to prevent erosion, and shall not exceed 200 cubic yards of fill below the top of bank or high water mark, unless a larger amount is required in order to comply with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90; and
  4. The cartway, shoulder, and side slopes of the roadway shall be the minimum necessary for the crossing and shall not exceed the limits in the New Jersey Department of Community Affairs' Residential Site Improvement Standards at N.J.A.C. 5:21. If the project is not a residential development, the cartway, shoulder, and side slopes of the roadway shall be the minimum necessary for safety.
- (d) In evaluating whether there is an alternative onsite location and/or configuration for a road crossing under (b)1 above, the Department shall make the presumptions at (d)1 through 5 below. However, these presumptions may be rebutted based on site-specific or unusual circumstances:
1. Disturbance of a non-transition area upland would have less adverse environmental impact than disturbance of a transition area, State open water or freshwater wetland;
  2. Disturbance of a transition area would have less adverse environmental impact than disturbance of a freshwater wetland or State open water;
  3. Disturbance of a freshwater wetland would have less adverse environmental impact than disturbance of a State open water;
  4. Expansion or upgrading of an existing and currently serviceable drive or crossing would have less adverse environmental impact than placement of a new crossing; and
  5. Placement of a new crossing in an area that is already significantly disturbed would have less adverse environmental impact than disturbance of a previously undisturbed wetland and/or State open water.
- (e) Activities under general permit 10B shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

N.J.A.C. 7:7A-5.10C Combined general permit 10A and flood hazard area permit

- (a) If an activity authorized under general permit 10A also requires a flood hazard area permit under N.J.A.C. 7:13, the Department shall issue a combined flood hazard area permit and general permit 10A for the activity if all of the following requirements are met:
1. The road crossing meets all requirements for authorization under N.J.A.C. 7:7A-5.10A;
  2. The road crossing meets all requirements for authorization under the Department's Flood Hazard Area Control Act rules at N.J.A.C. 7:13; and
  3. Either of the following criteria is met:
    - i. The site of the road crossing is covered by a valid letter of interpretation showing the boundaries of any wetlands on the site, issued by the Department under N.J.A.C. 7:7A-3; or
    - ii. The road crossing will result in disturbance of State open waters only, and will not involve regulated activities in a freshwater wetland or transition area, as described at N.J.A.C. 7: 7A-2.
- (b) The combined permit provided for under this section shall be subject to the conditions for combined permits found at N.J.A.C. 7:7A-4.6. an application for the combined general permit 10A and flood hazard area permit shall meet the application requirements for combined permits at N.J.A.C. 7:7A-10.7.

7:7A-5.11 General Permit 11 - Outfalls and intake structures

- (a) General permit 11 authorizes activities in freshwater wetlands, transition areas, and State open waters necessary for the construction of:
1. A stormwater outfall structure;
  2. An outfall structure that discharges other than stormwater into state open waters, and which is covered by a valid NJPDES permit issued by the Department under N.J.A.C. 7:14A;
  3. An intake structure located in a State open water, for which all approvals required by the Department other than this general permit authorization have been obtained;
  4. A well that is part of a non-public water system, as defined under the Department's Safe Drinking Water Act rules at N.J.A.C. 7:10-1.3, (this includes certain small private potable water wells) provided that:
    - i. There is no alternative onsite location for the well that would have less environmental impact;

- ii. The source of the water supply to the well does not affect the hydrology of the freshwater wetlands; and
    - iii. All approvals required by the Department other than this general permit authorization have been obtained;
  5. Conveyance structures, such as pipes and headwalls, associated with an outfall or intake listed in 1, 2, or 3 above; and
  6. Energy dissipation structures, such as rip-rap, gabion baskets, and scour holes, associated with an outfall or intake listed in 1, 2, or 3 above.
- (b) General permit 11 does not authorize the construction or placement of a detention or retention facility in freshwater wetlands, transition areas, or State open waters.
- (c) Activities under general permit 11 shall comply with the following limits:
  1. The activities shall disturb no more than one quarter acre of freshwater wetlands, transition areas, and/or State open waters, including both temporary and permanent disturbance;
  2. The area disturbed during construction of a conveyance structure shall be no wider than is necessary to comply with the United States Occupational Safety and Health Administration safety standards for excavations, set forth at 29 CFR Part 1926, Subpart P; and
  3. The amount of rip-rap or other energy dissipating material placed shall be the minimum necessary to prevent erosion, and shall not exceed 10 cubic yards of fill per outfall, unless a larger amount is required in order to comply with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90.
- (d) In addition to meeting all other requirements under general permit 11, an intake structure shall:
  1. Be designed and equipped so as to minimize impacts to fish and other fauna through measures including, but not limited to, the following:
    - i. The structure's location and orientation;
    - ii. Protective structures that prevent entrapment of fauna in the structure itself, or in a diversionary canal or embayment;
    - iii. Protective structures that prevent aquatic biota from being sucked up against the structure (impingement) or being sucked up into the structure (entrainment). Examples of such structures are radial wells, fish bucket screens, and wedge-wires; and
  2. Be designed so as to ensure that the wetlands are not drained;
  3. Have an intake velocity no greater than 0.5 feet of water per second; and

4. Comply with all applicable requirements for intake structures in the Department's Safe Drinking Water Act rules at N.J.A.C. 7:10-11.8(c).
- (e) All activities under general permit 11 shall comply with the specifications and requirements in the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90, including activities which are exempted from or not regulated by those Standards.
  - (f) Stormwater discharged from an outfall authorized under general permit 11 shall be treated in accordance with water quality requirements in the Department's Flood Hazard Area Control Act rules at N.J.A.C. 7:13-2.8.
  - (g) For any excavated area in freshwater wetlands, transition areas, and/or State open waters, the following requirements apply:
    1. The excavation shall be backfilled to the preexisting elevation;
    2. The uppermost 18 inches of the excavation shall be backfilled with the original topsoil material if feasible; and
    3. The area above the excavation shall be replanted, in accordance with applicable BMPs, with indigenous wetlands species.
  - (h) Any pipes laid through wetlands, transition areas, or State open waters shall be:
    1. Properly sealed so as to prevent leaking or infiltration;
    2. Designed so as not to form a path for groundwater to be discharged or drained from the wetland; and
    3. Placed entirely beneath the pre-existing ground elevation unless the applicant shows that placing some or all of the pipe above ground would be more environmentally beneficial.
  - (i) A swale in a wetland or transition area shall not be used as a substitute for stormwater treatment. However, a swale may be used to convey stormwater through a wetland or transition area if:
    1. Conditions on the site make it impracticable to use a buried pipe; and
    2. The applicant demonstrates that the swale will not result in drainage of the wetlands or transition areas. To demonstrate this, the applicant shall provide profiles and cross-sections along the entire length of the swale, and any other information necessary to demonstrate that drainage will not occur.
  - (j) Activities under general permit 11 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.11A Combined general permit 11 and flood hazard area permit

- (a) If an activity authorized under general permit 11 also requires a flood hazard area permit under N.J.A.C. 7:13, the Department shall issue a combined flood hazard area permit and general permit 11 authorization for the activity if all of the following requirements are met:
1. The activities meet all of the requirements for authorization under general permit 11 at N.J.A.C. 7:7A-5.11;
  2. The activities meet the applicable requirements of N.J.A.C. 7:13; and
  3. Either of the following criteria is met:
    - i. The site is covered by a valid letter of interpretation showing the boundaries of any wetlands on the site, issued by the Department under N.J.A.C. 7:7A-3; or
    - ii. The activities will result in disturbance of State open waters only, and will not involve regulated activities in a freshwater wetland or transition area, as described at N.J.A.C. 7:7A-2.
- (b) The combined permit provided for under this section shall be subject to the conditions for combined permits found at N.J.A.C. 7:7A-4.6. An application for the combined general permit 11 and flood hazard area permit shall meet the application requirements for combined permits at N.J.A.C. 7:7A-10.7.

7:7A-5.12 General Permit 12 - Surveying and investigating

- (a) General permit 12 authorizes activities in freshwater wetlands, transition areas and State open waters necessary for surveying and investigative activities such as:
1. Soil borings dug by machine;
  2. Hand dug soil borings larger than three feet in diameter or depth. A hand dug soil boring three feet or less in diameter and depth is not regulated pursuant to N.J.A.C. 7:7A-2.2(c) and thus does not require Department approval;
  3. Cutting of vegetation by machine for a survey line that is no wider than five feet;
  4. Cutting of vegetation by hand for a survey line larger than three feet wide. Cutting of vegetation by hand for a survey line that is three feet wide or less is not regulated pursuant to N.J.A.C. 7:7A-2.2(c) and thus does not require Department approval; and
  5. Digging of exploratory pits and/or other temporary activities necessary for a geotechnical or archaeological investigation.
- (b) Disturbance under general permit 12 shall be the minimum necessary to obtain the desired information.

- (c) If activities under general permit 12 disturb soil, the soil shall be restored to its pre-existing elevation, retaining its original soil layers, unless the soil disturbance is 6 inches in diameter or smaller. This subsection shall not apply if other permits which allow permanent impacts in the same location have been obtained.
- (d) Activities under general permit 12 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.13 General Permit 13 - Lake dredging

- (a) General permit 13 authorizes up to one acre of dredging in palustrine emergent freshwater wetlands, as defined at N.J.A.C. 7:7A-1.4, necessary to restore or maintain a lake, pond, or reservoir, as defined at N.J.A.C. 7:7A-1.4, to its original bottom contours. General permit 13 does not authorize dredging or other disturbances in wetlands that are not palustrine emergent wetlands. General permit 13 does not authorize disturbance of transition areas except as necessary to obtain access to a dredging project pursuant to (e) below.
- (b) In accordance with N.J.A.C. 7:7A-2.2(b), if a dredging project meets all the following criteria, the project does not require Department approval under this chapter:
  - 1. The project disturbs State open waters only, and does not disturb wetlands located in the lake, pond, or reservoir;
  - 2. The project does not disturb wetlands or transition areas adjacent to the lake, pond, or reservoir; and
  - 3. The project does not involve the discharge of dredged or fill material in the State open water. For example, if the project involves placement of fill in a lake bed for an access road, or involves temporary placement of dredged material on the lake bed prior to removal of the dredged material, the project would be regulated and would require Department approval.
- (c) If the lake, pond or reservoir is to be lowered during dredging:
  - 1. The permittee shall obtain a lake lowering permit from the Department's Division of Fish and Wildlife;
  - 2. Regulated activities shall not begin until the lake, pond or reservoir is lowered in accordance with the lake lowering permit; and
  - 3. All regulated activities shall be discontinued before the lake, pond or reservoir is refilled.
- (d) In order to minimize adverse impacts on fish and on the downstream environment, the permittee shall:
  - 1. Take all necessary measures, including adjusting the timing of the dredging, to prevent any detrimental effect to spawning of fish in the lake, pond or reservoir or downstream; and

2. Ensure that there is a continuous flow of sediment-free water to the area downstream of the lake, pond or reservoir at all times during activities under general permit 13.
- (e) The permittee may temporarily disturb wetlands (palustrine emergent or otherwise), transition areas, or State open waters, beyond those disturbed directly by the dredging, in order to obtain vehicular access for the dredging. Disturbance for access shall be limited to one eighth of an acre, unless the applicant demonstrates in accordance with the standards at N.J.A.C. 7:7A-5.10B(d) that there is no alternative onsite location and/or configuration that would provide access to the dredging with less adverse environmental impact. If such a demonstration is made, the access disturbance may be increased as necessary but shall not exceed one quarter acre. All access disturbances under this subsection shall be restored to their pre-existing elevation and condition upon completion of dredging.
  - (f) The application for authorization under general permit 13 shall include:
    1. Documentation, including but not limited to, aerial photography, original construction plans, core borings, and/or other information, showing that dredging will go no deeper than the original configuration and bottom contours of the lake, and will not enlarge the lake beyond the original configuration; and
    2. For a lake larger than five acres, the following information:
      - i. A USGS quad map showing all of the upstream land and water surface area which drains to the lake. The map shall be marked to identify the main land uses in that upstream drainage area;
      - ii. A list of the sources of sediment in the lake, including all stormwater pipes, outfalls, ditches and similar features that discharge directly into the lake or that discharge into a tributary to the lake within 1,000 feet of the lake. The location of each listed source shall be indicated on the map required in (f)2i above; and
      - iii. An estimate of the percentage of that upstream drainage area that is covered by impervious surfaces.
  - (g) The Department shall not authorize activities under general permit 13 more frequently than once every five years for a particular lake, pond or reservoir.
  - (h) The permittee shall dispose of dredged material in accordance with the requirements in the standard conditions for all general permits at N.J.A.C. 7:7A-4.3. The Department may require testing of dredged material if there is reason to suspect that the material is contaminated.
  - (i) Activities under general permit 13 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.14 General Permit 14 - Water monitoring devices

- (a) General permit 14 authorizes the placement and use of the following in freshwater wetlands, transition areas, and State open waters:
  - 1. Water level recording devices;
  - 2. Water quality monitoring and testing devices;
  - 3. Small weirs or flumes for recording water quantity or velocity;
  - 4. The drilling of monitoring wells; and
  - 5. Similar small scientific devices.
- (b) General permit 14 does not authorize any activity that significantly disrupts the movement of aquatic species native to the water body, or of species which normally migrate through the area.
- (c) If an applicant cannot determine at the time of application how many monitoring wells will be needed, the Department may issue a "blanket" authorization under general permit 14 for drilling of monitoring wells, such as those used in cleanups of contaminated groundwater. A "blanket" authorization allows the placement of multiple monitoring wells on a site over the term of the permit authorization, provided that the permittee reports the number and location of all wells to the Department when all of the wells have been drilled. To be eligible for a "blanket" authorization, the monitoring wells must be approved by the Department's Site Remediation Program or by the U.S. Environmental Protection Agency.
- (d) An item listed at (a) above is not regulated under this chapter and therefore does not require Department approval if it meets both of the following criteria:
  - 1. The item is placed into and/or used in State open waters only, and not in freshwater wetlands or transition areas; and
  - 2. The placement and/or use of the item does not involve the placement of fill, as defined at N.J.A.C. 7:7A-1.4.
- (e) Activities under general permit 14 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.15 General Permit 15 - Mosquito control activities

- (a) General permit 15 authorizes activities in freshwater wetlands, transition areas, and State open waters necessary for mosquito control water management activities conducted by a county mosquito control agency, or by a Federal agency on Federal land.
- (b) The agency shall submit an individual, site-specific project proposal to the State Office of Mosquito Control Coordination. If the State Office of Mosquito Control Coordination determines that the project is necessary to control a documented mosquito problem

affecting existing residents, the agency shall submit an application to the Department for authorization to act under general permit 15.

- (c) In conducting activities under general permit 15, an agency shall:
  - 1. Comply with "Best Management Practices for Mosquito Management", issued by the State Mosquito Control Commission, and available from the Department at P.O. Box 400, Trenton, N.J., 08625;
  - 2. Use best management practices including, but not limited to, shallow swales no more than three feet wide, and low sills no more than three feet wide;
  - 3. Minimize disturbance of vegetation; and
  - 4. Use only light equipment.
- (d) The agency shall remove excavated or dredged material. Alternatively, if the agency demonstrates that the material will not alter the character of the wetlands, the agency may spread it evenly in a shallow layer no more than three inches deep.
- (e) The agency shall ensure that excessive drainage does not occur, and that the existing hydrologic condition of the hydric soils is maintained.
- (f) A county agency applying for authorization under general permit 15 shall provide public notice of the application in accordance with this subsection, and shall not be subject to the public notice requirements found at N.J.A.C. 7:7A-10.9. The county agency shall publish a display advertisement describing the proposed general permit activities. The advertisement shall be:
  - 1. At least four column inches in size;
  - 2. Published in a newspaper with local circulation, including the municipality; and
  - 3. Published in a newspaper with regional circulation, including the county.
- (g) The Department shall not authorize activities under general permit 15 more frequently than once every five years for a particular site.
- (h) Activities under general permit 15 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.16 General Permit 16 - Habitat creation and enhancement activities

- (a) General permit 16 authorizes habitat creation and enhancement activities in freshwater wetlands, transition areas, and State open waters, necessary to implement a plan for the restoration, creation or enhancement of the habitat and water quality functions and values of wetlands, which is sponsored or substantially funded by a Federal or State agency or other entity described in (b) below. For the purposes of this general permit, a "sponsor" shall be an active participant in or substantial financial contributor to the activities, and shall approve the activities in writing.

- (b) General permit 16 authorizes any of the following:
1. A fish and/or wildlife management plan created or approved by the Department's Division of Fish and Wildlife;
  2. A project plan approved under the Partners for Fish and Wildlife program, administered by the U.S. Fish and Wildlife Service;
  3. A project plan created by the U.S. Department of Agriculture's Natural Resources Conservation Service under the Wetlands Reserve program, the Conservation Reserve program, the Conservation Reserve Enhancement program, the wildlife habitat incentive program (WHIP), or a similar program, and approved by the local Soil Conservation District;
  4. A plan approved by the Department's Office of Natural Resource Damages for the restoration, creation or enhancement of natural resources injured as the result of an oil spill or release of a hazardous substance;
  5. A mitigation project required by and approved by a government agency, such as the U.S. Army Corps of Engineers;
  6. A habitat creation or enhancement plan carried out by one of the Federal or State agencies at 1 through 5 above or by a government resource protection agency such as a parks commission; or
  7. A habitat creation or enhancement plan carried out by a charitable conservancy, as defined at N.J.A.C. 7:7A-15.1, provided that the plan is part of a program listed at 2 through 5 above.
- (c) To be eligible for authorization under general permit 16, an applicant shall demonstrate that the proposed project:
1. Is part of a comprehensive plan for the restoration, creation or enhancement of the habitat and water quality functions and values of wetlands, transition areas, and/or State open waters;
  2. Is sponsored or partially funded by an appropriate entity in accordance with (b) above;
  3. Is consistent with the goals of the Freshwater Wetlands Protection Act;
  4. Will improve the values and functions of the ecosystem; and
  5. Will have a reasonable likelihood of success.
- (d) General permit 16 does not authorize an activity unless the sole purpose of the activity is habitat creation or enhancement. For example, general permit 16 does not authorize construction of a detention basin in wetlands for stormwater management, even if the detention basin or the project of which the basin is a part will also result in habitat creation

or enhancement. Similarly, general permit 16 does not authorize a flood control project that may also result in creation or enhancement of some wildlife habitat.

(e) Examples of habitat creation and enhancement activities that may be authorized under general permit 16 are:

1. Altering hydrology to restore or create wetlands conditions, such as by blocking, removing, or disabling a human-made drainage ditch or other drainage structure such as a tile, culvert or pipe;
2. Breaching a structure such as a dike or berm in order to allow water into an area;
3. Placing habitat improvement structures such as:
  - i. Nesting islands;
  - ii. Fencing to contain, or to prevent intrusion by, livestock or other animals; and
  - iii. Fish habitat enhancement devices or fish habitat improvement structures such as placed boulders, stream deflectors, or brush piles;
4. Regrading to provide proper elevation or topography for wetlands restoration, creation, or enhancement; and
5. Cutting, burning or otherwise managing vegetation in order to increase habitat diversity or control nuisance flora.

(f) Activities under general permit 16 shall meet the following requirements:

1. The activities shall disturb the minimum amount of freshwater wetlands, transition areas, and/or State open waters necessary to successfully implement the project plan; and
2. The activities shall not decrease the total combined area of freshwater wetlands, State open waters and/or transition areas on a site. However, the Department may approve such a decrease if the Department determines that the activities causing the decrease are sufficiently environmentally beneficial to outweigh the negative environmental effects of the decrease. In addition, the Department may approve conversion of wetlands to State open waters or transition area, conversion of State open waters to wetlands or transition area, or the conversion of transition area to freshwater wetlands or State open waters, if the Department determines that such conversion is environmentally beneficial.

(g) An application for authorization under general permit 16 does not require an application fee under N.J.A.C. 7:7A-11.

(h) If a project complies with general permit 16 and also includes an activity covered under another general permit, the entire project shall be authorized through general permit 16 and shall not require authorization under the other general permit, provided that each activity covered by another general permit complies with that general permit's requirements and limits. For example, if a habitat creation project includes bank stabilization activities,

and meets all requirements of general permit 20 as well as general permit 16, the Department may authorize the project under general permit 16 alone.

- (i) If an activity is exempt under this chapter, it shall not require authorization under general permit 16 solely by virtue of being conducted as part of a program included in (b) above. For example, if a farmer proposes a habitat enhancement project that is eligible for authorization under general permit 16, and some of the activities involved in the project meet the requirements for the farming exemption under N.J.A.C. 7:7A-2.8(c), those activities do not lose their exempt status merely by virtue of being part of a project authorized under general permit 16.
- (j) Activities under general permit 16 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.17 General Permit 17 - Trails and boardwalks

- (a) General permit 17 authorizes activities in freshwater wetlands, transition areas, and/or State open waters necessary for construction of a trail and/or boardwalk for use by pedestrians, bicycles, and other non-motorized methods of transport. General permit 17 does not authorize construction of a restroom, gazebo, rain shelter, or any covered or enclosed structure. General permit 17 does not authorize construction of a roadway for use by automobiles, golf carts, motorcycles, motorized trail bikes, all-terrain vehicles, or other motor vehicles.
- (b) The total area of freshwater wetlands, transition areas, and/or State open waters disturbed under general permit 17 shall not exceed one quarter acre, except that this limit shall not apply to a site that is publicly owned.
- (c) The trail or boardwalk shall be no wider than six feet, unless the applicant demonstrates that it must be wider in order to comply with the Barrier Free Subcode of the Standard Uniform Construction Code, N.J.A.C. 5:23-7.
- (d) The trail or boardwalk shall:
  - 1. Be located and configured so as to minimize adverse environmental impact; and
  - 2. Incorporate features designed to educate the user about the importance of freshwater wetlands, transition areas, and State open waters; for example, through signs identifying plants and animals or explaining hydrology, ecology, or other significant environmental features or phenomena.
- (e) The permittee shall take all measures necessary to ensure that activities under general permit 17 do not interfere with the natural hydrology of the area, such as installation at grade or use of cross drains to allow the passage of water. The permittee shall minimize the impact of the activities on vegetation.
- (f) An application for authorization under general permit 17 for a project on publicly owned land does not require an application fee under N.J.A.C. 7:7A-11.
- (g) Activities under general permit 17 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.18 General Permit 18 - Dam repair

- (a) General permit 18 authorizes activities in freshwater wetlands, transition areas, and State open waters as necessary for the repair, rehabilitation, replacement, maintenance, reconstruction, or removal of a dam, as defined in the Department's dam safety rules at N.J.A.C. 7:20-1.2.
- (b) A dam that is currently serviceable may be repaired, rehabilitated, replaced, maintained or reconstructed under general permit 18. A dam is considered currently serviceable if it meets any of the following criteria:
  - 1. The dam is in use, that is, the dam is impounding water at a normal pool elevation for which it was designed, at the time of submittal of the general permit application;
  - 2. The dam is not in use, and has been out of use for no more than five years prior to submittal of the general permit application; or
  - 3. The dam is not in use, but has been out of use for up to ten years prior to submittal of the general permit application, but the applicant documents that public funding was actively sought for repairs during the ten years.
- (c) A dam that is not currently serviceable, as defined in (b) above, may not be repaired, rehabilitated, replaced, maintained or reconstructed, but may be removed.
- (d) Activities under general permit 18 are subject to the following limits:
  - 1. All activities shall be conducted in accordance with a permit issued pursuant to N.J.A.C. 7:20 by the Department's Dam Safety Section in the Division of Engineering and Construction;
  - 2. There shall be no more than one acre of permanent disturbance of wetlands, transition areas, and/or State open waters. Draining of a State open water or freshwater wetland by removing a dam shall not be considered permanent disturbance under this paragraph;
  - 3. Temporary disturbance shall be the minimum necessary to comply with the dam safety permit;
  - 4. The permittee shall minimize adverse impacts on freshwater wetlands, transition areas, and/or State open waters through the use of best management practices including, but not limited to:
    - i. Disposing of any excess soil, gravel, or other material immediately upon completion of construction. This material shall be disposed of outside of freshwater wetlands, transition areas, State open waters, and areas regulated under the Department's Flood Hazard Area Control Act rules;
    - ii. Backfilling the uppermost 18 inches of any excavation with the original topsoil material;

- iii. Replanting the disturbed area with indigenous wetlands plants;
  - iv. Stabilizing the disturbed area in accordance with the requirements of the appropriate Soil Conservation District; and
5. A repaired, rehabilitated, replaced, maintained or reconstructed dam shall not deviate from its original structure, except for minor deviations due to changes in materials or construction techniques, or deviations required for safety reasons in accordance with the Department's Dam Safety Standards, N.J.A.C. 7:20; and
  6. Activities under general permit 18 shall not increase the normal water surface elevation over the historic elevation as of the date the dam was originally completed.
- (e) If a dam is removed under general permit 18, and the dam owner also owns or controls any of the property containing the lake bottom, the Department may require the owner to execute and record a conservation restriction covering the lake bottom area. The conservation restriction shall prohibit any development or regulated activity for five years from the date the dam is removed, in order to allow the stream corridor and associated wetlands in the lake bottom area to revert to their natural state. The conservation restriction shall include the land covered by the lake bottom, and all associated wetlands, as they exist at the time the dam is removed. When the conservation restriction expires, the Department's jurisdiction under this chapter shall be based on existing conditions on the site.
- (f) Activities under general permit 18 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.19 General Permit 19 - Docks and piers

- (a) General permit 19 authorizes:
1. Activities in freshwater wetlands and/or transition areas necessary to construct or improve a dock or pier on pilings in order to obtain access to State open waters. General permit 19 does not cover docks or piers on pilings in State open waters because the placement of pilings to support a dock or pier in State open waters is not a regulated activity pursuant to N.J.A.C. 7:7A-2.2(c)5 and therefore does not require approval under this chapter; and
  2. Activities in freshwater wetlands, transition areas, and/or State open waters, necessary for the construction of a public boat ramp. Private boat ramps are not covered by this general permit.
- (b) All activities under general permit 19, when combined, shall meet the following criteria, as applicable:
1. For a dock or pier, the activities shall disturb no more than one tenth acre of wetlands and/or transition area. Wetlands or transition area shaded by a dock or pier shall be considered disturbed for the purposes of general permit 19;

2. For a boat ramp, the activities shall disturb no more than one tenth acre of freshwater wetlands, transition areas, and/or State open waters; and
  3. For a dock or pier and a boat ramp on the same site, the combined activities shall disturb no more than one tenth acre of freshwater wetlands, transition areas, and/or State open waters.
- (c) A dock or pier shall be elevated on pilings so that it does not affect the hydrology of the surrounding wetland. In tidal wetlands that are subject to this chapter but not subject to the Department's coastal permitting program under N.J.A.C. 7:7 or N.J.A.C. 7:7E, a dock or pier shall be elevated at least four feet above the ground surface.
- (d) The portion of a dock, pier or boat ramp that crosses freshwater wetlands and/or transition areas shall be perpendicular to the shoreline of the State open waters, unless a different configuration would cause less impact to wetlands and aquatic resources.
- (e) A public dock or pier is a dock or pier which is open to all members of the public. A private dock or pier is a dock or pier which is not a public dock or pier.
- (f) A private dock or pier shall meet the following requirements, in addition to the requirements at (b) through (d) above:
1. There shall be no more than one crossing over wetlands and/or transition areas per lot for dock or pier access. If there is an existing dock on the lot, general permit 19 does not authorize another crossing over wetlands and/or transition areas for dock or pier access. However, general permit 19 does authorize improvements to the portion of the dock or pier that crosses wetlands and/or transition areas, within the limits in general permit 19. In such a case, the total disturbance resulting from the existing dock or pier and additions made under general permit 19 shall not exceed one tenth of an acre; and
  2. The portion of the dock or pier that crosses wetlands and/or transition areas shall be no wider than six feet unless the portion must be wider in order to comply with the Barrier Free Subcode of the Standard Uniform Construction Code, N.J.A.C. 5:23-7, in which case the portion shall be the minimum width necessary to comply.
- (g) An applicant who proposes to build a public dock or pier shall, in addition to meeting the requirements at (b) through (d) above, ensure that the portion of the dock or pier that crosses wetlands and/or transition areas is no more than six feet wide unless:
1. The portion must be wider in order to comply with the Barrier Free Subcode of the Standard Uniform Construction Code, N.J.A.C. 5:23-7, in which case the portion shall be the minimum width necessary to comply; or
  2. The primary purpose of the dock or pier is to provide group instruction or a similar function, in which case the portion of the dock or pier shall be the minimum width necessary to accomplish this purpose.
- (h) An applicant who proposes to build a public boat ramp shall, in addition to meeting the requirements at (b) through (d) above, demonstrate that there is no feasible onsite alternative location that will involve less or no disturbance of wetlands, transition areas, and/or State open waters.

- (i) Activities under general permit 19 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.20 General Permit 20 - Bank Stabilization

- (a) General permit 20 authorizes activities in freshwater wetlands, transition areas, and/or State open waters, necessary to stabilize the bank of a water body in order to reduce or prevent erosion. Examples of bank stabilization activities are the placement of gabions, rip-rap, or geotextiles along a stream bank. General permit 20 does not authorize the channelization of a stream or the stabilization of the bottom of the stream.
- (b) The applicant shall use vegetative or bioengineering stabilization methods unless the applicant demonstrates that, based on the velocity and configuration of the channel or other factors, the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90 require other methods.
- (c) The total cumulative length of water body bank affected by bank stabilization activities under general permit 20 shall meet the applicable length limit below. These limits apply to the total linear footage of stream bank affected, regardless of which side of the stream it is on, or whether the activities are contiguous. For example, a bank stabilization using only rip-rap could disturb one bank of a stream for a distance of 150 feet, or both banks for 75 feet. The applicable length limits are as follows:
  - 1. For bank stabilization activities involving the placement of rip-rap, no more than 150 feet of stream bank;
  - 2. For the following bank stabilization activities, no more than 300 feet of stream bank:
    - i. Soil bioengineering systems for stream bank stabilization set forth at, and performed in accordance with, 650.1601(d)(2) in Chapter 16 of the NRCS Engineering Field Handbook, published December 1996; and
    - ii. Soil bioengineering systems not included in (c)2i above but approved by the Department in writing, which are appropriate to the site and which provide environmental benefits similar to those provided by the measures in (c)2i above. Examples of such measures are the placement of coconut fiber rolls or sand filled textile containers, parallel to the shoreline of a stream bank; and
  - 3. For bank stabilization activities that meet the following criteria, no more than 500 feet of stream bank:
    - i. The activities are funded by the Department's Division of Watershed Management, or are included on an "action now" list, prepared for each region of the State by the Division of Watershed Management. These "action now" lists are available from the Division of Watershed Management at (609) 984-0058; and

- ii. The stream bank is not located in an area that has a threatened or endangered species associated with its wetlands; and
- 4. For vegetative planting measures for stream bank stabilization set forth at, and performed in accordance with, 650.1601(d)(1) in Chapter 16 of the NRCS Engineering Field Handbook, there is no length limit.
- (d) The bank stabilization activities described in (c) above may be used in combination. For example, a bank stabilization project might involve 100 feet of rip-rap authorized under (c)1 above, 300 feet of soil bioengineering authorized under (c)2i above, and 400 feet of vegetative planting measures authorized under (c)3i above.
- (e) A permittee shall minimize environmental impacts as follows:
  - 1. Activities under general permit 20 shall not impair surface water flow into or out of any wetland area;
  - 2. If wetlands or transition areas must be disturbed to provide access to stabilization activities, the area disturbed shall be the minimum necessary, and shall be no wider than 20 feet at any point;
  - 3. The Department shall allow replacement of previously eroded material as part of the bank stabilization only if the applicant demonstrates that such replacement would be environmentally beneficial;
  - 4. Activities under general permit 20 shall comply with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90;
  - 5. The activity shall be a single and complete project, not associated with any other regulated activity. For example, the bank stabilization activity cannot be conducted at the same location as a minor road crossing or a stormwater outfall structure; and
  - 6. The amount of rip-rap or other stabilization material placed shall be the minimum necessary to prevent erosion, and shall not exceed 150 cubic yards of fill below the top of bank or high water mark, unless a larger amount is required in order to comply with the Standards for Soil Erosion and Sediment Control in New Jersey at N.J.A.C. 2:90.
- (f) Activities under general permit 20 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.20A Combined general permit 20 and flood hazard area permit

- (a) If an activity authorized under general permit 20 also requires a flood hazard area permit under N.J.A.C. 7:13, the Department shall issue a combined flood hazard area permit and general permit 20 authorization for the activity if it meets the requirements for authorization under general permit 20 at N.J.A.C. 7:7A-5.20 and also meets the applicable requirements of the Department's Flood Hazard Area Control Act rules at N.J.A.C. 7:13.

- (b) The combined permit provided for under this section shall be subject to the conditions for combined permits found at N.J.A.C. 7:7A-4.6. An application for the combined general permit 20 and flood hazard area permit shall meet the application requirements for combined permits at N.J.A.C. 7:7A-10.7.

7:7A-5.21 General permit 21- Above ground utility lines

- (a) General permit 21 authorizes the following activities in freshwater wetlands, transition areas, and/or State open waters, necessary for the construction of an above ground utility line, as defined at N.J.A.C. 7:7A-1.4:
1. Installation of poles, towers, or other supports from which to suspend a pipe, wire or cable;
  2. Construction of a pad mounted transformer;
  3. Placement of an above ground pipe, wire or cable;
  4. Clearing of vegetation under and around utility lines, within the limits at (b) below; and
  5. Minor, temporary disturbances, as defined at N.J.A.C. 7: 7A-1.4, necessary for access during construction.
- (b) Activities under general permit 21 shall comply with the following limits:
1. Temporary disturbance of freshwater wetlands, transition areas, and/or State open waters during construction shall be no more than sixty feet wide, including vegetative clearing and disturbance for access under (a)5 above; and
  2. Permanent disturbance of freshwater wetlands, transition areas, and/or State open waters, including the area of vegetative clearing to be maintained underneath the utility line, shall be:
    - i. No greater than one acre; and
    - ii. No wider than twenty feet, unless the applicant demonstrates that a wider disturbance is necessary to comply with applicable laws.
- (c) Activities under general permit 21 shall not interfere with the natural hydrologic characteristics of the wetland, transition area, or State open water. The applicant shall place the utility line on pilings if necessary, in order to satisfy this condition.
- (d) After the utility line is constructed, any freshwater wetlands, transition areas, or State open waters disturbed, which are not within the cleared area to be maintained under (b)2 above, shall be allowed to revert to their natural condition.
- (e) Activities under general permit 21 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.22 (Reserved)

7:7A-5.23 General permit 23 - Expansion of cranberry growing operations in the Pinelands

- (a) General permit 23 authorizes the expansion of certain cranberry growing operations in the Pinelands. To be eligible for authorization under the general permit, the cranberry growing operation must be a single, discrete legal entity that, prior to the date general permit 23 becomes operative under (u) below:
1. Is located in the Pinelands, as defined at N.J.A.C. 7:50-2.11;
  2. Is in active cranberry production; and
  3. Was reported as a cranberry growing operation to the United States Department of Agriculture Cranberry Marketing Committee under the Federal Cranberry Marketing Order (7 C.F.R. Part 929, as amended).
- (b) Activities authorized under general permit 23 include, but are not limited to, the construction or expansion of a bog, reservoir, canal, ditch, dike, tail water recovery system, water quality improvement system, or other similar support type facility. General permit 23 does not authorize:
1. Construction or expansion of maintenance or storage sheds;
  2. Construction or expansion of housing; or
  3. Establishment of new sites for storing or stockpiling sand or other materials.
- (c) The Department shall authorize activities under general permit 23 only if the activities will be conducted on the area with the lowest number ranking on the list at (d) below, which is available and has the following characteristics:
1. The area is water accessible, that is, has direct access to free drainage and can be directly served by existing sources of water, or can feasibly be connected to a water source. The Natural Resources Conservation Service can assist the applicant in determining whether an area is water accessible. To minimize environmental impact, areas which can reasonably be served by existing infrastructure are preferred; and
  2. Has access to a water supply with a minimum flow rate of 227 gallons per minute per acre (that is, one acre foot of water for every bog acre in production per day).
- (d) For the purposes of general permit 23, State open waters and wetland types are ranked in the order that they shall be considered for use for the expansion of a cranberry growing operation, as follows:
1. State open waters;
  2. Abandoned blueberry fields;

3. Abandoned cranberry bogs;
  4. Abandoned agricultural fields;
  5. Freshwater wetlands dominated by emergent vegetation;
  6. Freshwater wetlands dominated by scrub/shrub vegetation;
  7. Forested freshwater wetlands that are not Atlantic white-cedar wetlands; and
  8. Atlantic white-cedar wetlands.
- (e) For the purposes of general permit 23, if a freshwater wetlands area was forested, but the trees have been harvested within the five years immediately preceding submittal of an application for authorization, the area is considered forested.
- (f) The Department shall not issue more than one authorization under general permit 23 per year to a single cranberry growing operation.
- (g) The Department shall not issue an authorization under general permit 23 for activities that will cause a net loss of freshwater wetlands at a single cranberry growing operation.
- (h) The Department shall limit authorizations issued to any single cranberry growing operation under general permit 23 so as to ensure that the loss and/or disturbance of freshwater wetlands and/or State open waters at that single operation meets all of the following criteria:
1. No more than ten acres of freshwater wetlands and/or State open waters shall be lost and/or disturbed in any one year;
  2. No more than ten acres of forested freshwater wetlands shall be lost and/or disturbed over the five year term of general permit 23; and
  3. No more than four of the 10 acres lost and/or disturbed under (h)2 above shall be Atlantic white-cedar wetlands.
- (i) The Department shall limit authorizations issued Statewide so as to ensure that the total Statewide loss and/or disturbance of freshwater wetlands and/or State open waters under general permit 23 meets all of the following criteria:
1. No more than 60 acres of freshwater wetlands and/or State open waters shall be lost and/or disturbed in any one year that general permit 23 is operative, except that if the Department authorizes fewer than 60 acres of loss and/or disturbance in any year, up to 30 acres of unused loss or disturbance may be carried forward to a subsequent year, but in no case shall more than 90 acres of freshwater wetlands and/or State open waters be lost or disturbed in one year;
  2. No more than 300 acres of freshwater wetlands and/or State open waters shall be lost and/or disturbed during the five year term of general permit 23;

3. No more than 80 of the 300 acres lost and/or disturbed under (i)2 above shall be forested freshwater wetlands; and
  4. No more than 25 of the 80 acres of forested freshwater wetlands lost and/or disturbed under (i)3 above shall be Atlantic white-cedar wetlands.
- (j) If an applicant proposes activities under general permit 23 that will result in the loss and/or disturbance of Atlantic white-cedar wetlands, the applicant shall, in addition to meeting all other requirements, demonstrate that there is no suitable upland area available, which is owned by the applicant, which the applicant could use in order to eliminate or minimize impacts to Atlantic white-cedar wetlands. For purposes of this subsection, a suitable upland area is an upland area which meets all of the following criteria:
1. The area is water accessible, as described at (c)1 above, and has adequate water as required at (c)2 above;
  2. Soils of the area are composed of Klej, Lakehurst, Pemberton, Hammonton, Woodstown or other soil types that are somewhat poorly drained or moderately well drained, as defined in the applicable county soil survey, published by the United States Department of Agriculture's Natural Resources Conservation Service, as amended and/or supplemented;
  3. The seasonal high water table is within 24 inches of the surface; and
  4. All of the soil to be excavated can be used in the construction of new bogs and sanding operations, or, if the soil cannot be used for construction, a storage or disposal site is available.
- (k) If an applicant proposes activities under general permit 23 in an Atlantic white-cedar wetlands that is larger than five acres, the applicant shall, in addition to meeting all other requirements of this section, submit a written statement from the Natural Resources Conservation Service that the activities will minimize, to the extent feasible, the impacts to the remaining Atlantic white-cedar wetlands.
- (l) If an applicant proposes activities that will result in the loss and/or disturbance of more than one half acre of freshwater wetlands and/or State open waters, the applicant shall transfer Pinelands Development Credits (PDCs) to the Department in accordance with the following:
1. The applicant shall transfer PDCs in the following ratios to acres of loss and/or disturbance:
    - i. For Atlantic white-cedar wetlands, four tenths of a PDC for every acre of loss and/or disturbance;
    - ii. For forested freshwater wetlands that are not Atlantic white-cedar wetlands, fifteen one hundredths of a PDC for every acre of loss and/or disturbance;
    - iii. For emergent or scrub/shrub wetlands, one tenth of a PDC for every acre of loss and/or disturbance; and

- iv. For wetlands that are abandoned blueberry, cranberry, or agricultural fields, or State open waters, zero PDCs;
2. Each portion of the site that is one quarter acre or larger shall be assigned its own PDC requirement, and these requirements shall be summed to calculate the PDC requirement for the entire site. A portion smaller than one quarter acre will be given the ranking of the area surrounding it. For example, an applicant may have three acres of state open waters, and one eighth acre of Atlantic white-cedar wetlands surrounded by eight and seven eighths acres of scrub/shrub wetlands. The disturbance of the state open waters requires no PDCs under (l)1iv above. The one eighth acre of Atlantic white-cedar wetlands is smaller than one quarter acre and therefore is treated as part of the surrounding scrub/shrub wetlands. Under (l)1iii above, nine tenths of a PDC are required for the disturbance of the scrub/shrub wetlands. This would be the total for the site; and
  3. The total PDC requirement for the site shall be rounded up to the nearest one quarter PDC. Under the example at 2 above, the PDC requirement for the entire site is nine tenths of a PDC, which would then be rounded up to one PDC.
- (m) The applicant shall transfer any PDCs required under (l) above to the Department, or to a nonprofit or governmental agency designated by the Department, prior to beginning activities authorized under general permit 23, and no later than 90 days after receiving the general permit authorization. The Department or its designee shall convey the PDCs to the Pinelands Development Credit Bank in accordance with the MOA established under (n) below, and shall use the resulting funds to establish and/or restore Atlantic white-cedar wetlands in the Pinelands.
- (n) The Department shall enter into a memorandum of agreement (MOA) with the Pinelands Commission and the Pinelands Development Credit Bank. The MOA shall include a general plan for implementing the Atlantic white-cedar restoration program required by this section, and shall:
1. Identify at least one potential site for Atlantic white-cedar restoration;
  2. Include a requirement for at least one acre of Atlantic white-cedar restoration for each acre of Atlantic white-cedar wetlands lost and/or disturbed under general permit 23;
  3. Include clear success criteria for the Atlantic white-cedar restoration program; and
  4. Ensure that Atlantic white-cedar restoration efforts will not adversely impact existing areas of forested wetlands.
- (o) To minimize impacts to freshwater wetlands and/or State open waters, a permittee under general permit 23 shall:
1. Follow, to the maximum extent practicable, the management practices recommended by the Rutgers Cranberry and Blueberry Experiment Station;
  2. Stabilize all disturbed areas in accordance with the New Jersey Field Office Technical Guide, 1998 edition, as amended and supplemented, issued by the U.S.

Department of Agriculture's Natural Resources Conservation Service (NRCS), available from the NRCS at 1370 Hamilton Street, Somerset, New Jersey 08873;

3. Use only suitable, clean, non-toxic fill material;
  4. Use integrated pest management techniques; and
  5. Design and carry out the activities to avoid irreversible adverse impacts on the survival of any local populations of threatened or endangered plants of the Pinelands, consistent with the Pinelands Comprehensive Management Plan at N.J.A.C. 7:50-6.27.
- (p) The requirements of (c), (j), (k), (l), and (m) above shall not apply to the proposed activities under general permit 23 if the Department determines that the activities:
1. Will improve water conservation or water quality; and
  2. Will result in a loss and/or disturbance of one half acre or less of freshwater wetlands and/or State open waters at that cranberry growing operation during the five year term of the general permit.
- (q) Each year, the Commissioner shall make a finding as to whether the pace of impacts under the general permit is proportional to the pace of Atlantic white-cedar restoration efforts. The Commissioner shall consult with the Pinelands Commission, and shall consider, among other factors, whether restoration efforts are making reasonable progress towards the goals in the Department's overall plan for Atlantic white-cedar restoration. The Department shall publish the Commissioner's finding as a public notice in the New Jersey Register by October 31 of each year:
1. If the Commissioner finds that the pace of impacts is proportional to the pace of restoration efforts, the Department shall publish a finding of continuance of the general permit. A finding of continuance shall remain in effect until the next October 31 following the publication of the finding; or
  2. If the Commissioner finds that the pace of impacts is out of proportion to the pace of Atlantic white-cedar restoration efforts, the Department shall publish a finding of temporary hold of general permit authorizations, and shall stop issuing authorizations under general permit 23. A finding of temporary hold shall remain in effect until the Commissioner determines that the pace of impacts under the general permit has again become proportional to restoration efforts, and the Department publishes a finding of continuance.
- (r) The Commissioner reserves the right (i.e., discretion) to modify, suspend, or revoke general permit 23 authorizations. Modification means the imposition of additional or revised terms or conditions on the authorization. Suspension means the temporary cancellation of the authorization while a decision is made to either modify, revoke, or reinstate the authorization. Revocation means the cancellation of the authorization. The Commissioner may assert discretionary authority by modifying, suspending, or revoking general permit 23 authorizations for a specific geographic area or class of waters, whenever the Commissioner determines sufficient concerns for the environment under the Freshwater Wetlands Protection Act or the Federal Section 404(b)(1) Guidelines, or if the

Commissioner otherwise determines that the general permit would result in more than minimal adverse environmental effects either individually or cumulatively. Whenever the Commissioner determines that a proposed specific activity covered by general permit 23 would have more than minimal individual or cumulative adverse effects on the environment, the Commissioner must either modify the general permit 23 authorization to reduce or eliminate the adverse impacts, or notify the prospective permittee that the proposed activity is not authorized by general permit 23 and provide instructions on how to seek authorization under an individual permit. The Commissioner will restore authorization under general permit 23 at any time that the Commissioner determines that the reason for asserting discretionary authority has been satisfied by a condition, project modification, or new information.

- (s) An application for authorization under general permit 23 shall be submitted within 90 days after the general permit becomes operative under (u) below. Within 180 days after general permit 23 becomes operative, the Department shall make a final decision on all applications submitted within the 90 day deadline. Thereafter, applications shall be submitted to the Department by January 1 of each year. The Department shall issue decisions on applications by March 1 of each year.
- (t) If the Department receives applications for authorization under general permit 23 which would, if approved, result in a total Statewide loss and/or disturbance of freshwater wetlands and/or State open waters that exceeds the limits at (i) above, the Department shall give priority to applications involving areas with the lowest number rankings on the list at (d) above, taking into consideration overall environmental impacts. If two or more applications involve similarly ranked land and similar environmental impacts, the Department shall give priority to the application submitted and determined complete under N.J.A.C. 7:7A-9.5(d) first.
- (u) General permit 23 shall become operative as of the date that the Department publishes a notice in the New Jersey Register announcing that:
  - 1. The Department has signed the Memorandum of Agreement required under (n) above; and
  - 2. Twenty-five thousand dollars has been deposited from public sources to the fund established by the Department under the Memorandum of Agreement for the implementation of the Atlantic white-cedar restoration program.
- (v) In order to ensure compliance with the Endangered Species Act of 1973, 16 U.S.C. 1531 et seq., general permit 23 will be added to the list of general permits subject to coordination procedures with the U.S. Fish and Wildlife Service under the Department's Memorandum of Agreement regarding the Endangered Species Act and New Jersey's assumption of the Federal 404 program.

#### 7:7A-5.24 General permit 24 - Spring developments

- (a) General permit 24 authorizes activities in farmed wetlands, or in State open waters, necessary for the construction of a spring development or other structure that diverts or collects water for the purpose of watering livestock. Activities authorized under general permit 24 include the installation of a collecting trench, a cutoff wall, crushed rock,

perforated tubing, and/or a spring box. General permit 24 does not authorize diversion or use of water for irrigation, or for any purpose other than watering livestock. The activities authorized under general permit 24 constitute soil and water conservation practices that are exempt in transition areas under N.J.A.C. 7:7A-2.8(c)1.

- (b) Activities under general permit 24 shall disturb no more than one quarter acre of freshwater wetlands and/or State open waters. Activities under general permit 24 shall not drain, or remove from jurisdiction, any additional or adjacent wetlands other than the one quarter acre directly impacted by the general permit activities.
- (c) An activity is authorized under general permit 24 only if:
  - 1. The activity is necessary to implement a farm management plan developed by the Natural Resources Conservation Service and approved by the appropriate Soil Conservation District;
  - 2. The activity will be conducted at an established, ongoing farming, ranching or silviculture operation, as defined at N.J.A.C. 7:7A-1.4; and
  - 3. The activity is located in a farmed wetland, as defined at N.J.A.C. 7:7A-1.4, that is eligible for a farmland assessment under the New Jersey Farmland Assessment Act, N.J.S.A. 54:4-23.1 et seq.
- (d) Any portion of a spring development from which livestock will drink, such as a watering trough or tub, shall be located outside of wetlands and State open waters.
- (e) Activities under general permit 24 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.25      General permit 25 - Malfunctioning individual subsurface sewage disposal (septic) systems

- (a) General permit 25 authorizes activities in freshwater wetlands and transition areas necessary for the repair or modification of a malfunctioning individual subsurface sewage disposal system. General permit 25 does not authorize activities in State open waters.
- (b) For the purpose of general permit 25:
  - 1. "Individual subsurface sewage disposal system" means a system for disposal of sanitary sewage into the ground which is designed and constructed to retain most of the settleable solids in a septic tank and to discharge the liquid effluent to a disposal field. This does not include outhouses, dry wells or similar facilities; and
  - 2. "Malfunctioning" means that the use is impaired, and the system is not functioning to treat sewage as it was designed.
- (c) All activities under general permit 25 on the site shall disturb no more than one quarter acre of freshwater wetlands and/or transition areas combined.
- (d) The Department shall not authorize activities under general permit 25 if the need for repair or modification is directly or indirectly caused by an expansion of the facility the individual

subsurface sewage disposal system serves, or by a change in its use, including a change from disuse or abandonment to any type of use.

- (e) Activities under general permit 25 are not subject to the application contents requirements at N.J.A.C. 7:7A-10, except for the public notice requirements at N.J.A.C. 7:7A-10.9, and there is no application fee for an authorization under general permit 25. Instead, an applicant for authorization under general permit 25 shall submit the following in writing to the Department, at least thirty days prior to starting work:
1. A description and plan of the activities;
  2. The location of the site, including the county and municipality, and the block and lot; and
  3. A letter from the local board of health with jurisdiction over the individual subsurface sewage disposal system, stating that:
    - i. The proposed activities are authorized under, and comply with, the Department's Standards for Individual Subsurface Sewage Disposal Systems at N.J.A.C. 7:9A;
    - ii. The proposed activities are not directly or indirectly caused by an expansion of the facility the individual subsurface sewage disposal system serves, or a change in its use; and
    - iii. There is no alternative location on the site that:
      - (a) Has a seasonal high water table deeper than one and one half feet below the existing ground surface; and
      - (b) Can be used for a subsurface sewage disposal system.
- (f) Upon receipt of an application under general permit 25, the Department shall process the application as follows:
1. Within 20 days of the Department's receipt of the application, the Department shall notify the applicant if the application is not administratively complete (that is, if it does not include all of the information required under (d) above). If the Department so notifies the applicant, the time period in (e)2 below shall not begin to run. If the Department does not so notify the applicant, the application shall be deemed administratively complete 20 days after the Department receives it; and
  2. If the application includes all of the information required under (d) above, the Department shall have 30 days after receipt of the complete application to notify the applicant that the activities are not authorized under general permit 25, or that the activities may be authorized but require a full application review under N.J.A.C. 7:7A-10. If the Department does not so notify the applicant, the application is automatically approved, to the extent that the activity does not violate other laws then in effect.

- (g) Activities under general permit 25 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

7:7A-5.26 General permit 26 - Minor channel or stream cleaning for local government agencies

- (a) General permit 26 authorizes a county, municipality or a designated agency thereof to conduct activities in freshwater wetlands, transition areas and State open waters within their jurisdiction, necessary to remove accumulated sediment, debris and garbage from a channel or stream in order to remove obstructions to flow, or to desnag the channel or stream.
- (b) To be authorized under general permit 26, a channel or stream cleaning, clearing, or desnagging project shall meet all of the following criteria:
1. The sole purpose of the activities is to remove obstructions to flow, or to desnag a channel or stream;
  2. The activities are necessary and in the public interest;
  3. The activities will disturb only the channel or stream bed, and shall not disturb the stream bank or its vegetation, except in areas necessary to gain access to the channel or stream. Where access is needed, disturbance to the stream bank and its vegetation shall be the minimum necessary for access;
  4. The activities shall not alter the natural banks of the stream. Such modification may in some cases be authorized under general permit 20. General permit 26 does not authorize the straightening or realignment of a channel or stream. Straightening or realignment constitutes channel modification and requires an individual permit;
  5. The activities shall consist only of:
    - i. The removal of accumulated sediment, debris and/or garbage from a channel or stream with a natural bed. General permit 26 does not authorize removal of material below the natural bottom; or
    - ii. The removal of any accumulated material from a channel or stream previously channelized with concrete or similar artificial material;
  6. The permittee shall make every effort to perform work from only one stream bank;
  7. The permittee shall ensure that the use of heavy equipment within the stream channel is avoided to the maximum extent practicable; and
  8. The permittee shall ensure that vegetation and tree canopy on the more southerly or westerly stream banks is preserved in order to shade the channel or stream.
- (c) If a channel or stream cleaning, clearing, or desnagging project involves removal of sediment, it shall meet all of the requirements at (b) above, and in addition, the affected portion of the channel or stream shall meet all of the following criteria:

1. It is less than 500 feet long;
  2. The channel or stream bed is 15 feet or less in average width;
  3. The channel or stream has a documented history of flooding that is sufficiently severe so that the flooding results, or can result, in property damage necessitating the proposed cleaning, clearing, or desnagging;
  4. The stream is not classified as a Pinelands water or category one water under the Department's Surface Water Quality Standards at N.J.A.C. 7:9B; and
  5. The stream is not located in an area that has a threatened or endangered species, as defined at N.J.A.C. 7:7A-1.4, associated with its wetlands.
- (d) All materials, including dredged material, removed from a channel or stream during activities authorized under general permit 26 shall be disposed of outside of freshwater wetlands, transition areas, State open waters, and areas regulated under the Department's Flood Hazard Area Control Act rules at N.J.A.C. 7:13, unless the applicant demonstrates that this would cause more environmental harm than disposing of the material in these areas. For example, if removal of dredged material requires construction of a long temporary road through a very wet area to enable trucks to transport the dredged material offsite, this might cause more environmental harm than using a large blower to spread the dredged material thinly over a large area of wetlands.
- (e) Activities under general permit 26 are not subject to the application requirements in N.J.A.C. 7:7A-10, except for the public notice requirements at N.J.A.C. 7:7A-10.9. An application for authorization under general permit 26 shall include the following:
1. The location of the affected portion of the channel or stream, including the county and municipality, and the block(s) and lot(s);
  2. A USGS quad map showing the affected portion of the stream;
  3. Color photographs and a brief narrative description of the affected portion of the channel or stream, including the access points where workers and equipment will be brought to the channel or stream;
  4. The classification, under the Department's Surface Water Quality Standards, N.J.A.C. 7:9B, of the affected portion of the channel or stream;
  5. A description of the nature of the project and the methods that will be used;
  6. A description of the disposal location and methods for all material that will be removed from the channel or stream;
  7. Documentation that the public notice requirements of N.J.A.C. 7:7A-10.9 have been met; and
  8. A certification that meets both of the following criteria:

- i. The certification is signed by a licensed professional engineer who is the county or municipal engineer, or who is employed by the appropriate Soil Conservation District; and
  - ii. The certification lists each condition in (b), (c) and/or (d) above that applies to the project, and states whether the condition has been satisfied or will be satisfied.
- (f) Within 15 days of the Department's receipt of an application submitted under (e) above for a project that does not involve sediment removal, the Department shall do one of the following:
  1. Notify the applicant either that the application is not administratively complete (that is, that it does not include all of the information required under (e) above), or that the application is administratively complete but that the application requires a full application review under N.J.A.C. 7:7A-10. If the application is not administratively complete, the Department shall request more information. If the application requires a full application review, the Department shall provide the applicant with the reasons for this. For example, an application may require a full review because of a sighting of a threatened or endangered species which must be investigated;
  2. Notify the applicant that the project does not qualify for authorization under general permit 26; or
  3. Take no action. If the Department takes no action, the channel or stream cleaning project is authorized under general permit 26 to the extent that the project does not violate other laws then in effect.
- (g) Within 60 days of the Department's receipt of an application submitted under (e) above for a project that does involve sediment removal, the Department shall do one of the following:
  1. Notify the applicant that the application is not administratively complete (that is, that it does not include all of the information required under (e) above) and request more information;
  2. Notify the applicant that the project does not qualify for authorization under general permit 26; or
  3. Take no action. If the Department takes no action, the channel or stream cleaning project is authorized under general permit 26 to the extent that the project does not violate other laws then in effect.
- (h) If the Department notifies the applicant under (f)2 or (g)2 above that a channel or stream cleaning, clearing, or desnagging project is not authorized under general permit 26, the Department shall provide the applicant with the technical reasons for the decision. If the Department's technical reasons are based upon the inability to determine the natural stream bed, the Department shall, at the request of the applicant, assist in identifying the natural stream bed.
- (i) Upon completion of a project under general permit 26 that involves the removal of sediment, the permittee shall submit to the Department a written notice that the project has

been completed. The notice shall contain a certification that meets both of the following criteria:

1. The certification is signed by a licensed professional engineer who is the county or municipal engineer, or who is employed by the appropriate Soil Conservation District; and
  2. The certification states each condition in (b), (c) and/or (d) above that applies to the project, and states whether the condition has been satisfied.
- (j) Activities under general permit 26 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

#### 7:7A-5.26A Combined general permit 26 and flood hazard area permit

- (a) If an activity authorized under general permit 26 also requires a flood hazard area permit under N.J.A.C. 7:13, the general permit 26 authorization shall constitute a combined freshwater wetlands general permit authorization and flood hazard area permit for the project.
- (b) The combined permit provided for under this section shall be subject to the conditions for combined permits found at N.J.A.C. 7:7A-4.6. An application for the combined general permit 26 and flood hazard area permit shall meet the application requirements for an authorization under general permit 26, set forth at N.J.A.C. 7:7A-10.

#### 7:7A-5.27 General permit 27- Redevelopment of previously disturbed areas

- (a) General permit 27 authorizes the disturbance of certain degraded freshwater wetlands, transition areas, and/or State open waters necessary for redevelopment, as defined at N.J.A.C. 7:7A-1.4, of an area previously significantly disturbed by industrial or commercial activities.
- (b) General permit 27 authorizes activities only if:
  1. The activities are located in wetlands that were previously disturbed or were formed as a result of previous disturbance by commercial or industrial activities;
  2. The area is abandoned or underutilized;
  3. The area meets at least one of the following criteria:
    - i. It has been identified on the inventory of brownfield sites compiled by the Brownfields Redevelopment Task Force pursuant to N.J.S.A. 58:10B-23b;
    - ii. It is the subject of a redevelopment agreement entered into pursuant to N.J.S.A. 58:10B-27;
    - iii. It has been identified as an environmental opportunity zone pursuant to N.J.S.A. 54:4-3.150 et seq.; and

4. The freshwater wetlands, transition areas, and/or State open waters to be disturbed are significantly degraded by human disturbance or alteration and are of little ecological value. Examples of significantly degraded wetlands are those that have formed as a result of a landfill cap, ponding of contaminated ground or surface water, or as a result of demolition of structures on a previously developed site.
- (c) Activities under general permit 27 shall be limited as follows:
1. The activities shall disturb no more than one acre of a freshwater wetland, and/or State open water, which is not a water of the United States, as defined at N.J.A.C. 7:7A-1.4;
  2. The activities shall disturb no more than one acre of a transition area; and
  3. The activities shall disturb no more than one-half acre of a freshwater wetland and/or State open water, which is a water of the United States, as defined at N.J.A.C. 7:7A-1.4.
- (d) If activities under general permit 27 disturb more than one half acre of freshwater wetlands or State open waters, the applicant shall perform mitigation under N.J.A.C. 7:7A-15 for all of the disturbance authorized under general permit 27.
- (e) A disturbance authorized under general permit 27 does not count toward the one acre of disturbance allowed under multiple general permits under N.J.A.C. 7:7A-1.4.
- (f) Activities under general permit 27 shall comply with all applicable requirements at N.J.A.C. 7:7A-4.3, Conditions that apply to all general permits.

## SUBCHAPTER 6 TRANSITION AREA WAIVERS

### 7:7A-6.1 General transition area waiver provisions

- (a) This section sets forth the requirements for transition area waivers. The Department issues the following types of transition area waivers:
1. An averaging plan transition area waiver, addressed at N.J.A.C. 7:7A-6.2;
  2. A special activity transition area waiver for stormwater management, linear development, redevelopment, or activities eligible for an individual permit, addressed at N.J.A.C. 7:7A-6.3;
  3. A matrix type width reduction transition area waiver, addressed at N.J.A.C. 7:7A-6.4;
  4. A hardship transition area waiver, addressed at N.J.A.C. 7:7A-6.5;
  5. A general permit transition area waiver. If a general permit authorizes disturbance of a transition area, an authorization issued under the general permit constitutes a transition area waiver for the activities covered by the general permit. This waiver is

not addressed in this section, but in each general permit in N.J.A.C. 7:7A-5 that covers transition area disturbances. All general permits except for general permits 1, 7, 22 and 24 authorize activities in transition areas; and

6. An access transition area waiver. Each general permit authorization, individual freshwater wetlands permit and mitigation proposal shall include a limited transition area waiver to allow access to the authorized activity. No fee or application is required for this waiver. However, an access transition area waiver will allow regulated activities only:
    - i. In that portion of the transition area bordering on that portion of the freshwater wetland in which the authorized activity is to take place; and
    - ii. For an activity that the Department determines is necessary to accomplish the permitted activity. An activity not directly required in order to obtain access to the permitted activity shall require a separate transition area waiver.
- (b) Some transition area waivers change the shape or size of a transition area, while others do not change the transition area, but allow regulated activities in the transition area, as follows:
1. A matrix type width reduction transition area waiver reduces the width of a transition area on a site without changing its shape;
  2. An averaging plan transition area waiver changes the transition area shape without changing its size; and
  3. A special activity transition area waiver, hardship transition area waiver, general permit transition area waiver, and access transition area waiver allow regulated activities within a transition area. These waivers do not reduce the size or change the shape of the transition area. The waiver merely allows the specified regulated activities to be performed in the transition area.
- (c) Placement of a building or structure immediately adjacent to a transition area inevitably results in regulated activities occurring in the transition area during construction and use of the building, resulting in a substantial adverse impact on the freshwater wetland. Therefore, the Department shall not issue a transition area matrix type width reduction transition area waiver or averaging plan transition area waiver that will result in the following, unless the requirements of (d) below are met:
1. Construction of a non-residential building or structure within 20 feet of the outside boundary of a transition area; or
  2. Placement of a residential development project, as defined at N.J.A.C. 7:7A-1.4, within a transition area or wetland.
- (d) To satisfy the requirements of (c) above, the applicant shall demonstrate that:

1. Construction activities will be conducted in such a way that there will be no regulated activities in the transition area or the wetland except any that are authorized by a permit, as defined at N.J.A.C. 7:7A-1.4;
  2. The structure is designed and will be used in such a way that there will be no regulated activities in the transition area or the wetland except any that are authorized by a permit, as defined at N.J.A.C. 7:7A-1.4. To demonstrate this in regard to a single family or duplex dwelling, the applicant shall demonstrate that any transition area or wetland within the area covered by the residential development project will not be owned or controlled by the resident(s) of the dwelling;
  3. The transition area and/or wetland is fenced prior to construction of the structure (including site preparation), and the fence is permanently maintained, so as to clearly delineate its boundary and to prevent people from entering and/or disturbing the transition area and/or wetland; and
  4. Prior to beginning activities authorized by a permit, the applicant executes and records a conservation restriction, as defined at N.J.A.C. 7:7A-1.4, which prohibits any regulated activities in the transition area.
- (e) The Department shall include in a transition area waiver additional conditions as necessary to ensure that an activity does not result in a substantial impact on the adjacent wetlands, and does not impair the purposes and functions of transition areas as set forth in N.J.A.C. 7:7A-2.5.
- (f) If a site has more than one freshwater wetland, the Department shall treat each wetland and its associated transition area separately for purposes of transition area waivers. To determine whether a freshwater wetland area is all one wetland or is made up of multiple separate wetlands, the Department shall consider the following factors:
1. The proximity of the wetland areas to each other; and
  2. Whether the wetland areas are hydrologically connected.
- (g) An applicant whose application does not meet the requirements for any of the transition area waivers listed in (a) above may obtain a transition area waiver through scientifically documenting that a proposed activity will have no substantial impact on the adjacent wetlands. This documentation may include but is not limited to, nutrient or sediment transport models, buffer models such as "The Wetlands Buffer Delineation Method," prepared by Rogers, Golden and Halpern, Inc., the "Buffer Delineation Model for New Jersey Pinelands Wetlands," prepared by Charles T. Roman and Ralph E. Good, or wildlife habitat suitability studies. An application submitted under this subsection shall address the following, as they relate to the adjacent wetlands: sediment, nutrient, and pollutant transport and removal; impacts on sensitive species; and surface water quality impacts.
- (h) Each matrix type width reduction transition area waiver and averaging plan transition area waiver shall be conditioned on the recording of a Department-approved conservation restriction, as defined at N.J.A.C. 7:7A-1.4, restricting future activities in the entire transition area on the site. The conservation restriction shall be executed and recorded prior to the beginning of activities authorized under the transition area waiver, or prior to the transfer of

the site, whichever is sooner. The conservation restriction shall clearly show the boundaries of the transition area as modified from the standard transition area by the waiver. The conservation restriction shall meet the requirements for protecting mitigation sites from future disturbance, set forth at N.J.A.C. 7:7A-15.14, except that the restriction shall allow later regulated activities in the transition area, or a later reduction of the transition area, if the applicant demonstrates that:

1. There is a compelling public need for the activity, which is greater than the need to protect the transition area; and
  2. The activity has no practicable alternative which would not involve a transition area, or which would involve a transition area but:
    - i. Would have less adverse impact on the transition area and adjacent wetland; and
    - ii. Would not merely substitute other significant environmental consequences for those attendant on the original proposal.
- (i) The process at N.J.A.C. 7:7A-7.3 for requesting that the Department evaluate whether denial of a permit could result in a taking is also available to applicants for an individual transition area waiver.
- (j) A transition area waiver allowing the reduction of the transition area adjacent to an exceptional resource value wetland shall be conditioned on a transition area averaging plan which provides an average transition area width of at least 100 feet.
- (k) The Department shall not issue an individual transition area waiver under this section and a general permit authorization for the same site, if the combined effect of the individual transition area waiver and general permit authorization would be to expand the general permit activity beyond the limits set forth in the general permit.

#### 7:7A-6.2 Transition area averaging plan waiver

- (a) A transition area averaging plan waiver modifies the overall shape of a transition area without reducing its total square footage. The Department may approve a transition area averaging plan waiver for activities adjacent to an intermediate or exceptional resource value freshwater wetlands. A diagram of an example transition area averaging plan is shown in N.J.A.C. 7:7A-6, Appendix A.
- (b) The Department shall issue a transition area averaging plan waiver only if the transition area, as modified, will continue to serve the purposes of a transition area set forth in N.J.A.C. 7:7A-2.5. The Department shall presume that the following will result in a transition area that will not serve the purposes set forth in N.J.A.C. 7:7A-2.5, and shall not issue a transition area averaging plan waiver, unless the applicant demonstrates otherwise under N.J.A.C. 7:7A-6.1(g):
1. The portion of the existing, pre-activity transition area that will be reduced has a slope greater than 25 percent, as calculated under N.J.A.C. 7:7A-6.4(g);

2. A new individual subsurface sewage disposal (septic) system that discharges onsite will be placed within the existing, pre-activity transition area;
  3. An outfall structure that will discharge unfiltered or untreated stormwater into wetlands will be placed within the existing, pre-activity transition area; or
  4. The project involves a building or structure that meets the criteria in N.J.A.C. 7:7A-6.1(c)1 or 2 and the requirements of N.J.A.C. 7:7A-6.1(d) are not met.
- (c) In addition to the presumptions at (b) above, the Department shall also presume that, for a transition area adjacent to an intermediate resource value wetland, the following will result in a substantial impact on the adjacent freshwater wetlands, and the Department shall not issue a transition area averaging plan waiver unless the applicant demonstrates otherwise under N.J.A.C. 7:7A-6.1(g):
1. A structure, impervious surface, or stormwater management facility, as defined at N.J.A.C. 7:7A-1.4, will be placed within 20 feet of freshwater wetlands; or
  2. The transition area averaging plan proposes to:
    - i. Reduce any portion of the transition area to less than 10 feet wide;
    - ii. Reduce a transition area to less than 25 feet wide in an area containing critical habitat for fauna or flora, as defined at N.J.A.C. 7:7A-1.4;
    - iii. Reduce a transition area to 10 feet wide for a continuous distance of 100 linear feet or more along the freshwater wetlands boundary;
    - iv. Reduce a transition area to less than 25 feet wide within the watershed of a current or proposed National Wildlife Refuge; or
    - v. Compensate for a decrease in a transition area by increasing the width of any portion of the transition area to more than 75 feet.
- (d) In addition to the presumptions at (b) above, the Department shall also presume that, for a transition area adjacent to an exceptional resource value wetland, the following will result in a substantial impact on the adjacent freshwater wetlands, and the Department shall not issue a transition area averaging plan waiver unless the applicant demonstrates that the activity would qualify for an individual permit under this chapter:
1. The freshwater wetland adjacent to the transition area is a breeding or nesting habitat for a threatened or endangered species as defined at N.J.A.C. 7:7A-1.4;
  2. The freshwater wetland adjacent to the transition area discharges directly to a trout production water or a tributary thereof, except that a transition area averaging plan waiver shall not be disallowed under this subsection if:
    - i. The freshwater wetlands and transition area remaining adjacent to the trout production water after the averaging is at least 150 feet wide, measured from the top of the bank of the trout production water; or

- ii. The wetland drains to a tributary that is separated from the trout production water by an intervening lake; or
  - 3. The transition area averaging plan proposes to:
    - i. Reduce any portion of the transition area to less than 75 feet wide; or
    - ii. Compensate for a transition area reduction by increasing the width of any portion of the transition area to more than 225 feet.
- (e) Each transition area averaging plan shall be specific to a particular freshwater wetland and its associated transition area. To determine whether a freshwater wetland area is all one wetland or made up of multiple separate wetlands, the Department shall consider the factors listed at N.J.A.C. 7:7A-6.1(f). If an applicant proposes to expand a transition area to compensate for a reduction elsewhere, the expanded portion of the transition area shall:
- 1. Be an extension of the same transition area that is being reduced, located adjacent to the same freshwater wetlands as the reduced transition area;
  - 2. Be located on the same site, as defined at N.J.A.C. 7:7A-1.4, as the reduction;
  - 3. Be owned in fee simple by the applicant, unless the applicant demonstrates sufficient legal authority over the site to carry out all requirements of this chapter. For example, the expanded portion of the transition area shall not be subject to a utility easement or other encumbrance; and
  - 4. Have the same ecological characteristics as the reduced portion of the transition area, including the vegetation types, or have characteristics that are equivalent or better as regards the transition area's ability to serve the functions listed at N.J.A.C. 7:7A-2.5. For example, if a forested portion of the transition area is reduced, the expanded portion of the transition area must also be forested.

7:7A-6.3 Special activity transition area waiver

- (a) The Department shall issue a transition area waiver for certain special activities meeting the criteria in this section. However, the Department will issue a special activity waiver under this section only if the activities will not result in a substantial impact on the adjacent freshwater wetlands, and the proposed project will minimize impacts to the freshwater wetland and transition area.
- (b) The Department shall issue the following types of special activity transition area waivers:
  - 1. A stormwater management transition area waiver under (d) below;
  - 2. A linear development transition area waiver under (e) below;
  - 3. A redevelopment transition area waiver under (f) below; and
  - 4. An individual permit transition area waiver under (g) below.

- (c) When considering alternative locations under this section:
1. The Department shall consider an alternative location feasible if it is available and capable of being used after taking into consideration cost, existing technology, and logistics in light of the overall project purpose; and
  2. The Department shall consider an alternative location infeasible if its use for the project would cause other, more significant adverse environmental consequences.
- (d) The Department shall issue a special activity transition area waiver for stormwater management if there is no feasible alternative onsite location for the stormwater management facility. An alternative onsite location shall not be considered infeasible merely because it would require one or more of the following:
1. Relocating part or all of the facility outside of the transition area and into the upland;
  2. Modifying the type of facility;
  3. Redesigning the layout, size, scope or configuration of the buildings, roads or other aspects of the project in order to accommodate the facility; or
  4. Reducing the scope, size, or density of the project.
- (e) The Department shall issue a special activity transition area waiver for linear development, as defined at N.J.A.C. 7:7A-1.4, if there is no feasible alternative location for the linear development. In considering alternative locations, the Department shall consider the factors at (c) above and the following:
1. An alternative location shall be considered feasible when the proposed linear development can be located outside of the transition area by:
    - i. Modifying the route of the linear development to avoid or reduce impacts to freshwater wetlands and transition areas; or
    - ii. Reducing the width of the linear development; and
  2. An alternative shall not be excluded from consideration merely because it includes or requires an area not owned by the applicant which could reasonably have been or be obtained or used to fulfill the basic purpose of the proposed activity.
- (f) The Department shall issue a special activity transition area waiver for redevelopment of a significantly disturbed area if all of the following conditions are met:
1. The area of proposed activity is significantly disturbed so that it is not functioning as a transition area at the time of application, for example, the area is covered by an impervious surface such as pavement, or by gravel or paver blocks. For example, a lawn is not considered to be so significantly disturbed that it is not functioning as a transition area;

2. The significant disturbance in the area of proposed activity was legally existing in the transition area prior to July 1, 1989, or has been permitted under this chapter;
  3. No additional disturbance is proposed that would expand the disturbed area; and
  4. Where practicable, any remaining disturbed portion of the transition area shall be planted with indigenous plants that are beneficial to the wetland, and protected from future development by a conservation restriction that meets the requirements at N.J.A.C. 7:7A-15.14.
- (g) The Department shall issue a special activity transition area waiver for an activity if the applicant demonstrates that, if the activity were instead proposed in a freshwater wetland, it would meet the standards for a freshwater wetlands individual permit at N.J.A.C. 7:7A-7.

7:7A-6.4 Matrix type width reduction transition area waiver

- (a) This section sets forth the requirements for a matrix type width reduction transition area waiver, or "transition area matrix waiver", for a project proposed in a transition area adjacent to an exceptional or intermediate resource value wetland.
- (b) The Department shall issue a transition area matrix waiver only if all of the following criteria are met:
1. If the freshwater wetland is located adjacent to a waterway that meets either of the criteria at i or ii below, the activities must be approved by the National Park Service:
    - i. The waterway is a component of the Federal or State Wild and Scenic River System designated pursuant to 16 U.S.C. §1271 et seq. or N.J.S.A. 13:8-45 et seq.; or
    - ii. The waterway is in an official study status for designation by Congress or the State Legislature as a "study river" for possible inclusion in either system described in i above;
  2. The proposed activities would not cause the disturbance or exposure of acid producing deposits, as defined at N.J.A.C. 7:7A-1.4;
  3. The site is not located adjacent to a local, county, State, or Federal park, wildlife refuge, sanctuary, management area or area listed on the New Jersey Register of Natural Areas; and
  4. The application does not include construction or expansion of any of the following:
    - i. A mineral extraction and/or processing operation, including mining or processing of construction sand, industrial sand, gravel, ilmenite, glauconite, limestone, or other minerals;
    - ii. A wastewater treatment or individual subsurface disposal system located within 150 feet of an exceptional resource value wetland or within 50 feet of an intermediate resource value wetland;

- iii. A solid waste facility; or
  - iv. A facility for the storage, processing, or disposal of hazardous substances as defined in the Department's rules governing the prevention and reporting of discharges of hazardous substances at N.J.A.C. 7:1E-1.7.
- (c) The only type of exceptional resource value wetland for which a transition area matrix waiver may be issued is a wetland that meets both of the following criteria:
- 1. The wetland is located on a tributary to an FW1 water or on a tributary to an FW2 trout production water; and
  - 2. The wetland does not:
    - i. Contain a present or documented habitat for threatened or endangered species, as defined at N.J.A.C. 7:7A-1.4; or
    - ii. Discharge into FW1 waters or trout production waters.
- (d) The Department shall not issue a transition area matrix waiver for a transition area on an intermediate resource value wetland that is a critical habitat for fauna or flora, as defined at N.J.A.C. 7:7A-1.4.
- (e) The Department shall determine the width of a transition area using the matrix in Table B or Table C below, as applicable, based on the factors listed at (e)1 through 3 below:
- 1. The slope of the portion of the transition area contained within the site, as determined under (g) below;
  - 2. The dominant vegetational community in the portion of the transition area contained within the site, as determined under (h) below,; and
  - 3. The development intensity of the proposed project, as determined under (i) below.

Table B

Matrix for determining the width of a transition area (in feet) on an exceptional resource value wetlands

| Slope %         | Dominant vegetational community | Development intensity |                    |             |
|-----------------|---------------------------------|-----------------------|--------------------|-------------|
|                 |                                 | Low (0-10%)           | Moderate (>10-40%) | High (>40%) |
| Herba-<br>Ceous | 0-2                             | 100                   | 120                | 140         |
|                 | >2                              | 150                   | 150                | 150         |
| Scrub/shrub     | 0-2                             | 75                    | 75                 | 80          |
|                 | >2-5                            | 95                    | 115                | 130         |
|                 | >5                              | 150                   | 150                | 150         |
| Forest          | 0-2                             | 75                    | 75                 | 75          |
|                 | >2-5                            | 75                    | 75                 | 85          |
|                 | >5-10                           | 75                    | 85                 | 95          |
|                 | >10-15                          | 95                    | 105                | 115         |
|                 | >15-20                          | 115                   | 125                | 135         |
|                 | >20                             | 135                   | 145                | 150         |

Table C

Matrix for determining the width of a transition area on an intermediate resource value wetlands

| Conditions   | Transition area width |
|--|-----------------------|
| Forest<br>(1% slope<br>< 20% development intensity)                    | 25 feet               |
| Scrub/shrub or herbaceous<br>(1% slope<br>< 20% development intensity) | 35 feet               |
| Forest<br>(3% slope<br>< 40% development intensity)                    | 35 feet               |

- (f) For a transition area on an intermediate resource value wetland, if a site and/or proposed project does not meet one of the three sets of conditions in the matrix in Table C, a transition area matrix waiver is not available.

- (g) To determine the slope of the transition area for use in the applicable matrix at (e) above, an applicant shall:
1. Measure the percent change in ground elevation from the outside boundary of the standard transition area to the inner (closest to the wetlands) edge of the area to be disturbed;
  2. Repeat the measurement in (g)1 above at representative intervals along the outside transition area boundary, covering all of the transition area proposed to be reduced; and
  3. Determine the arithmetic mean of the slope measurements taken under (g)2 above as the average slope for use in the applicable transition area matrix at (e) above.
- (h) The dominant vegetational community in a transition area is the plant community which covers the most surface area of the transition area on the site. Transition area vegetational communities are classified as follows:
1. An herbaceous vegetational community is characterized by annual and perennial plant species or bare ground;
  2. A scrub-shrub vegetational community is characterized by shrub and herbaceous plant species with an average height equal to or less than 20 feet. For the purposes of this section, a forested area with little or no herbaceous or shrub layer (understory) shall be considered a scrub-shrub vegetational community; and
  3. A forested vegetational community is characterized by tree species with an average height greater than 20 feet accompanied by an herbaceous or shrub layer.
- (i) To determine the development intensity of a site for use in the applicable matrix at (e) above, an applicant shall:
1. Determine the total area of the site in square feet;
  2. Identify all freshwater wetlands, transition areas, or State open waters on the site, and determine the area, in square feet, covered by each;
  3. Total the areas identified in (i)2 above;
  4. Subtract (i)3 from (i)1. This is the net land area;
  5. Determine the total area, in square feet, on the site which will be covered with impervious surfaces, as defined at N.J.A.C. 7:7A-1.4, when the proposed project is completed;
  6. Divide the total proposed impervious surface from (i)5 by the net land area from (i)4; and
  7. Multiply (i)6 by 100 percent. This is the development intensity of the project, for use in the applicable matrix at (e) above.

7:7A-6.5 Hardship transition area waiver

- (a) The Department shall issue a hardship transition area waiver under this section if a site is not susceptible to a reasonable use if developed as authorized by this chapter, and this limitation results from unique circumstances peculiar to the site which:
1. Do not apply to or affect other property in the local region;
  2. Relate to or arise out of the site itself, rather than the personal situation of the applicant; and
  3. Are not the result of any action or inaction by the applicant, the site owner or the owner's predecessors in title.
- (b) The Department shall presume that a hardship under (a) above exists and shall issue a hardship transition area waiver that reduces the transition area in an amount determined under (c) below, provided that the applicant demonstrates that all of the following criteria are met:
1. The presence of transition areas on the site makes it impossible to build a single family dwelling on the site under the other provisions of this chapter;
  2. The lot or lots that make up the site were created by a subdivision occurring prior to July 1, 1988;
  3. The site has been owned continuously by the applicant since prior to July 1, 1988;
  4. The site is not contiguous with an improved property that was owned by the applicant on July 1, 1988;
  5. The applicant has not received a hardship transition area waiver based on these hardship criteria at any time during the five years prior to the present application for a hardship transition area waiver;
  6. The applicant has unsuccessfully attempted to purchase adjacent properties for fair market value in order to create a developable upland;
  7. The applicant has offered the site for sale at fair market value to adjacent property owners and the offer was refused; and
  8. The applicant has offered the site for sale at fair market value to interested public and/or private conservation organizations on a list provided by the Department, and the offer was refused.
- (c) The amount of transition area reduction authorized under a hardship transition area waiver shall be the minimum amount necessary to construct one single family home and any necessary appurtenances, such as a driveway or septic system. However, the transition area shall not be reduced under this section to less than 75 feet for a transition area

adjacent to exceptional resource value wetlands, or 25 feet for a transition area adjacent to intermediate resource value wetlands.

7:7A-6.6 Application for a transition area waiver

An application for a transition area waiver shall include the information required at N.J.A.C. 7:7A-10, Application contents and procedures. The applicant shall follow the application procedures at N.J.A.C. 7:7A-10, and the Department will review the application using the procedures at N.J.A.C. 7:7A-10.

Appendix A

Diagram: Example of a transition area waiver averaging plan

## SUBCHAPTER 7 INDIVIDUAL FRESHWATER WETLANDS AND OPEN WATER FILL PERMITS

### 7:7A-7.1 General provisions for individual permits

- (a) To be authorized under an individual permit, an activity shall meet the following requirements:
  - 1. All activities that require an individual permit shall meet all of the requirements at N.J.A.C. 7:7A-7.2;
  - 2. In addition to the requirements at N.J.A.C. 7:7A-7.2, a non water-dependent activity, as defined at N.J.A.C. 7:7A-1.4, shall meet the requirements at N.J.A.C. 7:7A-7.3, except if the activity disturbs only State open waters that are not special aquatic sites as defined at N.J.A.C. 7:7A-1.4; and
  - 3. In addition to the requirements at N.J.A.C. 7:7A-7.2 and N.J.A.C. 7:7A-7.3, a non water-dependent activity in an exceptional resource value wetland or trout production water shall meet the requirements at N.J.A.C. 7:7A-7.4.
- (b) The Department shall not consider a mitigation proposal in determining whether an individual permit will be issued for a project.
- (c) Each individual permit applies to the entire site upon which permitted activities occur. An applicant shall not segment a project or its impacts by applying for general permit authorization for one portion of the project and applying for an individual permit for another portion of the project. Similarly, an applicant shall not segment a project or its impacts by separately applying for individual permits for different portions of the same project.
- (d) In some cases, a regulated activity that requires an individual permit and is located in an area under the jurisdiction of the Pinelands Commission also requires approval by the Pinelands Commission, in accordance with the Pinelands Comprehensive Management Plan (CMP). For information on freshwater wetlands in the Pinelands, contact the Pinelands Commission at (609) 894-7300 or through its website at [www.state.nj.us/pinelands](http://www.state.nj.us/pinelands).

### 7:7A-7.2 Standard requirements for all individual permits

- (a) This section sets forth requirements that apply to all activities to be covered by an individual permit, including both water-dependent activities, as defined at N.J.A.C. 7:7A-1.4, and non water-dependent activities. Additional individual permit requirements that apply only to non water-dependent activities are found in N.J.A.C. 7:7A-7.3 and 7:7A-7.4.
- (b) The Department shall issue an individual freshwater wetlands or open water fill permit only if the regulated activity:
  - 1. Has no practicable alternative which would meet the requirements at 1i and 1ii below:

- i. The alternative would have a less adverse impact on the aquatic ecosystem or would not involve a freshwater wetland or State open water; and
  - ii. The alternative would not have other significant adverse environmental consequences, that is, it shall not merely substitute other significant environmental consequences for those attendant on the original proposal;
2. Will result in the minimum feasible alteration or impairment of the aquatic ecosystem including existing contour, vegetation, fish and wildlife resources, and aquatic circulation of the freshwater wetland and hydrologic patterns of the HUC 11 in which the activity is located;
3. Will not destroy, jeopardize, or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize the continued existence of a local population of a threatened or endangered species, as defined at N.J.A.C. 7:7A-1.4;
4. Will not be likely to result in the destruction or adverse modification of a habitat which is determined by the Secretary of the United States Department of the Interior or the Secretary of the U.S. Department of Commerce, as appropriate, to be a critical habitat under the Endangered Species Act of 1973, 16 U.S.C. §1531 et seq.;
5. Will not cause or contribute to a violation of any applicable State water quality standard;
6. Will not cause or contribute to a violation of any applicable toxic effluent standard or prohibition imposed pursuant to the Water Pollution Control Act;
7. Will not violate any requirement imposed by the United States government to protect any marine sanctuary designated pursuant to the Marine Protection, Research and Sanctuaries Act of 1972, 33 U.S.C. §§1401 et seq.;
8. Will not cause or contribute to a significant degradation, as defined at 40 C.F.R. 230.10(c), of ground or surface waters;
9. Will not adversely affect a property which is listed or is eligible for listing on the New Jersey or National Register of Historic Places unless the applicant demonstrates to the Department that the proposed activity avoids or minimizes impacts to the maximum extent practicable or the Department determines that any impact to the affected property would not impact the property's ability to continue to meet the criteria for listing at N.J.A.C. 7:4-2.3 or otherwise negatively impact the integrity of the property or the characteristics of the property that led to the determination of listing or eligibility. The Department shall not issue a conditional permit if it finds that the mitigation proposed is inadequate to compensate for the adverse affect. Any permit for an activity which may adversely affect a property listed or eligible for listing on the New Jersey or National Register of Historic Places shall contain conditions to ensure that any impact to the property is minimized to the maximum extent practicable and any unavoidable impact is mitigated. If the permittee, before or during the authorized work, encounters a probable historic property that has not been listed or determined eligible for listing on the New Jersey or National Register,

but which may be eligible for listing on the New Jersey or National Register, the permittee shall immediately notify the Department and proceed as directed by the Department;

10. Will not violate the Flood Hazard Area Control Act, N.J.S.A. 58:16A-50 et seq., or implementing rules at N.J.A.C. 7:13;
11. Is otherwise lawful;
12. Is in the public interest, as determined by the Department in consideration of the following:
  - i. The public interest in preservation of natural resources and the interest of the property owners in reasonable economic development. In determining whether a proposed activity is in the public interest, the Department shall consider, as one source of guidance, the goals, strategies, policy objectives and policies of the New Jersey State Development and Redevelopment Plan, adopted and/or readopted by the State Planning Commission pursuant to the New Jersey State Planning Act, N.J.S.A. 52:18A-196 et seq., and the State Planning Act rules, N.J.A.C. 17:32;
  - ii. The relative extent of the public and private need for the proposed regulated activity;
  - iii. Where there are unresolved conflicts as to resource use, the practicability of using reasonable alternative locations and methods, to accomplish the purpose of the proposed regulated activity;
  - iv. The extent and permanence of the beneficial or detrimental effects which the proposed regulated activity may have on the public and private uses for which the property is suited;
  - v. The quality and resource value classification pursuant to N.J.A.C. 7:7A-2.5 of the wetland which may be affected and the amount of freshwater wetlands to be disturbed;
  - vi. The economic value, both public and private, of the proposed regulated activity to the general area; and
  - vii. The functions and values provided by the freshwater wetlands and probable individual and cumulative impacts of the regulated activity on public health and fish and wildlife;
13. Will not involve a discharge of dredged material or a discharge of fill material, unless the material is clean, suitable material free from toxic pollutants in toxic amounts, which meets Department standards for use of dredged or fill material; and
14. Is consistent with the applicable approved Water Quality Management Plan (208 Plan) adopted under the New Jersey Water Quality Planning Act, N.J.S.A. 58:11A-1 et seq., unless the activities are not subject to the Department's Water Quality Management Planning rules at N.J.A.C. 7:15.

(c) The following shall apply to the Department's consideration of whether an alternative is practicable under (b)1 above, or under N.J.A.C. 7:7A 7:7A-7.3(b):

1. An alternative shall be practicable if it is available and capable of being carried out after taking into consideration cost, existing technology, and logistics in light of overall project purposes;
  - i. In considering cost in accordance with c)1 above, the Department shall consider the acquisition history of the property as a whole, as defined at N.J.A.C. 7:7A-1.4, and the amount, nature, and date of investments that the applicant has made in the property as a whole; and
2. An alternative shall not be excluded from consideration under this provision merely because it includes or requires an area not owned by the applicant which could reasonably have been or be obtained, utilized, expanded, or managed in order to fulfill the basic purpose of the proposed activity.

7:7A-7.3 Reserved.

7:7A-7.4 Additional requirements for a non water-dependent activity in a wetland or special aquatic site

- (a) In addition to meeting the requirements of N.J.A.C. 7:7A-7.2, a non water-dependent activity in a freshwater wetland or special aquatic site, as defined in N.J.A.C. 7:7A-1.4, shall meet the requirements of this section. If an activity is water-dependent, as defined at N.J.A.C. 7:7A-1.4, or if it disturbs only a State open water that is not a special aquatic site, this section does not apply to the activity.
- (b) There shall be a rebuttable presumption that there is a practicable alternative to a non water-dependent activity in a freshwater wetland or in a special aquatic site, which alternative does not involve a freshwater wetland or special aquatic site, and that such an alternative would have less of an impact on the aquatic ecosystem.
- (c) In order to rebut the presumption established in (b) above, an applicant must demonstrate all of the following:
  1. That the basic project purpose cannot reasonably be accomplished using one or more other sites in the general region that would avoid or reduce the adverse impact on an aquatic ecosystem;
  2. That the basic project purpose cannot reasonably be accomplished if there is a reduction in the size, scope, configuration, or density of the project as proposed;
  3. That the basic project purpose cannot reasonably be accomplished by an alternative design that would avoid or reduce the adverse impact on an aquatic ecosystem;

4. That in cases where the applicant has rejected alternatives to the project as proposed due to constraints such as inadequate zoning, infrastructure, or parcel size, the applicant has made reasonable attempts to remove or accommodate such constraints; and
5. If any portion of the proposed activity will take place in an exceptional resource value wetland or in trout production waters, that the requirements of N.J.A.C. 7:7A-7.4 are met.

7:7A-7.5 Additional requirements for a non water-dependent activity in exceptional resource value wetlands or trout production waters

- (a) If an applicant proposes a non water-dependent activity in wetlands of exceptional resource value or in trout production waters, the applicant, in addition to complying with all other requirements in this subchapter, shall also demonstrate either:
  1. That there is a compelling public need for the proposed activity greater than the need to protect the freshwater wetland or trout production water, and that the need cannot be met by essentially similar projects in the region which are under construction or expansion, or which have received the necessary governmental permits and approvals; or
  2. That denial of the permit would impose an extraordinary hardship on the applicant brought about by circumstances peculiar to the subject property.

## SUBCHAPTER 8 EMERGENCY PERMITS

7:7A-8.1 Emergency permits

- (a) The Department may issue a temporary emergency freshwater wetlands permit, open water fill permit, or transition area waiver only if:
  1. An unacceptable threat to life, severe loss of property, or severe environmental degradation will occur if an emergency permit is not issued; and
  2. The anticipated threat or loss may occur before a permit or waiver can be issued or modified under the procedures otherwise required by this chapter.
- (b) An emergency permit may be approved orally by the Director of the Department's Land Use Regulation Program or issued in writing, except that if it is approved orally, the Department shall issue a written authorization within five days after the oral approval.
- (c) The emergency permit shall incorporate, to the greatest extent practicable and feasible but not inconsistent with the emergency situation, the standards and criteria required for non-emergency regulated activities, including mitigation, and shall:
  1. Be limited in duration to the time required to complete the authorized emergency activity, not to exceed 90 days;

2. Require mitigation pursuant to N.J.A.C. 7:7A-15 of the freshwater wetland and/or State open waters within this 90 day period, except that if more than 90 days from the issuance of the emergency permit is required to complete mitigation, the emergency permit may be extended to complete this mitigation only;
  3. Fully describe the work that will be conducted under the emergency permit; and
  4. Specify the procedures that the permittee must follow under N.J.A.C. 7:7A-8.2 below to obtain a freshwater wetlands or open water fill permit, or transition area waiver.
- (d) Notice of the issuance of the emergency permit shall be published and public comments received, in accordance with the provisions of 40 C.F.R. 124.10 and 124.11, and of the Federal Act and applicable State law, provided that this notification shall be mailed no later than 10 days after issuance of the emergency permit.
- (e) The emergency permit may be terminated at any time without prior hearing upon a determination by the Department that this action is appropriate to protect human health or the environment.
- (f) Emergency activities in an area under the jurisdiction of the Pinelands Commission may require approval by the Pinelands Commission, in accordance with the Pinelands Comprehensive Management Plan. For information on freshwater wetlands and transition areas in the Pinelands, contact the Pinelands Commission at (609) 894-7300 or through its website at [www.state.nj.us/pinelands](http://www.state.nj.us/pinelands).

#### 7:7A-8.2 Obtaining an emergency permit

- (a) A person in need of an emergency permit shall inform the Department as to the extent of work to be performed, the reason for the emergency, and the location of the project. This information shall include a written description of the work, plans of the work, and photographs of the site, and shall be presented to the Department in writing prior to the issuance of the emergency permit.
- (b) If the Department receives a request for an emergency permit for a major discharge, the Department will notify the Regional Administrator of Region II of the USEPA before issuing an emergency permit, and will send a copy of the written permit to the USEPA upon issuance.
- (c) If the Director of the Department's Land Use Regulation Program gives oral approval for an emergency permit, the emergency work may be started. The person who received the oral approval shall keep Department staff informed by telephone at least once per week regarding the situation at the site. The Department will offer guidance and instructions in performing the work.
- (d) If the Director of the Department's Land Use Regulation Program does not give oral approval, the Department may issue a written emergency permit at any time within 15 days after the initial request.

- (e) Within 15 days after the Department gives an oral approval under (c) above, the permittee shall submit the following to the Department:
  - 1. "As-built" drawings, showing all activities conducted under the emergency permit, including all excavation, grading, structures, and other regulated activities;
  - 2. The applicable fee specified at N.J.A.C. 7:7A-11; and
  - 3. Any other information necessary for the Department to ensure compliance with this chapter.
- f) After following the application review procedures at N.J.A.C. 7:7A-12, the Department shall issue a freshwater wetlands permit, open water fill permit, or transition area waiver for the activities covered by the emergency permit. This permit or waiver may contain conditions, including but not limited to mitigation under N.J.A.C. 7:7A-15, necessary to minimize and/or compensate for any adverse impacts to the freshwater wetlands, State open waters, or transition areas resulting from the activities performed under the emergency permit.
- (g) Any regulated activities performed, other than those described to the Department in the request for the emergency permit and approved by the Department under this section, shall constitute a violation that is subject to enforcement action under N.J.A.C. 7:7A-16.

## SUBCHAPTER 9 PRE-APPLICATION CONFERENCES

### 7:7A-9.1 Purpose

A pre-application conference is recommended for any project that is complex or controversial. It allows the Department to inform potential applicants of the various procedures and policies which apply to the freshwater wetlands, open water fill, stream encroachment, and coastal program permitting process. Department staff will candidly discuss the apparent strengths and weaknesses of the proposed permit application at this conference, but all guidance provided at a pre-application conference shall be non-binding on the Department. A Department decision on a project or any aspect of a project is binding only if it is incorporated into a permit obtained in accordance with this chapter.

### 7:7A-9.2 Request for a pre-application conference

- (a) Potential applicants may request a pre-application conference with the Department. A request for a pre-application conference shall be made in writing and shall include:
  - 1. A project description;
  - 2. A plan view of the project;
  - 3. A tax lot and block designation of the site;
  - 4. The location of the project site, including the municipality and county;

5. A copy of any LOI issued for the site. If no LOI has been issued, the general location of freshwater wetlands, transition areas, and State open waters;
  6. A copy of the appropriate United States Soil Conservation Service map(s) locating the project; and
  7. A United States Geological Survey quadrangle map showing the site.
- (b) The Department encourages the applicant to obtain a letter of interpretation prior to the pre-application conference.
- (c) If a pre-application conference is to be held, the Department shall schedule the pre-application conference within 15 days after receiving a request for one. If a pre-application conference is not scheduled within this deadline, the applicant may apply directly for a permit.

## SUBCHAPTER 10 APPLICATION CONTENTS AND PROCEDURE

### 7:7A-10.1 Basic application information

- (a) This subchapter describes the application contents and procedures required for most Department permits, waivers, and authorizations.
- (b) This subchapter applies to an application for all of the following:
1. A letter of interpretation, including an extension or modification of a letter of interpretation;
  2. Authorization to act under a general permit, except that the following activities are subject to application requirements in the general permits listed below, and are not subject to any of the application requirements in this subchapter except for the public notice requirements at N.J.A.C. 7:7A-10.9:
    - i. The ongoing maintenance of an off-stream stormwater management facility created in uplands under general permit 1;
    - ii. The repair or modification of an individual subsurface disposal system (septic system) under general permit 25; and
    - iii. Minor channel or stream cleaning performed by a local government agency under general permit 26;
  3. A combined flood hazard area permit and general permit authorization;
  4. An individual transition area waiver;
  5. An individual open water fill permit;
  6. An individual freshwater wetlands permit; and

7. A minor modification, major modification, or extension of a permit, including a transition area waiver or general permit authorization.
- (c) This subchapter does not apply to the following:
1. An exemption letter. Application requirements for an exemption letter are found at N.J.A.C. 7:7A-2.10; or
  2. A mitigation proposal. Application requirements for a mitigation proposal are found at N.J.A.C. 7:7A-15.12.
- (d) An application shall be submitted by the owner of the site which is the subject of the application, or by a person who has the legal authority to perform the activities proposed in the application on the site, and to carry out all requirements of this chapter.
- (e) An applicant shall include on an application all planned activities which are related to the proposed project.
- (f) Failure to provide all required information of which the applicant, its consultants, or agents is aware may result in denial or termination of the permit under N.J.A.C. 7:7A-14.5, and may subject the applicant to penalties for submittal of false information under N.J.A.C. 7:7A-16.9.
- (g) For each application, the applicant shall provide all information necessary for the Department to determine if the requirements of this chapter are met. The Department will provide an application checklist setting forth the information required for an administratively complete application. Each application checklist will require different information depending on the type of approval sought.
- (h) Application checklists and application forms for Land Use Regulation Program approvals can be downloaded and/or printed from the Land Use Regulation Program website at [www.state.nj.us/dep/landuse](http://www.state.nj.us/dep/landuse), or they can be obtained by contacting the Department at the address in N.J.A.C. 7:7A-1.3.
- (i) In general, the level of detail and documentation required for an application shall be reasonably commensurate with the size and impact of the proposed project, its proximity to critical areas, and its potential to adversely affect freshwater wetlands, transition areas, and/or State open waters. The Department will, upon request, provide applicants with guidance regarding the appropriate level of detail.
- (j) An applicant shall supply each required document in multiple copies as specified in the application checklist. In some cases, the application checklist will also specify the size or material (such as mylar) of a document, and may require the document to be folded for easier handling.
- (k) To minimize permit processing time, an applicant should carefully review the application checklist and make sure the application includes all required information. Following are the Department's average application processing times for 2000, from the date an application is submitted until the Department's final decision on the application. An applicant should assume that at least this amount of time will be required for Department review of the application. Some applications will take longer, depending on how quickly the applicant

responds to Department requests for additional information, and on the size and complexity of the application:

1. For a letter of interpretation, approximately 69 calendar days;
  2. For an authorization under a general permit, approximately 65 calendar days;
  3. For an individual transition area waiver, approximately 71 calendar days; and
  4. For an individual permit, approximately 161 calendar days,
- (l) If a project requires more than one permit or waiver under this chapter, one application may be submitted for all permits or waivers.
- (m) If a project requires approvals from the Land Use Regulation Program under other chapters, the Department encourages, but does not require, the applicant to submit one application for all project approvals. If an application covers more than one Land Use Regulation Program approval, the application shall:
1. Comply with the application requirements of each permit program;
  2. Include the application fee required at N.J.A.C. 7:7A-11 for multiple approvals; and
  3. Include a comprehensive environmental plan, showing all activities on the site that are regulated by the Land Use Regulation Program.
- (n) An applicant shall keep all data used to complete an application, and any information submitted to the Department during the application review process, for three years after the application is submitted to the Department, or for the duration of the permit if one is issued, whichever is longer.
- (o) If a project requires mitigation, the applicant shall submit a mitigation proposal complying with the mitigation proposal requirements at N.J.A.C. 7:7A-15 with the application, or alternatively, the applicant shall submit the mitigation proposal later, during the application review process or after a permit is approved. Regardless of when the mitigation proposal is submitted, regulated activities shall not begin on a site for which mitigation is required until the Department approves the mitigation proposal and the mitigation is also begun.
- (p) An application for regulated activities in an area under the jurisdiction of the Pinelands Commission shall be submitted to the Pinelands Commission rather than to the Department, except for an application for an individual freshwater wetlands permit, which shall be submitted to the Department in accordance with this subchapter.

#### 7:7A-10.2 Basic content requirements for all applications

- (a) This section includes basic information required for every approval covered by this subchapter (see N.J.A.C. 7:7A-10.1(b)). Each application checklist will require this information and in addition will require information specific to the type of approval sought. The additional information required for each specific approval is set forth below at N.J.A.C. 7:7A-10.3 through 7:7A-10.8.

- (b) The application checklist for every application covered by this subchapter shall require the following:
1. An application form, including a certification of truth and accuracy that meets the requirements at N.J.A.C. 7:7A-10.10, completed as directed in the instructions and/or application checklist. The application form will include basic information regarding the site, the applicant, and the activities proposed;
  2. Unconditional written consent from the owner of the site, as defined at N.J.A.C. 7:7A-1.4, for Department representatives to enter the site to conduct site inspections;
  3. The appropriate fee, set forth at N.J.A.C. 7:7A-11;
  4. Visual materials, including but not limited to maps, plans, surveys, diagrams, or photographs as necessary to accurately portray the site, existing conditions on the site, and any activities proposed on the site;
  5. Written narrative information and/or reports as necessary to accurately describe the site, its location (including State plane coordinates), site conditions, and any planned activities, including schedules for performing regulated activities, if appropriate;
  6. Documentation that the applicable requirements at N.J.A.C. 7:7A-10.9, Public notice requirements for applications, have been met;
  7. Information and/or certifications regarding the presence or absence of endangered or threatened species habitat, historic or archaeological resources, or other features on the site that are relevant to determining compliance with the requirements of this chapter. Failure to provide all such information of which the applicant, its consultants, or agents is aware may result in denial or termination of the permit under N.J.A.C. 7:7A-14.5, and may subject the applicant to penalties for submittal of false information under N.J.A.C. 7:7A-16.9;
  8. The names and addresses of all consultants, engineers, and other persons providing technical assistance in preparing the application; and
  9. Any other information not listed herein, if necessary to ensure compliance with the Federal rules governing the Department's assumption of the Federal 404 program at 40 CFR §233.30.
- (c) In addition to the information required at (b) above, the Department may require any information necessary to clarify information previously submitted, to ensure compliance with State and/or Federal law, or to determine whether an application meets State and/or Federal standards.
- (d) Whenever the Department requires a construction plan or other visual depiction of proposed activities, the Department may require that certain information pertinent to the construction work be placed directly on the plan in order to provide notice of Department construction requirements to the workers who will carry out the permitted activities.

7:7A-10.3 Additional application requirements for an LOI

- (a) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2 above, an application checklist for an LOI shall require the information specified in this section.
- (b) The application checklist for a presence/absence LOI for a portion of a site under N.J.A.C. 7:7A-3.2 shall require information identifying the portion(s) of the site which is the subject of the application.
- (c) No additional information is required for an application for a line delineation LOI issued under N.J.A.C. 7:7A-3.3.
- (d) The application checklist for a line verification LOI issued under N.J.A.C. 7:7A-3.4 shall require the following:
  - 1. A proposed delineation of all freshwater wetlands, transition areas, and State open waters on the site, or portion thereof, which is the subject of the application. The delineation shall be clearly marked in the field as required by the application checklist;
  - 2. Soil borings and/or other physical indicators of the presence or absence of freshwater wetlands, transition areas, and/or State open waters;
  - 3. Data sheets or other materials that explain and support the delineation; and
  - 4. If the LOI is for a portion of a site, documentation that the site and portion meet the requirements at N.J.A.C. 7:7A-3.4(b)2i through iii, and information identifying the subject portion of the site in accordance with N.J.A.C. 7:7A-3.4(b)2iv.

7:7A-10.4 Additional application requirements for a general permit authorization

- (a) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2 above, the application checklist for a general permit authorization shall require:
  - 1. Any information specified as an application requirement in the general permit itself at N.J.A.C. 7:7A-5, if not included in N.J.A.C. 7:7A-10.2 above;
  - 2. A line delineation LOI issued under N.J.A.C. 7:7A-3.3, or a line verification LOI issued under N.J.A.C. 7:7A-3.4, if an LOI of either type has been issued. A presence/absence LOI issued under N.J.A.C. 7:7A-3.2 is not sufficient. If no LOI has been issued, or if only a presence/absence LOI has been issued, the application checklist shall require all information required for an application for a line delineation LOI or line verification LOI, covering the portion of the site that will be affected by the general permit activities;
  - 3. Information regarding whether other approvals are required for the activities by Federal, interstate, State and local agencies for the activity; information regarding whether any such approvals or denials have been received; and information

regarding whether the proposed activities are consistent with the rules, plans, or policies of other Federal, interstate, State and local agencies; and

4. If a site is known or suspected to be contaminated with toxic substances, and if the Department requests it, a laboratory analysis of representative samples of the soil or sediment on the site.

7:7A-10.5 Additional application requirements for an individual transition area waiver

(a) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2 above, an application checklist for an individual transition area waiver, as defined at N.J.A.C. 7:7A-1.4, shall require the following:

1. A line delineation LOI issued under N.J.A.C. 7:7A-3.3, or a line verification LOI issued under N.J.A.C. 7:7A-3.4, if an LOI of either type has been issued. A presence/absence LOI issued under N.J.A.C. 7:7A-3.2 is not sufficient. If no LOI has been issued for the site, or if only a presence/absence LOI has been issued, the application checklist shall require all information required for an application for a line delineation LOI or line verification LOI;
2. Information regarding whether other approvals are required for the activities by Federal, interstate, State and local agencies for the activity; information regarding whether any such approvals or denials have been received; and information regarding whether the proposed activities are consistent with the rules, plans, or policies of other Federal, interstate, State and local agencies; and
3. If a site is known or suspected to be contaminated with toxic substances, and if the Department requests it, a laboratory analysis of representative samples of the soil or sediment on the site.

(b) In addition to the information required at (a) above, the application checklist for a hardship transition area waiver under N.J.A.C. 7:7A-6.5 shall require the information required for an Individual freshwater wetlands permit application at 10.6(b).

7:7A-10.6 Additional application requirements for an individual freshwater wetlands or open water fill permit

(a) In addition to the basic information required for all applications in N.J.A.C. 7:7A-10.2, the application checklist for an individual freshwater wetlands or open water fill permit shall require the following information:

1. The basic project purpose of the proposed activity, including whether it is water-dependent, as defined at N.J.A.C. 7:7A-1.4;
2. A line delineation LOI issued under N.J.A.C. 7:7A-3.3, or a line verification LOI issued under N.J.A.C. 7:7A-3.4, if an LOI of either type has been issued. A presence/absence LOI issued under N.J.A.C. 7:7A-3.2 is not sufficient. If no LOI has been issued for the site, or if only a presence/absence LOI has been issued,

the application checklist shall require all information required for an application for a line delineation LOI or line verification LOI;

3. Information regarding whether other approvals are required for the activities by Federal, interstate, State and local agencies for the activity; information regarding whether any such approvals or denials have been received; and information regarding whether the proposed activities are consistent with the rules, plans, or policies of other Federal, interstate, State and local agencies; and
  4. If a site is known or suspected to be contaminated with toxic substances, and if the Department requests it, a laboratory analysis of representative samples of the sediment on the site.
  5. A copy of the deed and/or other legal documents pertaining to the site;
  6. Information regarding special aquatic sites, public lands, critical habitat, and other relevant environmental features of the site; and
  7. An alternatives analysis that meets the requirements at (b) below.
- (b) To ensure that the Department can evaluate all potential alternatives to a proposed project, the application checklist for an individual freshwater wetlands permit shall require an alternatives analysis that allows the Department to evaluate whether the requirements of N.J.A.C. 7:7A-7.2 are met, including, at a minimum the following:
1. A description of all alternatives considered, including offsite alternatives as well as onsite alternatives that could minimize environmental impacts on the site, and the reasons for rejecting each alternative;
  2. Information regarding the history of the property as a whole, as necessary to evaluate the cost to the property owner of various alternatives. Such information may include:
    - i. Document(s) showing when the property as a whole, as defined at N.J.A.C. 7:7A-1.4, was acquired and its purchase price;
    - ii. Documentation of any investments made to maintain and/or develop the property as a whole;
    - iii. Documentation of attempts by the property owner to sell the property or to obtain other property; and
  3. Documentation of the environmental impacts of the proposed project, and of ways to minimize those impacts.
- 7:7A-10.7 Additional application requirements for a combined flood hazard area permit and general permit authorization
- (a) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for a combined freshwater wetlands general permit 2 authorization

and flood hazard area permit authorizing an underground utility line shall require both of the following:

1. All information required under N.J.A.C. 7:7A-10.4 for an application for authorization under general permit 2; and
  2. Any additional information necessary to demonstrate compliance with N.J.A.C. 7:7A-5.2A.
- (b) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for a combined freshwater wetlands general permit 10A authorization and flood hazard area permit authorizing a very minor road crossing shall require both of the following:
1. All information required under N.J.A.C. 7:7A-10.4 for an application for authorization under general permit 10A; and
  2. Any additional information required under N.J.A.C. 7:13 to demonstrate compliance with the Department's Flood Hazard Area Control Act rules.
- (c) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for a combined freshwater wetlands general permit 11 authorization and flood hazard area permit shall require both of the following:
1. All information required under N.J.A.C. 7:7A-10.4 for an application for authorization under general permit 11; and
  2. Any additional information required under N.J.A.C. 7:13 to demonstrate compliance with the Department's Flood Hazard Area Control Act rules.
- (d) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for a combined freshwater wetlands general permit 20 authorization and flood hazard area permit shall require both of the following:
1. All information required under N.J.A.C. 7:7A-10.4 for an application for authorization under general permit 20; and
  2. Any additional information required under N.J.A.C. 7:13 to demonstrate compliance with the Department's Flood Hazard Area Control Act rules.
- (e) The application checklist for a combined general permit 26 authorization and flood hazard area permit shall require either of the following:
1. The basic information required for all applications under N.J.A.C. 7:7A-10.2, and in addition all information required under N.J.A.C. 7:7A-10.4 for an application for authorization under general permit 26; or
  2. The information required for approval of a project for cleaning, clearing, or desnagging a channel under the Flood Hazard Area Control Act rules at N.J.A.C. 7:7A-13.

7:7A-10.8 Additional application requirements for a modification or extension

- (a) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for a modification shall require the applicable information required in this section.
- (b) An application checklist for a minor modification shall require the following:
  - 1. For a change in ownership or operational control of a permitted site or activity under N.J.A.C. 7:7A-14.3(c)3:
    - i. A certification that no other change in the original permit is necessary; and
    - ii. A written agreement, signed by the current and the new permittees, containing a date for transfer of responsibility, coverage, and liability between the current and new permittees; and
  - 2. For a minor modification not covered at (b)1 above, a copy of the permit condition proposed for modification, the proposed modification, and information demonstrating that the modification is a minor modification under N.J.A.C. 7:7A-14.3(c).
- (c) An application for a minor modification does not require a fee under N.J.A.C. 7:7A-11, or public notice under N.J.A.C. 7:7A-10.9.
- (d) An application checklist for a major modification shall require the same information as an application for a new individual permit, except that the application need only address the portions of the existing permit affected by the proposed modification. Portions of the existing permit that are not affected by the proposed modification are not subject to public notice, public hearing, or other procedures that would apply to a new application.
- (e) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for a permit extension under N.J.A.C. 7:7A-14.6 shall include information reasonably necessary for the Department to evaluate whether the project or activities will comply with this chapter if extended as proposed.
- (f) In addition to the basic information required for all applications under N.J.A.C. 7:7A-10.2, the application checklist for an LOI extension under N.J.A.C. 7:7A-3.6 shall include any information reasonably necessary to determine if the information in the original LOI remains correct.

7:7A-10.9 Public notice requirements for applications

- (a) This section sets forth basic public notice requirements for applications. The application checklist for each type of permit, waiver, or general permit authorization will include more detail regarding how to comply with the notice requirements for the approval sought. An applicant shall fulfill the requirements in this section before submitting the application, and the application must include documentation that this section has been complied with.

- (b) The public notice requirements in this section apply to the applications listed in N.J.A.C. 7:7A-10.1(b), except that:
1. An application by a county or municipal agency for authorization to act under general permit 15, mosquito control activities, shall be subject only to the notice requirements found in that general permit at N.J.A.C. 7:7A-5.15; and
  2. An application for a minor modification under N.J.A.C. 7:7A-14.3 shall not require public notice.
- (c) Each notice or application required to be provided under this section shall be sent by certified mail, return receipt requested.
- (d) An applicant shall provide a copy of the complete application, as submitted to the Department, to the municipal clerk in each municipality in which the project site is located.
- (e) In addition to all other requirements in this section, an applicant shall provide a notice of the application, which meets the requirements in (g) below, to the following:
1. The construction official of each municipality in which the site is located;
  2. The municipal environmental commission, or other government agency with similar responsibilities;
  3. The municipal planning board of each municipality in which the site is located;
  4. The planning board of each county in which the site is located;
  5. All owners of land within 200 feet of the proposed disturbance, or of the site. If the proposed project is a linear development greater than one half mile long, the requirement for landowner notice under this paragraph may instead be met by following the procedures in (f) below; and
  6. For an individual permit application, a Department-generated list of interested parties in the area, if such a list exists.
- (f) If the proposed project is a linear development, as defined at N.J.A.C. 7:7A-1.4, or a trail or boardwalk, which is greater than one half mile long, an applicant for a permit other than an individual permit may satisfy the requirement in (e)5 above to notify neighboring landowners by:
1. Sending a notice complying with (g) below to all owners of land within 200 feet of any proposed above surface structure (not including conveyance lines suspended above the ground or small utility support structures such as telephone poles) related to the linear facility, such as a pump station, access road, treatment plant, power substation, grade separated interchange or similar structure; and
  2. Publishing a display advertisement. The advertisement shall be:
    - i. At least four column inches in size;

- ii. Published in the newspaper of record for each municipality in which the site is located; and
  - iii. Published in a newspaper with regional circulation in the region in which the site is located.
- (g) The notice of application required under this section shall include:
  - 1. A brief description of the proposed project;
  - 2. A map showing the location of the project site; and
  - 3. A copy of a form letter to the neighboring landowners specified in (e)5 above, with all blanks filled in to provide specific information regarding the proposed project. This form letter will be supplied by the Department with the application checklist.
- (h) The notice of application required under this section may cover applications for more than one project. However, for each project application covered by the notice, the information at (g)1 through 3 above must be included in the notice of application.
- (i) An applicant for an individual permit or for an open water fill permit shall comply with (c) through (g) above, as applicable, and in addition shall:
  - 1. Publish a display advertisement at least four column inches in size in the newspaper of record for each municipality in which the site is located; and
  - 2. If the proposed project involves more than ten acres of fill, publish a display advertisement in a newspaper with regional circulation in the region in which the site is located.
- (j) If an applicant amends an application during the application review process, the applicant shall comply with the notice requirements at N.J.A.C. 7:7A-12.6(f).
- (k) Upon request, the Department shall provide the applicant with copies of any comments submitted to the Department on the application.

7:7A-10.10 Signatories to permit applications and reports

- (a) A permit application shall be signed by the person or persons specified below:
  - 1. For a corporation, by a principal executive officer of at least the level of vice president;
  - 2. For a partnership or sole proprietorship, by a general partner or the proprietor, respectively;
  - 3. For a municipality, State, Federal, or other public entity, by either a principal executive officer or ranking elected official; or

4. For an entity not covered at (a) 1 through 3 above, by all individual owners of record.
- (b) All reports required by permits and other information requested by the Department shall be signed by a person described in (a) above, or by a duly authorized representative of that person. A person is a duly authorized representative only if:
    1. The authorization is made in writing by a person described in (a) above;
    2. The authorization specifies either an individual or a position having overall responsibility for the construction and/or completion of the regulated project or activity, such as the position of contractor, construction site supervisor, or position of equivalent responsibility. A duly authorized representative may, thus, be either a named individual or any individual occupying a named position; and
    3. The written authorization is submitted with the application to the Department.
  - (c) If an authorization under (b) above is no longer accurate because a different individual or position has overall responsibility for the construction and/or completion of the regulated facility or activity, a new authorization satisfying the requirements of (b) above must be submitted to the Department prior to or together with any reports, information, or applications to be signed by an authorized representative.
  - (d) If an application, report, survey, environmental impact statement, or other document required under this chapter is prepared for an applicant by a professional such as a consultant, engineer, architect, surveyor, attorney, or scientist; the document shall include the certification required under (e) below, signed by the professional responsible for preparing the document. This certification shall be in addition to the certification signed by the applicant.
  - (e) Any person signing a document under (a) or (b) above shall make the following certification:

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining and preparing the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment."
  - (f) Any survey submitted under this chapter shall be performed by a surveyor licensed in New Jersey. In addition, the Department may in some cases require that other documents be submitted, signed, sealed, and/or certified by a person with relevant qualifications such as a license or certification.

#### 7:7A-10.11 Confidentiality

- (a) Any information submitted to the Department under this chapter may be claimed as confidential by the submitter at the time of submittal.
- (b) Claims of confidentiality for the following information will be denied:

1. The name and address of any permit applicant or permittee;
  2. Effluent data;
  3. Permit application; and
  4. Permit decision.
- (c) Claims of confidentiality for all information not listed in (b) above will be denied unless the claimant can show that the information should be kept confidential under the requirements and procedures of 40 CFR Part 2.

## SUBCHAPTER 11 FEES

### 7:7A-11.1 General fee provisions

- (a) Each application submitted to the Department under this chapter shall include a fee, except as provided at (b) below. An application that does not include the fee required under this subchapter shall be considered administratively incomplete, and shall be handled accordingly under N.J.A.C. 7:7A-12.1. The fees for each application are set forth in the fee tables below.
- (b) The following applications shall not require an application fee:
1. An application submitted by an agency of the State under N.J.A.C. 7:7A-2.1(b);
  2. An application for authorization under general permit 16 or general permit 25, found at N.J.A.C. 7:7A-5.16 and 5.25, respectively;
  3. An application for authorization of activities on public land under general permit 17, found at N.J.A.C. 7:7A-5.17; and
  4. An application for a minor modification under N.J.A.C. 7:7A-14.3(c).
- (c) All fees shall be paid by personal check, certified check, attorney check, government purchase order, or money order, in accordance with the applicable application checklist.
- (d) If proposed activities require approval under this chapter and in addition require one or more other Land Use Regulation Program permits (such as a CAFRA permit, waterfront development permit, coastal wetlands permit, or flood hazard area permit), the application fee shall be the sum of the following:
1. The highest single application fee of all the permits required for the project; and
  2. Seventy-five percent of the application fee for each additional approval required.
- (e) Any fee required under this chapter that is subject to N.J.A.C. 7:1L shall be payable in installments in accordance with N.J.A.C. 7:1L.

- (f) An application fee is refundable if the Department returns the application as administratively incomplete under N.J.A.C. 7:7A-12.1(b). An application fee is not refundable once the application has been declared administratively complete under N.J.A.C. 7:7A-12.1. However, if the Department denies an application, or if the applicant withdraws the application under N.J.A.C. 7:7A-12.6, the Department shall credit the fee towards a new application for a revised project on the same site, if the new application is submitted within one year of the denial or withdrawal.
- (g) In some cases, an applicant's act or omission makes it necessary for Department staff to perform more than one site visit during the review of an application. In such a case, the Department shall assess an additional fee of up to one thousand dollars for each additional site visit. No permit, waiver, or letter of interpretation shall be issued until this fee has been paid.

### FEE TABLES

Application fees for LOIs (N.J.A.C. 7:7A-3):

| <u>Type of LOI</u>   | <u>Fee</u>  |
|--|---|
| Presence/absence LOI -- whole site   | \$200.00  |
| Presence/absence LOI under N.J.A.C. 7:7A-3.2 -- portion of a site<br>or footprint of disturbance | \$400.00  |
| Line delineation LOI under N.J.A.C. 7:7A-3.3 - site smaller than one acre                        | \$500.00  |
| Line verification LOI under N.J.A.C. 7:7A-3.4 - site smaller than one acre                       |   |
| Line verification LOI under N.J.A.C. 7:7A-3.4 - site one acre or larger                          | \$500.00<br>plus \$70.00 per acre <sup>1</sup> ,<br>up to \$50,000.00 |
| LOI extension under N.J.A.C. 7:7A-3.6  | \$200.00, or 25% of<br>original fee whichever is<br>greater           |
| LOI (any type) and a transition area waiver, (any type) if the site is one acre or smaller.      | \$700.00  |

Note: This application fee is for a combined transition area waiver and LOI, since the wetlands must be delineated before the review of the transition area waiver application.

LOI (any type) and a transition area waiver, (any type) if the site is larger than one acre. \$900.00 plus \$80.00 per acre<sup>1</sup>

Note: This application fee is for a combined transition area waiver and LOI, since the wetlands must be delineated before the review of the transition area waiver application.

LOI (any type) and a general permit authorization. Sum of applicable LOI and general permit authorization fees

LOI (any type) and an individual permit Applicable individual permit fee

1. When these fee tables refer to a cost "per acre," this means the cost is per acre or fraction thereof. For example, an area of one and one third acres would have the same fee as an area of two acres. When these fee tables refer to a cost "per 1/10 acre," this means the cost is per tenth of an acre or fraction thereof, such that an acre of 0.12 acres would have the same fee as an area of 0.2 acres. When these fee tables refer to an "acre affected," this means an acre of freshwater wetlands, State open waters, or transition area that will be affected by a regulated or prohibited activity.

Application fees for general permit authorizations (N.J.A.C. 7:7A-5):

| <u>Type of general permit</u>   | <u>Fee</u>   |
|---|--|
| Any general permit authorization, except:<br>General permit 16 (wildlife management);<br>General permit 25 (septic repair); or<br>General permit 17 (trail/boardwalk) on public land. | \$500.00   |
| Authorization under any of the following:<br>General permit 16 (wildlife management);<br>General permit 25 (septic repair); or<br>General permit 17 (trail/boardwalk) on public land. | None   |
| Multiple general permit authorizations for one site   | \$500.00 plus \$200.00<br>for each additional general permit |
| General permit authorization extension  | \$200.00   |
| Combined general permit 2 authorization and flood hazard area permit  | \$975.00   |
| General permit 10A, 11, or 20 authorization combined with a major flood hazard area permit  | \$4,375.00   |
| General permit 10A, 11 or 20 combined with a minor flood hazard area permit   | \$975.00   |
| Combined general permit 26 authorization and flood hazard area permit   | \$500.00   |

Application fees for transition area waivers (N.J.A.C. 7:7A-6):

| <u>Type of transition area waiver</u>   | <u>Fee</u> |
|---|------------|
| Any transition area waiver, if:<br>The entire site is covered by a valid line delineation or line verification LOI; and<br>the site is one acre or smaller. | \$200.00   |
| Any transition area waiver, if:<br>The affected portion of the site is covered by a valid line delineation or line verification LOI; and                    |            |

the site is over one acre. \$500.00 plus \$40.00 per acre affected<sup>2</sup>

Any transition area waiver, if:  
The site is not covered by a valid LOI, or has a presence/absence LOI only; and  
the site is one acre or less. \$700.00

Note: This application fee is for a combined transition area waiver and LOI, since the wetlands must be delineated before the review of the transition area waiver application.

Any transition area waiver if:  
The site is not covered by a valid LOI, or has a presence/absence LOI only; and  
the site is larger than one acre. \$900.00 plus \$80.00 per acre affected<sup>3</sup>

Note: This application fee is for a combined transition area waiver and LOI, since the wetlands must be delineated before the review of the transition area waiver application.

Multiple transition area waivers (unless all are special activity transition area waivers)  
Sum of all fees for all of the applicable transition area waivers

Multiple special activity transition area waivers for a single site \$500.00 plus \$200 for  
each additional special activity waiver

Transition area waiver (any type) and an individual freshwater wetlands or open water fill permit  
Either the applicable transition area waiver fee or the individual permit fee,  
whichever is higher

Transition area waiver (any type) and one or more general permit authorizations  
The applicable transition area waiver fee, plus \$500.00 for the first general permit  
authorization, and \$200.00 for each additional general permit authorization

Transition area waiver extension \$200.00

2. See note 1 above.

3. See note 1 above.

4. See note 1 above.

Application fees for exemption letters (N.J.A.C. 7:7A-2.10):

| <u>Type of approval</u> | <u>Fee</u> |
|-------------------------|------------|
| Exemption letter        | \$200.00   |

Application fees for individual permits (N.J.A.C. 7:7A-7):

| <u>Type of approval</u>                                  | <u>Fee</u>  |
|--|---|
| Individual freshwater wetlands or open water fill permit | \$2,000.00 plus \$200.00<br>per 1/10 acre affected <sup>4</sup> |
| Individual permit extension                              | \$1,000.00  |

Application fees for modifications (N.J.A.C. 7:7A-14):

| <u>Type of approval</u>                   | <u>Fee</u>   |
|---|--|
| Minor modification                        | None   |
| General permit authorization modification | \$200.00   |
| Major modification                        | 25% of the application fee originally charged for the approval that is being modified, or \$200.00, whichever is higher. |

Application Fee for Water Quality Certifications (N.J.A.C. 7:7A-2.1(d)):

| <u>Type of approval</u>             | <u>Fee</u>                                      |
|-------------------------------------|---|
| Water Quality Certificate           | \$2,000 plus<br>\$200.00 per 1/10 acre affected |
| Water Quality Certificate Extension | \$1,000.00                                      |

SUBCHAPTER 12 DEPARTMENT REVIEW OF APPLICATIONS

7:7A-12.1 Completeness review

- (a) Within twenty working days, as defined at N.J.A.C. 7:7A-1.4, after receiving an application, the Department shall review the application as follows:
1. If all items required by the application checklist are included, the Department shall declare the application administratively complete. However, if an included item is clearly deficient, the item shall not be considered to be included and the Department shall declare the application administratively incomplete; and
  2. If each application item is adequate to allow the Department to determine if the proposed project complies with this chapter, the Department shall declare the application technically complete.
- (b) If the application is not administratively complete under (a)1 above, the Department shall return the application to the applicant with a list of the missing items. The applicant may resubmit the application at any time. If the application is resubmitted within one year, the original application fee will be credited to the fee for the resubmitted application. If the application is not resubmitted, the applicant may obtain a fee refund upon request.
- (c) If the application is administratively complete under (a)1 above, the Department shall:
1. Notify the applicant that the application is administratively complete;

2. Transmit a copy of the application to other agencies if required under this chapter. For example, an application for an individual permit or a major discharge must be transmitted to EPA for comment under N.J.A.C. 7:7A-12.2;
  3. Publish notice of the application in the DEP Bulletin; and
  4. If the application is not technically complete under (a)2 above, request any additional information necessary for technical completeness.
- (d) If the Department requests additional information under (c)4 above, the applicant shall provide copies of the additional information to the persons who received a copy of the initial application under N.J.A.C. 7:7A-10.9, and to the reviewing agencies who received a copy under (c)2 above.
- (e) If an application is returned for incompleteness under (b) above, the applicant may submit a new application without repeating the public notice requirements of N.J.A.C. 7:7A-10.9 if the new application:
1. Is submitted within 60 days after the date the Department returned the original submittal; and
  2. Is sufficiently similar to the original submittal that the original public notice would provide reasonable notice of the characteristics of the new submittal to potential interested parties.
- (f) If a person submits an application and does not receive a response from the Department within the deadlines imposed in this subchapter, the person shall not be entitled to assume that the application is approved, except if the application is for authorization of the following activities and complies with the applicable general permit:
1. Maintenance of a stormwater management facility under general permit 1;
  2. Repair of a malfunctioning individual subsurface sewage disposal system under general permit 25; or
  3. Minor channel or stream cleaning activities under general permit 26.

#### 7:7A-12.2 USEPA review

- (a) Because the Department has assumed responsibility for the Federal 404 program in most freshwater wetlands and State open waters in New Jersey, the Federal Act requires that the USEPA oversee the State's administration of the program set forth in this chapter. The procedures in (b) through (j) below explain USEPA's oversight role, and the procedures which the State will follow to facilitate USEPA's oversight. In areas where the Department has assumed the Federal 404 program, the Department's freshwater wetlands or open water fill permit constitutes the permit required under this chapter as well as the Federal 404 permit, unless the permit specifies otherwise.
- (b) The Department shall transmit the following items to USEPA for review:

1. Each new proposed draft general permit. In general, an application for authorization to act under an adopted general permit will not require USEPA review, unless the activity proposed under the general permit itself constitutes a major discharge;
  2. Each application involving a major discharge, as defined at N.J.A.C. 7:7A-1.4;
  3. Any permit application, or category of permit applications, that the Department determines is appropriate for USEPA review;
  4. Any permit application that USEPA requests to review;
  5. Any additions or changes made to an application listed at 2 through 4 above after the application has been submitted to USEPA, as a result of a contested case proceeding in the Office of Administrative Law; and
  6. For informational purposes, an initial decision issued by an administrative law judge in a contested case proceeding which involves an application listed at 2 through 4 above.
- (c) For an item that requires USEPA review under (b) above, the Department shall promptly transmit to the Regional Administrator:
1. A complete copy of the item;
  2. Notice of every significant action taken by the Department related to the consideration of the permit application or other item; and
  3. A copy of any decision on the application or other item.
- (d) If USEPA intends to comment upon, object to, or make recommendations with respect to an item, or with respect to the Department's failure to accept the recommendations of an affected state pursuant to N.J.A.C. 7:7A-12.3(d); USEPA may notify the Department of this intent within 30 days of receipt of the permit application or other item. If the Department has been so notified, the permit or other item shall not be issued until after the receipt of such comments or within 90 days of the USEPA's receipt of the application or other item, or the Department response, whichever comes first. The USEPA may notify the Department within 30 days of receipt that there is no comment but that USEPA reserves the right to object within 90 days of receipt, based on any new information brought out by the public during the comment period or at a hearing.
- (e) When the Department has received a USEPA objection or requirement for a permit condition under this section, the State shall not issue the Federal 404 permit unless the steps required by the USEPA to eliminate the objection have been taken. However, the Department may issue a freshwater wetlands permit. Such a permit shall satisfy only the requirements of the New Jersey Freshwater Wetlands Protection Act and the permit shall not constitute a 404 permit. In such a case, the applicant would be responsible for obtaining any necessary 404 program approvals from the ACOE.
- (f) Within 90 days after receiving an objection or requirement for a permit condition by the USEPA, the Department or any interested person may request that the USEPA hold a

public hearing on the objection or requirement. USEPA shall conduct a public hearing if requested by the Department, or if warranted by significant public interest based on requests received.

- (g) If USEPA holds a public hearing under (f) above, USEPA shall, following that hearing, reaffirm, modify or withdraw the objection or requirement for a permit condition. USEPA shall notify the Department of this decision.
- (h) If USEPA holds a public hearing, the Department shall have 30 days after USEPA gives the Department notice of its decision under (g) above to take either of the actions at (i)1 or 2 below. If USEPA does not hold a public hearing, the Department shall have 90 days after receiving USEPA's original objection or requirement for a permit condition to take either of the actions at (i)1 or 2 below.
- (i) The Department shall take one of the following actions within the applicable deadline in (g) or (h) above:
  - 1. If the USEPA has withdrawn the objection or requirement for a permit condition, the State may issue the Federal 404 permit; or
  - 2. If the USEPA has not withdrawn the objection or requirement for a permit condition, the Department must do one of the following:
    - i. Issue a revised permit satisfying the USEPA's objection or including the required permit condition;
    - ii. Notify USEPA of its intent to deny the permit. If the Department intends to deny the permit it shall notify EPA of this intent within 30 days after receiving USEPA's notification; or
    - iii. Issue a State freshwater wetlands permit that does not constitute a Federal 404 permit and require the applicant to apply to the appropriate Federal agency for a permit under the Federal 404 program.
- (j) No Federal 404 permit shall be issued by the Department in the following circumstances, although the Department may issue a State freshwater wetlands permit that does not constitute a Federal 404 permit:
  - 1. When the Regional Administrator has objected to issuance of the permit and the objection has not been resolved;
  - 2. When the proposed discharges would be in an area which has been prohibited, withdrawn, or denied as a disposal site by the USEPA under Section 404(c) of the Federal Act, or when the discharge would fail to comply with a restriction imposed thereunder; or
  - 3. If the Army Corps of Engineers determines, after consultation with the Secretary of the Department in which the Coast Guard is operating, that anchorage and navigation of any of the navigable waters would be substantially impaired.

(k) The Department shall submit an application to the U.S. Fish and Wildlife Service for review of the potential for impacts on Federally listed threatened or endangered species if the application is for an individual permit, or for authorization under general permit 2, 4, 5, 6, 7, 10A, 10B, 11, 13, 15, 17, 18, 20, 22, 23, 24, 26 or 27; and the site is located in a municipality that has documented occurrences of threatened or endangered species, or critical habitat, as defined in the Federal Endangered Species Act, 16 U.S.C. §§1531 et seq. If an application is submitted for such review, the time required for a final decision on the application will be extended as necessary to complete the review in accordance with the time limits set forth in the Memorandum of Agreement between the Department and the U.S. Fish and Wildlife Service, executed in order for the Department to assume responsibility for the Federal 404 program.

(l) The Department shall identify all wetland permit applications for proposed projects that may affect properties which are listed, or are eligible for listing, on the New Jersey or National Register of Historic Places. In accordance with N.J.A.C. 7:4-8.1(a), an "effect" on "property which is listed or is eligible for listing on the New Jersey or National Register of Historic Places" can be direct or indirect and occurs whenever any aspect of the project causes or may cause any change, beneficial or adverse, in the quality of the historical, architectural, archaeological, or cultural characteristics that qualified a historic property to meet the criteria of evaluation for inclusion in the New Jersey or National Register.

Applications reflecting any of the following characteristics shall be deemed to present a high probability of the presence of historic and archaeological resources, requiring assessment:

1. Proposed projects within project areas containing known historic or archaeological resources, based upon information contained within the application, or as identified on copies of historic property maps prepared by the Department;
2. Proposed projects containing a project area exceeding 20 acres in size which includes a permanent water body (for example wetlands, pond, lake, river or perennial stream) or is located within 250 feet of a permanent water body;
3. Proposed projects for which available maps, photographs, or other information, or observations made during a site visit, indicate the presence of buildings, structures, or ruins over 50 years old within the project area that could potentially be affected by the proposed project;
4. Proposed projects including new, replacement, reconstructed, or rehabilitated bridges or culverts; and
5. Proposed projects on which letters are received from concerned citizens or others indicating the possible presence of historic properties within or adjacent to the project area.

(m) Applicants who are or will be pursuing Federal financial assistance, permits, licenses, or other approvals for the project that is the subject of the freshwater wetlands permit application shall supply a copy of the consultation comments provided by the Department's Historic Preservation Office (HPO) in its role as staff to the Federally designated State Historic Preservation Officer (SHPO) under Section 106 of the National Historic

Preservation Act (16 U.S.C. 470(f), together with a statement detailing how the comments have been incorporated into the project, with the State freshwater wetlands permit application. The Department will consider that information as a part of its review under this chapter.

1. If an applicant is not or will not be pursuing Federal financial assistance as described in (m) above, the applicant shall provide the Department with a statement to that effect.

- (n) Public entities that are or will be pursuing a project authorization application, pursuant to N.J.A.C. 7:4-7 for the project that is the subject of the freshwater wetlands permit application shall comply with either 1. or 2. below. For the purposes of this subsection, "public entities" means the State, County, Municipality, or an agency or instrumentality thereof:
1. If the public entity has received a project authorization from the Department pursuant to N.J.A.C. 7:4-7 prior to applying for a State freshwater wetlands permit, a copy of the project authorization shall be submitted with the permit application. The Department will consider that authorization as a part of its review under this Chapter; or
  2. If the public entity has not yet begun the process for obtaining a project authorization pursuant to N.J.A.C. 7:4-7 at the time of application for a State freshwater wetlands permit, the applicant shall consult directly with the Department's Historic Preservation Office to initiate the project authorization process at the same time as the permit application is processed.

#### 7:7A-12.3 Public comment on an application

- (a) The Department shall publish notice in the DEP Bulletin of each administratively complete application in accordance with N.J.A.C. 7:7A-12.1, except for an application for a minor modification. This notice shall constitute notice of the application to all interested persons except those who must be notified by the applicant under N.J.A.C. 7:7A-10.9.
- (b) The Department shall make copies of all applications available for public inspection by appointment in the offices of the Department in Trenton (see N.J.A.C. 7:7A-1.3 for address) during normal business hours.
- (c) The applicant shall transmit a copy of each application to the clerk of the municipality in which the project is located in accordance with N.J.A.C. 7:7A-10.9, to be made available for public inspection.
- (d) The public shall have 30 days to comment on an application after the Department publishes notice of the application in the DEP Bulletin under (a) above. The Department shall consider all written public comments submitted within this time. The Department may, in its discretion, consider comments submitted after this date.
- (e) If a proposed discharge may affect the biological, chemical, or physical integrity of the waters of any state(s) other than New Jersey, the Department shall provide an opportunity for such state(s) to submit written comments within the public comment period and to suggest permit conditions. If these recommendations are not accepted, the Department

shall notify the affected state and the USEPA in writing, prior to permit issuance, of the Department's intent not to accept these recommendations, together with the reasons for so doing. The EPA shall then have the same amount of time provided for applications and draft general permits in N.J.A.C. 7:7A-12.2 to comment upon, object to, or make recommendations regarding the Department's action.

7:7A-12.4 Hearings on an application for an individual permit or individual transition area waiver

- (a) Within 30 days after a notice of an application for an individual permit or individual transition area waiver is published in the DEP Bulletin, interested persons may request in writing that the Department hold a public hearing on the application. Requests shall state the nature of the issues proposed to be raised at the hearing.
- (b) The Department may issue or deny an individual permit or individual transition area waiver without a public hearing. However, the Department will hold a public hearing if:
  - 1. There is a significant degree of public interest in the application, as manifested by written requests for a hearing within the 30 day hearing request period set forth in (a) above. In considering the degree of public interest, the Department will consider whether the issues raised in the hearing requests are relevant to the application review;
  - 2. A public hearing is requested by USEPA; or
  - 3. The Department determines that the public interest would be served by holding a hearing.
- (c) If a hearing is to take place, the Department shall, within 30 days after the end of the 30 day hearing request period set forth in (a) above:
  - 1. Set a date and time for the public hearing;
  - 2. Choose a location for the hearing, in the county where the freshwater wetlands, transition areas, and/or State open waters affected by the application are located;
  - 3. Notify the applicant; and
  - 4. Publish a notice announcing the date, place, and time of the public hearing in the DEP Bulletin.
- (d) A public hearing held under this section shall be a non-adversarial proceeding, conducted solely to provide information to the public and the Department regarding the application under review.
- (e) The applicant shall give public notice of the public hearing by doing the following, at least 30 days before the hearing:
  - 1. Sending a completed public hearing notice form, obtained from the Department at the address in N.J.A.C. 7:7A-1.3 or the Land Use Regulation Program website at [www.state.nj.us/dep/landuse](http://www.state.nj.us/dep/landuse), to the following:

- i. All persons to whom a complete application must be sent under N.J.A.C. 7:7A-10.9(d);
    - ii. All persons to whom a notice of an application must be sent under N.J.A.C. 7:7A-10.9(e); and
    - iii. All persons who submitted comments on the application during the hearing request period set forth in (a) above; and
  - 2. Publishing a display advertisement containing the completed hearing notice form, in accordance with N.J.A.C. 7:7A-10.9(h).
- (f) The applicant shall submit proof that public notice of the hearing has been provided in accordance with this section. This proof of notice shall be submitted to the Department at least three days prior to the public hearing. If proof of publication is unavailable three days prior to the hearing, the applicant may submit a notarized affidavit stating that notice of the hearing has been published, and specifying the date and newspaper in which such notice was published.
  - (g) The Department shall maintain a copy of the hearing transcript and all written comments received. The transcript and written comments shall be made part of the official record on the application and shall be available for public inspection in the Department's Trenton Office. See N.J.A.C. 7:7A-1.3 for address.
  - (h) The applicant shall provide a court reporter, bear the cost of the hearing and provide the Department with a transcript.
  - (i) The presiding official at the non-adversarial public hearing shall have broad discretion with respect to oral and written presentations by interested persons. This discretion shall be exercised to allow every person the opportunity to speak, to reasonably limit the length of individual testimony, and to ensure the maintenance of an orderly forum. At the conclusion of statements by interested persons, the applicant shall be afforded the opportunity to speak on the statements offered by interested persons.
  - (j) Any interested person may submit information and comments concerning the application. The information and/or comments must be submitted in writing within 15 days after the hearing.

#### 7:7A-12.5 Final decisions

- (a) The Department shall issue or deny a permit or waiver within 180 days of submittal of a complete application, provided the Department has satisfied all of the requirements in N.J.A.C. 7:7A-12.2.
- (b) If the Department issues or denies a permit, the Department shall send notice thereof to the applicant.

- (c) The Department may issue a permit imposing conditions necessary for compliance with the Freshwater Wetlands Protection Act, this chapter, the Federal Act and the New Jersey Water Pollution Control Act. Any regulated activities undertaken under the authority of any issued permit, waiver, or general permit authorization shall constitute an acceptance by the applicant of the entire permit including all conditions therein.
- (d) Decisions by the Department shall be published in the DEP Bulletin and a copy of every issued individual permit which requires USEPA review under N.J.A.C. 7:7A-12.2 shall be transmitted to USEPA.
- (e) The permit application review process may be extended by mutual agreement between the applicant and the Department.
- (f) Whenever possible, the Department shall make a final decision on an application for a combined general permit authorization and flood hazard area permit within the deadlines that apply to flood hazard area permits under the Flood Hazard Area Control Act rules at N.J.A.C. 7:13 and the 90-day construction permit rules at N.J.A.C. 7:1C. However, if the Department does not make a final decision on such an application within those deadlines, only the portion of the application that is governed by the substantive standards in N.J.A.C. 7:13 shall be deemed approved. The portion of the application that is governed by the substantive standards in this chapter shall not be deemed approved until the Department issues a written general permit authorization for the regulated activities.

#### 7:7A-12.6 Cancellation, withdrawal, resubmission and amendment of applications

- (a) The Department may cancel an application, whether or not the application has been declared administratively complete. An applicant may withdraw, amend, and/or resubmit its application. This section applies to all applications, including an application for a permit as defined at N.J.A.C. 7:7A-1.4, an application for a letter of interpretation, and a request for an exemption letter.
- (b) The Department shall cancel an application if the Department requests additional information regarding the application, and the information is not submitted within thirty days after the date of the request. Before canceling an application, the Department shall send the applicant a letter stating that the application will be cancelled. If, within 15 days of the date of the Department's letter, the applicant submits the information, or a letter providing good cause for the delay, the Department shall extend the time required for submittal of the information. If the applicant does not submit the information or a letter providing good cause, the Department shall cancel the application.
- (c) If the Department cancels an application, the application fee will not be refunded. The Department will purge the cancelled application from its files and a new application, including a new application fee, will be required if the applicant wishes to pursue the project.
- (d) An applicant may withdraw an application at any time in the application review process. If an application is withdrawn, the application fee will not be refunded. However, if the requirements of (e)2 below are met, the fee may be credited toward a future application.

- (e) If the Department cancels an application, or if the applicant withdraws an application, the applicant may resubmit an application for a revised project on the same site. The Department will treat the resubmitted application as a new application. The fees for the resubmitted application shall be as follows:
1. If the Department cancelled the original application under (b) above, a new fee under N.J.A.C. 7:7A-11 will be required;
  2. If the applicant withdrew the original application under (d) above, and resubmits the application within one year of the date of withdrawal, the original application fee will be credited to the new application.
- (f) An applicant may choose to amend an application at any time as part of the permit review process. If an applicant amends an application:
1. The applicant shall provide a copy of the new or changed information to the same persons who received a complete copy of the initial application under 7:7A-10.9, Public notice requirements for applications. The information need not be provided to persons who received only a notice of the application, unless the Department determines that the change will increase the environmental impact of the project; and
  2. The amendments shall constitute a new submission and the Department may, at its discretion, require reinitiation of the entire application and review process.

#### 7:7A-12.7 Resubmittal of a denied application

If the Department denies an application, the applicant may resubmit an application for a revised project on the same site. The Department will treat the resubmitted application as a new application. The resubmitted application shall include a new fee in accordance with N.J.A.C. 7:7A-11.

### SUBCHAPTER 13 CONTENTS OF PERMITS AND WAIVERS

#### 7:7A-13.1 Standard conditions that apply to all permits

- (a) The following conditions apply to all permits issued under this chapter, including all waivers and general permit authorizations:
1. **Duty to comply:** The permittee shall comply with all conditions of the permit. Any noncompliance with a permit, including a waiver or general permit authorization, constitutes a violation of the Freshwater Wetlands Protection Act and this chapter, and is grounds for enforcement action, for termination, termination and reissuance, or modification, or for denial of an extension. In some cases, noncompliance with a permit or general permit authorization, may also constitute a violation of the Water Pollution Control Act and/or the Federal Act;

2. Duty to reapply: If the permittee wishes to continue an activity covered by the permit after the expiration date of the permit, the permittee must apply for and obtain a permit extension or a new permit, prior to the permit's expiration;
3. Duty to halt or reduce activity: It shall not be a defense for a permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of the permit;
4. Duty to minimize environmental impacts: The permittee shall take all reasonable steps to prevent, minimize or correct any adverse impact on the environment resulting from activities conducted pursuant to the permit, or from noncompliance with the permit. Mitigation consistent with N.J.A.C. 7:7A-15 will also be required for freshwater wetlands permits, open water fill permits and some General permits;
5. Proper operation and maintenance: The permittee shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the permit. Proper operation and maintenance includes effective performance, adequate funding, adequate operator staffing and training, and adequate laboratory and process controls, including appropriate quality assurance procedures. This provision requires the operation of back-up or auxiliary facilities or similar systems only when necessary to achieve compliance with the permit. This provision requires the proper execution of any approved mitigation proposal designed to mitigate losses caused by the permitted activity. The permittee shall maintain the authorized work areas in good condition and in accordance with the permit;
6. Permit actions: The permit may be modified, suspended, or terminated for cause. The filing of a request by the permittee for a modification, or a notification of planned changes or anticipated noncompliance does not stay any condition of a permit, including a waiver or general permit authorization;
7. Property rights: The permit does not convey any property rights of any sort, or any exclusive privilege;
8. Duty to provide information: The permittee shall furnish to the Department within a reasonable time, any information which the Department requests to determine whether cause exists for modifying, terminating and reissuing, or terminating the permit, or to determine compliance with the permit. The permittee shall also furnish to the Department, upon request, copies of records required to be kept by the permit or waiver;
9. Inspection and entry: The permittee shall allow the Department, or an authorized representative, upon the presentation of credentials, to:
  - i. Enter upon the permittee's premises where a regulated facility or activity is located or conducted, or where records must be kept under the conditions of the permit;
  - ii. Have access to and copy, at reasonable times, any records that must be kept under the conditions of the permit;

- iii. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under the permit; and
  - iv. Sample or monitor at reasonable times, for the purposes of assuring compliance or as otherwise authorized by the Federal Act, by the Freshwater Wetlands Protection Act, or by any rule or order issued pursuant thereto, any substances or parameters at any location;
10. Monitoring and records requirements are as follows:
- i. Samples and measurements taken for the purpose of monitoring shall be representative of the monitored activity;
  - ii. The permittee shall retain records of all monitoring information, including all calibration and maintenance records and all original strip chart recordings for continuous monitoring instrumentation, copies of all reports required by the permit, and records of all data used to complete the application for the permit, for a period of at least three years from the date of the sample, measurement, report or application. This period may be extended by the Department at any time;
  - iii. Records of monitoring information shall include:
    - (1) The date, exact place, and time of sampling or measurements;
    - (2) The individual(s) who performed the sampling or measurements;
    - (3) The date(s) analyses were performed;
    - (4) The individual(s) who performed the analyses;
    - (5) The analytical techniques or methods used; and
    - (6) The results of such analyses;
11. Signatory requirement: All applications, reports, or information submitted to the Department shall be signed and certified as required in N.J.A.C. 7:7A-10.10; and
12. Reporting requirements are as follows:
- i. Planned changes: The permittee shall give notice to the Department as soon as possible of any planned physical alterations or additions to the permitted project or activity;
  - ii. Anticipated noncompliance: The permittee shall give advance notice to the Department of any planned changes in the permitted project or activity which may result in noncompliance with permit requirements;
  - iii. Transfers: The permit is not transferable to any person except after notice to the Department. The Department may require modification or termination

and reissuance of the permit to change the name of the permittee and incorporate such other requirements as may be necessary to comply with N.J.A.C. 7:7A-14.3. In some cases, modification or termination and reissuance is mandatory;

- iv. Monitoring reports: Monitoring results shall be reported at the intervals specified elsewhere in the permit;
  - v. Twelve hour reporting: The permittee shall report any noncompliance which may endanger health or the environment. Any information shall be provided orally within 12 hours from the time the permittee becomes aware of the potentially dangerous circumstances. A written submission shall also be provided within five days of the time the permittee becomes aware of the circumstances. The written submission shall contain a description of the noncompliance and its cause; the period of noncompliance, including exact dates and times, and, if the noncompliance has not been corrected, the anticipated length of time it is expected to continue; and steps taken or planned to reduce, eliminate, and prevent recurrence of the noncompliance;
  - vi. Other noncompliance: The permittee shall report all instances of noncompliance not reported pursuant to (a)12 i, iv, and v above, at the time monitoring reports are submitted. The reports shall contain the information listed in (a)12v above; and
  - vii. Other information: Where the permittee becomes aware that it failed to submit any relevant facts in an application, or submitted incorrect information in an application or in any report to the Department, it shall promptly submit such facts or information; and
  - viii. Duty to mitigate: The permittee shall perform any mitigation required under the permit prior to or concurrently with regulated activities in accordance with N.J.A.C. 7:7A-15.3(a). If a permittee performs permitted activities without performing required mitigation, the acreage of mitigation required shall be increased by 20% each year in accordance with N.J.A.C. 7:7A-15.3(b).
- (b) The permittee need not comply with the conditions of a permit, including a waiver or general permit authorization, to the extent and for the duration that such noncompliance is authorized in an emergency permit approved by the Department under N.J.A.C. 7:7A-8.
- (c) If a permit, including a transition area waiver or general permit authorization, is issued, regulated activities are not authorized under the permit, and construction shall not be started, until the Department receives a written acceptance of the all terms and conditions of the permit from the permittee. A permit acceptance form is available from the Department as part of each application checklist. If a permittee begins regulated activities prior to submittal of the written permit acceptance, the permittee shall be deemed to have accepted all terms and conditions of the permit as of the date the activities were begun.
- (d) A copy of the permit, including an authorization or transition area waiver, shall be kept on the site and shall be available for public inspection. All projects authorized by an individual or general permit or transition area waiver shall be posted with a sign, prominently

displayed at the main entrance to the property or work site, at all times from commencement to completion of the permitted activity. The sign shall contain at least the following information:

1. The work which is authorized by the Department;
  2. The type of permit that authorized the work, and the Department's file number;
  3. A Department phone number for verification; and
  4. The location on the site at which the permit and plans may be inspected.
- (e) A permit, including a waiver or general permit authorization, runs with the land and is binding upon the permittee and the permittee's successors in interest in the land or in any part thereof.
- (f) A permit, including a waiver and/or a general permit authorization, issued under this chapter does not relieve a permittee from the obligation to obtain any other permits or approvals required by law.

#### 7:7A-13.2 Establishing permit conditions

- (a) In addition to the standard conditions required in all permits under N.J.A.C. 7:7A-13.1, the Department shall establish conditions in a permit, including a waiver or general permit authorization, as required on a case-by-case basis, to assure compliance with all applicable requirements of the Federal Act, the Freshwater Wetlands Protection Act, the Water Pollution Control Act, this chapter and other applicable rules or regulations. For the purposes of this subsection, an applicable requirement is a statutory or regulatory requirement which takes effect before the Department's final administrative decision on a permit, or before the modification or termination and reissuance of a permit.
- (b) In addition to the standard requirements in N.J.A.C. 7:7A- 13.1, each permit shall include information meeting the following requirements, when applicable:
1. A specific identification and description of the authorized activity, including:
    - i. The name and address of the permittee and the permit application identification number;
    - ii. The use or purpose of the regulated activity;
    - iii. The type and quantity of the materials to be discharged or used as fill;
    - iv. Any structures proposed to be erected;
    - v. The location and boundaries of the activity site(s), including a detailed sketch and the name and description of affected freshwater wetlands, State open waters, and transition areas, identification of the HUC 11, as defined at N.J.A.C. 7:7A-1.4; and

vi. A reference to the specific site plans depicting the approved regulated activity(ies);

2. Provisions ensuring that the regulated activity will be conducted in compliance with the environmental guidelines issued under section 404(b)(1) of the Federal Act (40 C.F.R. Part 230), the Freshwater Wetlands Protection Act, and this chapter, including conditions to ensure that the regulated activity shall be conducted in a manner which minimizes adverse impacts upon the physical, chemical, and biological integrity of the waters of the United States, such as requirements for restoration or mitigation;
  3. Any requirements necessary to comply with water quality standards established under applicable Federal or State law. If an applicable water quality standard is promulgated or modified after the permit or waiver is issued, the permit or waiver shall be modified as provided in N.J.A.C. 7:7A- 14;
  4. Requirements necessary to comply with any applicable toxic effluent standard or prohibition under section 307(a) of the Federal Act or applicable State or local law. If an applicable toxic effluent standard or prohibition is promulgated or modified after the permit or waiver is issued, the permit or waiver shall be modified as provided in N.J.A.C. 7:7A- 14;
  5. Applicable best management practices (BMPs) as defined at N.J.A.C. 7:7A-1.4;
  6. Any conditions necessary for general permits as required under N.J.A.C. 7:7A- 4 or 5;
  7. A specific date on which the permit shall automatically expire if the authorized work has not been commenced, unless before the automatic expiration date the permit is terminated and reissued, or modified, or extended; and
  8. Reporting of monitoring results. All permits and waivers shall specify:
    - i. Requirements concerning the proper use, maintenance, and installation, when appropriate, of monitoring equipment or methods (including biological monitoring methods when appropriate);
    - ii. Required monitoring including type, intervals, and frequency sufficient to yield data which are representative of the monitored activity including, when appropriate, continuous monitoring; and
    - iii. Applicable reporting requirements based upon the impact of the regulated activity.
- (c) The Department may in some cases include a permit condition requiring a preconstruction meeting on the site of permitted activities. Such a condition shall specify how many days prior to construction the permittee must notify the Department so that the preconstruction meeting can be scheduled.

- (d) All permit conditions shall be incorporated either expressly or by reference. If incorporated by reference, a specific citation to the applicable rules or regulations or requirements shall be given in the permit.

#### 7:7A-13.3 Duration of permits

- (a) A permit, including a waiver or general permit authorization, shall be effective for a fixed term not to exceed five years from the date the Department issues the permit. An extension may be available in some cases under N.J.A.C. 7:7A-14.6.
- (b) This section does not govern letters of interpretation or exemption letters. Provisions governing the duration and extension of LOIs are found at N.J.A.C. 7:7A-3.6. Provisions governing the duration of exemption letters are found at N.J.A.C. 7:7A-2.10.

#### 7:7A-13.4 Effect of a permit

- (a) Compliance with a permit, including a general permit authorization, during its term constitutes compliance, for enforcement purposes, with sections 301, 307, and 403 of the Federal Act, with the Freshwater Wetlands Protection Act, and with this chapter. Because transition areas are not regulated under the Federal Act, compliance with a transition area waiver during its term constitutes compliance, for enforcement purposes, with the Freshwater Wetlands Protection Act and with this chapter. However, a permit may be modified, terminated and reissued, suspended, or terminated during its term for cause as set forth in this chapter.
- (b) The issuance of a permit, including a waiver or general permit authorization, does not convey property rights of any sort, or any exclusive privilege.

### SUBCHAPTER 14 CHANGES TO ISSUED PERMITS OR WAIVERS

#### 7:7A-14.1 General provisions for changing an issued permit

- (a) The Department may modify a permit, including a waiver or general permit authorization for cause, or may approve a modification in response to a modification application from the permittee. The Department shall process a modification in accordance with N.J.A.C. 7:7A-14.3.
- (b) The Department shall suspend a permit for cause in accordance with N.J.A.C. 7:7A-14.4, or in response to a request from the permittee.
- (c) The Department shall terminate a permit for cause in accordance with N.J.A.C. 7:7A-14.5, or in response to a request from the permittee.
- (d) The Department may extend a permit in accordance with N.J.A.C. 7:7A-14.6.
- (e) Each modification, suspension, or termination that would require EPA review under N.J.A.C. 7:7A-12.2 if it were an application for a new permit shall be transmitted to EPA for review.

- (f) The Department shall not modify, suspend, or terminate a Federal 404 permit if USEPA objects under N.J.A.C. 7:7A-12.2.
- (g) The Department need not modify, suspend or terminate a permit prior to taking enforcement action under N.J.A.C. 7:7A-16.

#### 7:7A-14.2 Transfer of a permit

If a permittee wishes to transfer a site to another person, or to transfer operational control of permitted activities to another person, the permittee shall submit an application for a modification, which meets the requirements at N.J.A.C. 7:7A-14.3 below. If all permitted activities are completed, including any required mitigation, a modification is not required.

#### 7:7A-14.3 Modification of a permit

- (a) A modification of a permit, including a transition area waiver or general permit authorization, may be requested by a permittee or, in the cases set forth at (f) below, the Department may modify a permit on its own initiative.
- (b) A permittee shall apply for a change to an existing permit through one of the following:
  - 1. A minor modification under (c) below. A minor modification may be made to any permit, including a transition area waiver or general permit authorization;
  - 2. A major modification under (d) below. A major modification may only be made to an individual freshwater wetlands permit, open water fill permit, or transition area waiver; and
  - 3. A general permit authorization modification under (e) below.
- (c) The following changes are minor modifications that may be made to any permit, including a general permit authorization or transition area waiver:
  - 1. Correction of a typographical error that does not materially affect the terms of the permit or waiver;
  - 2. An increase in the frequency of monitoring or reporting by the permittee;
  - 3. A change in ownership or operational control of a project, where no other change in the original permit or waiver is necessary. If any other change in the permit is necessary, the change shall be made through a major modification; and
  - 4. A change in materials, construction techniques, or the minor relocation of an activity on a site, if the change is required by another permitting agency. However, this change is not a minor modification if the change would result in additional wetland, State open water or transition area impacts over those of the original permit or waiver.

- (d) Any change not listed at (c) above as a minor modification, if affecting a project covered by an individual freshwater wetlands permit, open water fill permit, or transition area waiver, shall constitute a major modification. To obtain approval for a major modification, an applicant shall meet the same substantive and procedural standards that would apply to an application for a new individual permit, except that the application need only address the portions of the permit affected by the proposed modification. Portions of the permit that are not affected by the proposed modification are not subject to public notice, public hearing, Department review, or other procedures that would apply to an application for a new individual permit.
- (e) Any change not listed at (c) above as a minor modification, if affecting a project covered by a general permit authorization, shall meet the following requirements:
1. The changed project would continue to be authorized under the same general permit; and
  2. The proposed change would not result in a significant change in the scale, use or environmental impact of the project as approved. A change that will result in a reduction in environmental impact shall not constitute a significant change. Examples of significant changes include, but are not limited to, increased clearing, grading, filling or impervious surfaces, a change in stormwater management technique, and movement of the project to a different wetland or location.
- (f) The following are causes for which the Department may modify a permit, including a transition area waiver or general permit authorization, on its own initiative:
1. The permittee proposes substantial changes or additions to the permitted activity, and these changes or additions justify conditions that are not in the existing permit or waiver;
  2. The Department receives information that was not available at the time the permit was issued (other than revised regulations, guidance, or test methods), which would have justified different conditions at the time of issuance. This includes information indicating that cumulative environmental effects of issued permits are unacceptable;
  3. Circumstances relating to the permitted activity have changed since the permit was issued and justify changed conditions;
  4. Cause exists for the Department to terminate the permit under N.J.A.C. 7:7A-14.5, but the Department determines that a modification will ensure that the project complies with this chapter;
  5. The standards or rules on which the permit was based have been amended, or changed by judicial decision, after the permit was issued; or
  6. The ownership or operational control of the site has been transferred to a person other than the permittee, the permitted activities are not completed, and the permittee has not applied for a minor modification reflecting the transfer as required under N.J.A.C. 7:7A-14.3(c).

- (g) If the Department intends to modify a permit, the Department shall notify the permittee in writing. The notice shall:
  - 1. State the reasons for the modification;
  - 2. Order the permittee to immediately stop the activities that had been authorized under the permit; and
  - 3. Notify the permittee of the right to request a meeting with the Department, or a public hearing, within ten days of the permittee's receipt of the notice.
- (h) An applicant for a modification shall follow the procedures at N.J.A.C. 7:7A-10.8. An application for a modification to a general permit authorization does not require public notice in accordance with N.J.A.C. 7:7A-10.9. An application for a minor modification does not require a fee under N.J.A.C. 7:7A-11, or public notice under N.J.A.C. 7:7A-10.9.
- (i) An application for a modification shall be reviewed in accordance with the applicable provisions of N.J.A.C. 7:7A-12, Department review of applications.

7:7A-14.4 Suspension of a permit, waiver, or general permit authorization

- (a) When the Department suspends a permit, including a waiver or general permit authorization, any work that is being conducted under the authority of the permit shall stop immediately upon receipt of the notice required under (c) below.
- (b) The Department shall suspend a permit if:
  - 1. The Department makes a written determination that immediate suspension would be in the public interest; or
  - 2. Cause exists for the Department to terminate the permit under N.J.A.C. 7:7A-14.5, but the Department determines that suspension is more appropriate.
- (c) The Department shall notify the permittee of a suspension in writing. The notice shall:
  - 1. State the reasons for the suspension, including the written determination of public interest, if one was prepared under (b)1 above;
  - 2. Order the permittee to immediately stop the activities that had been authorized under the suspended permit; and
  - 3. Notify the permittee of the right to request a meeting with the Department, or a public hearing, within ten days of the permittee's receipt of the notice.
- (d) If the permittee requests a public hearing regarding the suspension, the Department and permittee shall follow the procedures at N.J.A.C. 7:7A-12.4.
- (e) The Department shall reinstate, modify or terminate the permit after the hearing or meeting or, if no hearing or meeting is held, within a reasonable amount of time after the notice required under (c) above.

7:7A-14.5 Termination of a permit

- (a) The following are causes for the Department to terminate a permit, including a waiver or general permit authorization, during its term, or to deny a permit extension:
1. Noncompliance by the permittee with any portion or condition of the permit, including pursuing land uses other than those authorized by an individual permit. For example, if an individual permit authorizes construction of a 10,000 square foot preschool, construction of a 10,000 square foot retail store on the same footprint would constitute noncompliance with the permit;
  2. The permittee's failure in the application or during the permit issuance process to disclose fully all relevant facts, or the permittee's misrepresentation of any relevant facts at any time;
  3. A Department determination that the issuance of the permit was based on false or inaccurate information; or
  4. The permit has unanticipated negative environmental impacts such as, but not limited to, excessive erosion and subsequent siltation, destruction of vegetation not covered by the permit, or die-off of aquatic biota, which become apparent during the performance of the permitted activities.
- (b) Prior to a termination, the Department shall furnish written notice to the permittee by certified mail. The permittee shall stop all regulated activities immediately upon receiving the notice. Within ten days after receiving the notice, the permittee shall:
1. Remedy the violation or unanticipated negative environmental impacts;
  2. Submit a plan for bringing the activities back into compliance or correcting the unanticipated impacts; or
  3. Request a hearing under N.J.A.C. 7:7A-1.7.
- (c) If the permittee has not taken one of the actions required at (b) above within 10 days after receiving the Department's notice, the permit, waiver, or general permit authorization shall automatically terminate and the permittee shall remedy the unanticipated negative environmental impacts or violations. Once the impacts or violations are remedied, the Department may reinstate the permit or require the applicant to apply for a new permit.
- (d) If a permittee submits a plan under (b)2 above, the permittee shall begin implementation of the plan immediately upon the Department's approval of the plan, and shall remedy the violations or unanticipated impact within 60 days.
- (e) If a permit, including a waiver or general permit authorization, is terminated, the permittee shall restore the site to its pre-activity condition to the maximum extent practicable and feasible, or otherwise compensate for any loss in resource value through mitigation under N.J.A.C. 7:7A-15. This restoration or compensation shall be completed within 90 days after the permit is terminated, unless the Department authorizes in writing a longer period of time.

#### 7:7A-14.6 Permit extensions

- (a) This section governs the extension of a permit, including a waiver or a general permit authorization. This section does not apply to LOIs or exemption letters. Provisions governing the duration and extension of LOIs are found at N.J.A.C. 7:7A-3.6. Provisions governing the duration of exemption letters are found at N.J.A.C. 7:7A-2.10.
- (b) The Department shall issue one five-year extension of a permit only if:
  - 1. The permittee applies for the extension at least 90 days prior to the expiration of an individual permit or individual transition area waiver, and at least 30 days prior to the expiration of a general permit authorization; and
  - 2. The permittee demonstrates that there has been no significant change in any of the following between the date the permit was issued and the date the application for extension is submitted:
    - i. The project and activities that were approved in the original permit;
    - ii. The rules governing the site; and
    - iii. The conditions on the site, including the wetlands boundary and resource classification.
- (c) The Department shall deny a permit extension if the permittee has violated the terms of the original permit, or if any of the other causes for termination at N.J.A.C. 7:7A-14.5 exist.
- (d) If the requirements in this section for an extension are not met, the permit shall expire and regulated activities shall stop until a new permit is obtained.
- (e) An application for an extension of a permit shall meet the application requirements at N.J.A.C. 7:7A-10, including the public notice requirements at N.J.A.C. 7:7A-10.9.

### SUBCHAPTER 15 MITIGATION

#### 7:7A-15.1 Mitigation definitions

In addition to the terms defined at N.J.A.C. 7:7A-1.4, the following words and terms, when used in this subchapter, shall have the following meanings unless the context clearly indicates otherwise.

"Charitable conservancy" means a corporation or trust that meets the definition of a charitable conservancy at N.J.S.A. 13:8B-2, and amendments thereto. As of September 4, 2001, N.J.S.A. 13:8B-2 defines a charitable conservancy as a corporation or trust whose purposes include the acquisition and preservation of land or water areas or of a particular land or water area, or either thereof, in a natural, scenic or open condition, no part of the net earnings of which inures to the benefit of any private shareholder or individual, and which has received tax exemption under section 501(c) of the 1954 Internal Revenue Code.

"Council" means the Wetlands Mitigation Council.

"Creation" means the establishment of freshwater wetland or State open water characteristics and functions in uplands.

"Credit purchase" means the purchase of credits in a mitigation bank, as defined below, as a substitute for performance of restoration, creation, enhancement, or upland preservation by the purchaser. Each credit counts for a certain acreage amount of restoration, creation, or enhancement. Once a credit is applied to satisfy a mitigation obligation under this subchapter, it is exhausted and may not be sold or used again.

"Degraded wetland" means a wetland in which there is impaired surface water flow or groundwater hydrology, or excessive drainage; a wetland which has been partially filled or excavated, contaminated with hazardous substances, or which has an ecological value substantially less than that of undisturbed wetlands in the region.

"Enhancement" means the improvement of the ability of an existing, degraded wetland or State open water to support natural aquatic life, through substantial alterations to the soils, vegetation and/or hydrology. Improvement of a wetland or water that is not degraded does not constitute enhancement. Conversion of a State open water to a wetland does not by itself constitute enhancement, although the Department may approve a mitigation proposal that includes this in some cases as part of a larger mitigation project. The addition of human-made habitat improvement devices such as duck boxes does not constitute enhancement.

"In-kind mitigation" means mitigation that provides similar values and functions as the area disturbed, including similar wildlife habitat, similar vegetative species coverage and density, equivalent flood water storage capacity, and equivalency of other relevant values or functions. In the case of a mitigation bank, this is accomplished through the purchase of credits in a bank at which similar values and functions have been established.

"Land donation" means performing mitigation through giving land that has been determined acceptable for donation by the Wetlands Mitigation Council.

"Mitigation" means activities carried out in accordance with N.J.A.C. 7:7A-15 in order to compensate for the loss or disturbance of freshwater wetlands or State open waters.

"Mitigation area" means the portion of a site, right-of-way, or piece of property upon which mitigation is proposed or performed. If a mitigation area includes a wetland, a transition area is included as part of the mitigation area in accordance with N.J.A.C. 7:7A-15.8(b).

"Mitigation bank" means an operation in which wetlands, uplands and/or other aquatic resources are restored, created, enhanced, or preserved by a mitigation bank operator, for the purpose of providing compensatory mitigation for disturbances to freshwater wetlands and/or State open waters.

"Mitigation bank service area" means a geographic area within which a mitigation bank's credits may be used to compensate for a disturbance.

"Mitigation bank site" means the portion of a site, right-of-way, or piece of property upon which a mitigation bank is proposed or created.

"Monetary contribution" means giving money to the Wetlands Mitigation Fund.

"Out-of-kind mitigation" means mitigation that is not in-kind mitigation.

"Restoration" means:

1. The reestablishment of wetland and/or State open water characteristics and functions in an area that was once a freshwater wetlands and/or State open water but is no longer. For example, an area that has been drained and farmed could be restored to its original condition by blocking or removing drainage devices and replanting with appropriate wetlands plants; or
2. The reversal of a temporary disturbance and the reestablishment of the functions and values of the freshwater wetlands and/or State open water that was temporarily disturbed.

"Upland preservation" means the permanent protection of transition areas or other uplands from disturbance or development, through transfer of the property to a charitable conservancy as defined in this section, and the execution of legal instruments to prevent development, such as a conservation restriction.

"Watershed Management Area" means an aggregation of HUC 11s, as defined at N.J.A.C. 7:7A-1.4, designated by the Department as a watershed management area and shown on the map entitled "New Jersey's Watersheds, Watershed Management Areas, and Water Regions," dated April 2000, as amended and supplemented. The map of watershed management areas may be obtained from the Department's Division of Watershed Management at (609) 984-0058, or may be viewed on the internet at <http://www.state.nj.us/dep/gis>.

"Wetlands Mitigation Council" or "Council" means the body established under N.J.S.A. 13:9B-14 to perform the functions enumerated at N.J.S.A. 13:9B-15. The Wetlands Mitigation Council administers the Wetlands Mitigation Fund.

"Wetlands Mitigation Fund" means the repository for monetary contributions made for mitigation purposes, established at N.J.S.A. 13:9B-14a as the "Wetlands Mitigation Bank."

#### 7:7A-15.2 General mitigation requirements

- (a) The Department shall not consider a mitigation proposal in determining whether to approve a permit for a project.
- (b) The Department may require mitigation in accordance with this chapter in order to compensate for impacts to a freshwater wetland and/or State open water resulting from the following:
  1. Regulated activities authorized under an individual or general freshwater wetlands or open water fill permit; and
  2. Certain violations of the Freshwater Wetlands Protection Act and/or this chapter.

- (c) Mitigation shall, at a minimum, fully compensate for the loss of ecological value caused by a disturbance, by replacing any freshwater wetlands and/or State open waters values and functions lost or disturbed with equal values and functions. To do this, mitigation shall meet all of the following criteria:
1. The mitigation alternative and the location of the mitigation shall comply with N.J.A.C. 7:7A-15.5 or 7:7A-15.6, whichever applies;
  2. If the mitigation is restoration, creation, or enhancement:
    - i. The acreage amount of mitigation shall be that required under N.J.A.C. 7:7A-15.8; and
    - ii. The mitigation shall be in-kind mitigation, as defined at N.J.A.C. 7:7A-15.1, unless the Department determines that, because of special circumstances, out-of-kind mitigation would be more likely to provide equal functions and values;
  3. If the mitigation is credit purchase, the credits purchased shall be appropriate to the type of disturbance and the purchase shall comply with this chapter and the Council's authorization of the mitigation bank. For example, if credits were awarded by the Council for use as mitigation for disturbances of wetlands within a certain service area, the credits shall not be considered appropriate as mitigation for a disturbance outside of the service area. The amount of credits shall be determined under N.J.A.C. 7:7A-15.8(f);
  4. If the mitigation is uplands preservation, the mitigation shall meet the requirements of N.J.A.C. 7:7A-15.9;
  5. If the mitigation is a monetary contribution, the amount of the monetary contribution shall be approved by the Council in accordance with N.J.A.C. 7:7A-15.21; and
  6. If the mitigation is land donation, the land to be donated shall be approved by the Council in accordance with N.J.A.C. 7:7A-15.22.
- (d) To be approved under this subchapter, mitigation must have a high probability of long term success. At a minimum, this requires the following:
1. Adequate financial and other resources must be dedicated to the project;
  2. The project must be designed to take advantage of and work within the existing conditions in the proposed mitigation area to the extent possible;
  3. The hydrology in and around the mitigation area must be adequate to support wetland conditions year round and indefinitely into the future;
  4. The soils (and hydrology) in the mitigation area must be adequate to support wetland conditions; and
  5. The responsibility for long term maintenance of the mitigation area must be clearly assigned to an entity that has the resources to ensure long term maintenance of the mitigation area. For upland preservation or land donation, a maintenance fund shall

be created in accordance with N.J.A.C. 7:7A-15.17(c) or 7:7A-15.19(c), respectively.

- (e) Mitigation under this subchapter requires prior Department approval. In addition, if the mitigation will be through a monetary contribution or a land donation, the amount of money or the particular parcel of land must also be approved by the Wetlands Mitigation Council.
- (f) All correspondence with the Department and/or the Mitigation Council, including requests for application forms and checklists, and applications for Council approval or funding, shall be addressed to:

Mitigation Staff  
NJDEP Land Use Regulation Program  
P.O. Box 439  
Trenton, New Jersey, 08625  
(609) 984-0194  
lurweb@dep.state.nj.us

- (g) When the Department requires mitigation, the permit, approval or enforcement document under which the mitigation is required shall authorize any regulated or prohibited activities, as defined at N.J.A.C. 7:7A-1.4, necessary to accomplish the mitigation. When mitigation is required for a disturbance that is not subject to a Department-issued permit, for example, when mitigation is required by the ACOE, the mitigation itself must be authorized through a permit or enforcement document issued by the Department under this chapter. In some cases, mitigation also involves activities that require approval through one or more other Land Use Regulation Program permits, such as a flood hazard area, CAFRA, or Waterfront Development permit; or through other State or Federal permits. In such a case, mitigation shall not begin without these approvals.
- (h) If a mitigation requirement arises from a violation rather than a permit, the Department shall determine the mitigation alternative required on a case-by case basis, taking into consideration the size and severity of the violation and the functions and values provided by the proposed mitigation. A mitigation proposal submitted as part of a settlement of an enforcement action shall provide for mitigation that is at least as ecologically valuable as mitigation that would be required under this chapter as a result of a permit. This may include an increase in mitigation to compensate for the time lapse between the disturbance and the completion of mitigation, such as that required at N.J.A.C. 7:7A-15.3(b).
- (i) A mitigation area shall be permanently protected from future development in accordance with N.J.A.C. 7:7A-15.14.
- (j) If mitigation is performed through uplands preservation or land donation, the mitigator shall transfer all rights in the mitigation area to a government agency or charitable conservancy in accordance with N.J.A.C. 7:7A-15.17(c) or N.J.A.C. 7:7A-15.19(c), respectively. A mitigation banker shall also transfer a mitigation bank to a government agency or charitable conservancy after the bank is successfully completed, in accordance with N.J.A.C. 7:7A-15.23(i).

- (k) Upon approval by the Department, a permittee may aggregate the mitigation for multiple disturbances, so as to perform mitigation for more than one disturbance with a single mitigation project. Such an aggregated mitigation project shall be used only as mitigation for disturbances performed by the permittee, unless the permittee obtains Council approval of the project as a mitigation bank under this subchapter.
- (l) An activity that is required in order to satisfy Federal, State, or local government requirements, other than those imposed under this chapter, shall not qualify as mitigation under this subchapter. For example, if land is required by a county to be preserved as open space, the Department shall only approve the parcel for a land donation if the applicant also performs wetlands restoration or enhancement in accordance with this subchapter.
- (m) A permittee may use one mitigation alternative or a combination of mitigation alternatives to compensate for a permitted disturbance.

#### 7:7A-15.3 Timing of mitigation

- (a) Mitigation shall be performed within the applicable time period below:
  1. Mitigation for a disturbance authorized by a permit, other than a temporary disturbance, as defined at N.J.A.C. 7:7A-1.4, shall be performed prior to or concurrently with the permitted activity, and shall be continued to completion according to the schedule in the approved mitigation proposal;
  2. Mitigation for a temporary disturbance authorized by a permit shall be started immediately following completion of the activity that caused the disturbance, and shall be continued to completion within six months after the end of the activity that caused the disturbance; and
  3. Mitigation required as part of an enforcement action shall be performed in accordance with a schedule in the enforcement document.
- (b) If a permittee fails to perform mitigation within the applicable time period in (a) above, the acreage of mitigation required shall be increased by 20% each year after the date mitigation was to begin. This will compensate for the absence of the functions and values that were to be provided by the mitigation project during the delay. For example, a permit may authorize a disturbance, and require 10 acres of creation to compensate for that disturbance. If the disturbance is begun on January 1, 2001, but the mitigation is not performed prior to or concurrently with the disturbance and continued according to the approved schedule as required under (a)1 above, the acreage of creation required increases to 12 acres on January 1, 2002, in order to compensate for the absence of wetlands functions and values from the ecosystem during the time between the disturbance and the creation.
- (c) In order to ensure compliance with (a) above, if mitigation is required for a publicly funded project, all work necessary to complete the mitigation shall be included in the contract awarded for the project, unless the applicant demonstrates that the mitigation will be performed by the applicant's staff and will not be awarded through a contract.

7:7A-15.4 Property suitable for mitigation

- (a) Any offsite restoration, creation, enhancement, land donation, or upland preservation shall be carried out on private property, except that a government agency, as defined at N.J.A.C. 7:7A-1.4, may create, restore, or enhance on public land in accordance with this subchapter, as mitigation for a project funded solely with public monies, if the land was not acquired with Green Acres funding, as defined at N.J.A.C. 7:36-2.1, and either of the following criteria is met:
  - 1. The land is obtained or held by the government agency for mitigation; or
  - 2. The land is obtained by the government agency by default or operation of law, through a tax lien or other similar circumstance.
- (b) An improvement to a public facility which is intended for human use, such as a ball field, nature trail, or boardwalk, does not constitute mitigation.
- (c) A person seeking property for a mitigation project under this subchapter shall review the applicable watershed management area plan, if any, approved by the Department under the Water Quality Management Planning Act, N.J.S.A. 58:11A-1 et seq., and implementing rules at N.J.A.C. 7:15 to determine if suitable properties are listed, and shall also review the applicable county mitigation inventory, if any, prepared in accordance with N.J.S.A. 13:9C-1 et seq.
- (d) The Department shall not approve mitigation through creation, restoration, or enhancement in an area that is already highly ecologically valuable, for example if the area contains a mature, well developed, ecologically desirable natural community; a State open water that supports fish; a forested habitat; or significant cultural or historic resources.
- (e) The Department shall approve mitigation through creation, restoration, or enhancement only on property that is owned in fee simple and under the full legal control of the person responsible for performing the mitigation, or the person responsible for performing the mitigation shall demonstrate that the person has legal rights to the property sufficient to enable compliance with all requirements of this chapter. If a property is affected by an easement or other encumbrance, the person responsible for performing the mitigation shall ensure that the encumbrance is extinguished or shall demonstrate that the encumbrance will not inhibit compliance with the mitigation requirements of this chapter.
- (f) The Department shall require a habitat assessment if the Department deems such an assessment necessary to determine if an area is suitable for mitigation through enhancement. Any habitat assessment shall be performed in accordance with a scientific protocol approved by the Department.
- (g) The Department shall not approve mitigation that would destroy, jeopardize, or adversely modify a present or documented habitat for threatened or endangered species; and shall not jeopardize the continued existence of any local population of a threatened or endangered species.
- (h) The Department shall not approve mitigation in an area that contains contamination, unless the mitigator obtains a No Further Action letter for the mitigation area from the

Department's Site Remediation Program, and in addition demonstrates that the mitigation activities will not pose a risk of exposing contaminants or reintroducing them into the environment.

7:7A-15.5 Mitigation for a smaller disturbance

- (a) This section governs, for a smaller disturbance, the mitigation alternative required and the location of mitigation in relation to the disturbance. (See Figure 4 below for an illustration of the information in this section.) However, if a smaller disturbance is a temporary disturbance, as defined at N.J.A.C. 7:7A-1.4, it is governed by N.J.A.C. 7:7A-15.7. The acreage amount of mitigation required for both smaller and larger disturbances is determined under N.J.A.C. 7:7A-15.8.
- (b) A smaller disturbance is:
  - 1. A disturbance of 1.5 acres or less of freshwater wetlands or State open water; or
  - 2. A disturbance affecting only ordinary resource value wetlands.
- (c) The Department presumes that onsite mitigation for a smaller disturbance is not feasible. Therefore, mitigation for a smaller disturbance shall be performed through credit purchase in accordance with (d) below, unless the applicant demonstrates under (e) below that one of the following will be more environmentally beneficial:
  - 1. Onsite restoration, creation or enhancement; or
  - 2. Offsite restoration, creation, enhancement, or upland preservation, which is performed in the same HUC 11, as defined at N.J.A.C. 7:7A-1.4, as the disturbance, or performed in an adjacent HUC 11 within the same watershed management area as the disturbance.
- (d) Mitigation through credit purchase shall be performed as follows:
  - 1. Through the purchase of credits from either of the following:
    - i. A mitigation bank located in the same HUC 11 as the disturbance; or
    - ii. A mitigation bank approved by the Wetlands Mitigation Council prior to January 1, 1999, which includes the disturbance site in its bank service area. The service area for each mitigation bank is set forth in the Wetlands Mitigation Council approval for the bank;
  - 2. If no credits are available from a bank listed in (d)1 above, through the purchase of credits from a mitigation bank located in a HUC 11 that is both adjacent to the HUC 11 in which the disturbance is located and within the same watershed management area, as defined at N.J.A.C. 7:7A-15.1, as the disturbance;
  - 3. If no credits are available from a bank listed in (d)1 or 2 above, through the purchase of credits from a mitigation bank located anywhere in the same watershed management area as the disturbance; or

4. If no credits are available from a mitigation bank located in (d)1, 2, or 3 above, through the purchase of credits from a mitigation bank which includes the disturbance site in its bank service area.
- (e) In determining if onsite or offsite mitigation for a smaller disturbance would be environmentally beneficial for the purposes of (c) above, the Department will consider the following factors and any other relevant factors specific to the site or project:
1. Size. Generally, the larger a mitigation area, the greater its potential environmental benefit. A mitigation area that is associated with a large existing wetland complex is more likely to be environmentally beneficial for the purpose of (c) above;
  2. Location in relation to other preserved open space. A mitigation area adjacent to public land or other preserved areas is more likely to be environmentally beneficial;
  3. Habitat value. A mitigation area that will provide valuable habitat for critical wildlife species or threatened or endangered species is more likely to be environmentally beneficial; and
  4. Interaction with nearby resources. A mitigation project is more likely to be environmentally beneficial if it complements existing nearby resources. For example, a mitigation project that adds riparian wetlands habitat adjacent to an existing stream enhances the environmental value of both the riparian area and the stream.
- (f) If credit purchase under (d) above is not feasible, and onsite or offsite mitigation under (c) above is not feasible, mitigation shall be performed through a monetary contribution in accordance with N.J.A.C. 7:7A-15.21 or, if the Department determines that no other mitigation alternative is practicable or feasible, mitigation shall be performed through a land donation approved by the Wetlands Mitigation Council, in accordance with N.J.A.C. 7:7A-15.22.

Figure 4: Flow Chart Illustrating Mitigation Alternatives For A Smaller Disturbance

(See figure 4 in the New Jersey Administrative Code.)

#### 7:7A-15.6 Mitigation for a larger disturbance

- (a) This section governs, for a larger disturbance, the mitigation alternative required and the location of mitigation in relation to the disturbance. (See Figure 5 below for an illustration of the information in this section.) However, if a larger disturbance is a temporary disturbance, as defined at N.J.A.C. 7:7A-1.4, it is governed by N.J.A.C. 7:7A-15.7. The acreage amount of mitigation, regardless of the size of the disturbance, is determined under N.J.A.C. 7:7A-15.8.
- (b) A larger disturbance is a disturbance not listed at N.J.A.C. 7:7A-15.5(b).

- (c) Mitigation for a larger disturbance shall be performed through restoration, creation, or enhancement, carried out on the site of the disturbance to the maximum extent feasible. Onsite mitigation shall not be performed through upland preservation.
- (d) If onsite restoration, creation, or enhancement is not feasible, mitigation shall be performed through any of the following, at the applicant's option:
  - 1. The purchase of credits from a mitigation bank located in the same HUC 11 as the disturbance or in an adjacent HUC 11 within the same watershed management area;
  - 2. The purchase of credits from a mitigation bank approved by the Wetlands Mitigation Council prior to January 1, 1999, which includes the disturbance site in its bank service area; or
  - 3. Offsite restoration, creation, enhancement, or upland preservation, in the same HUC 11 as the disturbance or in an adjacent HUC 11 within the same watershed management area as the disturbance.
- (e) If mitigation under (d) above is not feasible, mitigation shall be performed through either of the following, at the applicant's option:
  - 1. The purchase of credits from a mitigation bank which includes the disturbance site in its bank service area; or
  - 2. Restoration, creation, enhancement, or upland preservation in the same watershed management area as the disturbance.
- (f) If mitigation is not feasible under (c), (d) or (e) above, mitigation shall be performed through a monetary contribution or, if the Department determines that no other mitigation alternative is not practicable or feasible, through a land donation approved by the Wetlands Mitigation Council in accordance with N.J.A.C. 7:7A-15.22.

Figure 5: Flow Chart Illustrating Mitigation Alternatives For A Larger Disturbance

(See figure 5 in the New Jersey Administrative Code.)

7:7A-15.7 Mitigation for a temporary disturbance

- (a) Mitigation for a temporary disturbance, as defined at N.J.A.C. 7:7A-1.4, shall be performed as follows:
  - 1. For a disturbance of non-forested freshwater wetlands or of State open waters, restoration of the area temporarily disturbed; or
  - 2. For a disturbance of forested freshwater wetlands, either:
    - i. Restoration of the area temporarily disturbed to a forested wetland; or

- ii. Restoration of the area temporarily disturbed to a non-forested wetland, and in addition, one acre of mitigation in accordance with this subchapter for each acre of disturbance.

(b) The transition area for a temporary disturbance shall be as follows:

1. If the mitigation is restoration performed on the site of the disturbance, the transition area shall be that which was required for the wetland prior to the temporary disturbance; and
2. If additional mitigation is performed under (a)2ii above, the width of the transition area on the mitigation area shall be the width required at N.J.A.C. 7:7A-15.8(b)1 or 3, as applicable.

#### 7:7A-15.8 Amount of mitigation required

(a) This section governs the amount of mitigation required, depending on the mitigation alternative selected under N.J.A.C. 7:7A-15.5 or 7:7A-15.6, except that this section does not address the amount of a monetary contribution or the size of a land donation. The amount of a monetary contribution or the size of a land donation is not determined by the Department, but instead must be approved by the Wetlands Mitigation Council in accordance with N.J.A.C. 7:7A-15.21 or 7:7A-15.22.

(b) A mitigation area involving restoration or creation shall include a transition area. The transition area shall not be counted in calculating the acreage of mitigation required. For example, if a person must create one acre of wetlands, the mitigation area shall include one acre of created wetlands and in addition a transition area around the created wetlands. The width of the transition area around a wetland resulting from mitigation shall be:

1. If the mitigation area includes or will include exceptional resource value wetlands, the transition area shall be 150 feet wide;
2. If mitigation is restoration under N.J.A.C. 7:7A-15.7(b)1 of an area temporarily disturbed, the transition area shall be that which was required for the wetland prior to the temporary disturbance; and
3. For all mitigation not listed at 1 or 2 above, the transition area shall be 50 feet wide.

(c) If restoration is the mitigation alternative, the Department shall require the following amount of mitigation unless the applicant demonstrates under (j) below that a smaller area will provide equal functions and values:

1. For a disturbance authorized by a permit, other than a temporary disturbance, as defined at N.J.A.C. 7:7A-1.4, restoration of two acres of freshwater wetlands and/or State open waters for each acre disturbed, with the addition of any transition area required under (b) above; and
2. For a temporary disturbance authorized by a permit, the amount of restoration required at N.J.A.C. 7:7A-15.7(a).

- (d) If creation is the mitigation alternative, the Department shall require creation of two acres of freshwater wetlands and/or State open waters for each acre disturbed, with the addition of any transition area required under (b) above, unless the applicant demonstrates under (j) below that a smaller area will provide equal functions and values.
- (e) If enhancement is the mitigation alternative, the Department shall evaluate the wetlands values and functions lost as a result of the disturbance and determine on a case-by-case basis the amount of enhancement required to ensure that the mitigation area results in wetlands of equal functions and values to those lost.
- (f) If credit purchase is the mitigation alternative, the Department shall evaluate the wetlands values and functions lost as a result of the disturbance and determine on a case-by-case basis the number of credits required to ensure that the mitigation results in wetlands of equal functions and values to those lost.
- (g) If upland preservation is the mitigation alternative, the acreage of upland preserved shall be determined under N.J.A.C. 7:7A-15.9(c).
- (h) If monetary contribution is the mitigation alternative, the contribution shall be equal to the lesser of the following costs:
  - 1. The cost of purchasing and enhancing existing degraded freshwater wetlands, resulting in the preservation of freshwater wetlands of equal functions and values to those which are being lost; or
  - 2. The cost of purchasing property and creating freshwater wetlands of equal functions and values to those which are being lost.
- (i) If land donation is the mitigation alternative, the Wetlands Mitigation Council shall determine on a case-by-case basis whether the acreage of land specified in the mitigation proposal will result in a mitigation area large enough to be a valuable component of the freshwater wetlands ecosystem. In making this determination, the Council shall consult the sources, and consider the conditions, referenced in (j) below and in N.J.A.C. 7:7A-15.22(b).
- (j) A person shall carry out the full acreage amount of mitigation required under this section, unless the person demonstrates, through use of productivity models or other similar studies, that a smaller mitigation area will result in a mitigation area sufficient to comply with this section. However, under no circumstances shall a mitigation area be smaller than the disturbed area. To demonstrate that a smaller mitigation area will be sufficient to provide equal functions and values to those lost, the person shall provide current scientific literature concerning wetlands, aquatic resources, and mitigation; as well as information regarding the conditions on the site of the disturbance and on the proposed mitigation site, including soil, vegetation, any existing contamination or other degradation, water quality functions, flood storage capacity, soil erosion and sediment control, wildlife habitat, and any other relevant data.
- (k) If a proposed mitigation area is affected by an easement or other encumbrance, the portion of the property affected by the encumbrance will not be considered in calculating the total amount of mitigation provided, unless the applicant demonstrates that the encumbrance will not inhibit compliance with the mitigation requirements of this chapter.

- (l) If a mitigation requirement arises from a violation, the Department shall determine the amount of mitigation required on a case-by case basis, taking into consideration the size and severity of the violation and the functions and values provided by the proposed mitigation. A mitigation proposal submitted as part of a settlement of an enforcement action shall require mitigation that provides functions and values at least equal to those that would be required under this chapter as a result of a permit. This may include an increase in mitigation to compensate for the time lapse between the disturbance and the completion of mitigation, such as that required at N.J.A.C. 7:7A-15.3(b).

#### 7:7A-15.9 Requirements for upland preservation

- (a) The Department shall approve mitigation through preservation of uplands only if the uplands meet the requirements in this section.
- (b) Preserved uplands shall be valuable for the protection of a freshwater wetlands ecosystem. Factors the Department will consider in evaluating an area for upland preservation include, but are not limited to:
1. The size and configuration of the uplands in relation to freshwater wetlands and/or State open waters, and the effect the preservation of these uplands would have on the wetlands or waters;
  2. The diversity of the ecological communities on the entire site;
  3. Whether the uplands to be preserved are located in the same HUC 11 as the disturbance;
  4. Whether the uplands to be preserved are adjacent to a freshwater wetland that:
    - i. Contains exceptional resource value wetlands;
    - ii. Contains critical habitat for flora or fauna, as defined at N.J.A.C. 7:7A-1.4;
    - iii. Contains wetlands or waters draining to trout maintenance waters, as defined at N.J.A.C. 7:9B, or into public drinking water sources;
    - iv. Is adjacent to public lands containing wetland preserves, such as Federal wildlife refuges, State wildlife management areas, State parks or forests, State, County or local wetland preservation areas, or wetland preservation areas held by non-profit conservation organizations;
    - v. Has unique aspects or characteristics that contribute to its ecological value, such as an unusual or regionally rare type of wetland;
  5. The relationship of the proposed uplands to existing and planned development;
  6. Whether the uplands have been designated for preservation in a watershed management area plan approved by the Department under the Water Quality

Management Planning Act, N.J.S.A. 58:11A-1 et seq., and implementing rules at N.J.A.C. 7:15; and

7. Whether the site contains solid or hazardous waste, or contains water or soil pollution. Uplands that contain waste or pollution shall not be considered valuable for the protection of a freshwater wetlands ecosystem.
- (c) The amount of uplands preserved shall be sufficient to ensure that the functions and values resulting from the preservation of the uplands will fully compensate for the loss of functions and values caused by the disturbance, in accordance with N.J.A.C. 7:7A-15.2(c). In determining if an upland preservation proposal will fully compensate for a disturbance, the Department shall consult the sources, and consider the conditions, referenced in N.J.A.C. 7:7A-15.8(j). At a minimum, the uplands preserved shall be:
1. At least five acres in size, and significantly larger than the area that would be required for any other mitigation alternative, to compensate for the fact that uplands preservation, unlike other mitigation alternatives, does not directly replace the wetland values and functions destroyed by a disturbance; and
  2. If adjacent to a wetland, the uplands preserved shall include the standard transition area required for the wetlands under N.J.A.C. 7:7A-2.5, plus an additional area at least 150 feet wide, measured from the outer edge of the transition area.
- (d) If mitigation is performed through upland preservation, the mitigator shall transfer the mitigation area in fee simple to a government agency or charitable conservancy, as defined at N.J.A.C. 7:7A-1.4, in accordance with N.J.A.C. 7:7A-15.17(c).

#### 7:7A-15.10 Conceptual review of a mitigation area

- (a) The Department strongly recommends that an applicant obtain the Department's conceptual review of any land being considered as a potential mitigation area, prior to submittal of a mitigation proposal involving restoration, creation, enhancement, uplands preservation, or land donation.
- (b) An applicant may request a conceptual review at any time prior to submittal of a mitigation proposal. However, the Department strongly recommends that an applicant obtain a Department conceptual review before buying the land for a mitigation area.
- (c) To obtain the Department's conceptual review of a mitigation area, the applicant shall submit a written request, including:
1. A brief description of the area and the mitigation project being considered;
  2. A map showing Department staff how to find the mitigation area;
  3. A USGS quad showing the mitigation area;
  4. A county soil survey showing the soils in the mitigation area; and

5. Unconditional written consent from the owner of the proposed mitigation area allowing Department representatives to enter the property and inspect the mitigation area.
- (d) Upon receipt of a complete request for a conceptual review, the Department may schedule a site inspection. At a site inspection, Department staff will candidly discuss the apparent strengths and weaknesses of the proposed mitigation area, but all guidance provided shall be non-binding on the Department. A Department decision on a proposed mitigation area or mitigation proposal is binding only if it is incorporated into an approval obtained in accordance with this subchapter. A conceptual review does not grant any property or other rights, and does not authorize mitigation activities.

7:7A-15.11 Basic requirements for all mitigation proposals

- (a) A mitigation proposal shall be submitted within the applicable time period below:
1. For mitigation required by an individual permit, the mitigation proposal shall be submitted at least 90 days prior to the start of activities authorized by the permit. Activities authorized by the permit shall not begin until the mitigation proposal is approved and the mitigation has begun;
  2. For mitigation required by a general permit authorization, the mitigation proposal shall be submitted concurrently with the application for the general permit authorization; and
  3. For mitigation requirements arising from a violation, the mitigation proposal shall be submitted by the deadline set forth in the Department's enforcement document.
- (b) The mitigation proposal shall provide all information necessary for the Department to determine if the requirements of this subchapter are met. The information required for each mitigation alternative is set forth in a mitigation proposal checklist, provided by the Department. To obtain the mitigation proposal checklist for a particular mitigation alternative, contact the Department at the address in N.J.A.C. 7:7A-15.2(f).
- (c) In order to demonstrate that an offsite mitigation alternative is not feasible under this subchapter, an applicant must provide to the Department a list of at least six potential areas upon which the mitigation alternative might be performed. Each of these potential areas shall:
1. Be located at a practical elevation suitable for a wetland or State open water;
  2. Have an adequate water supply;
  3. Be large enough for the mitigation proposed;
  4. Be available for purchase; and
  5. Meet the requirements of N.J.A.C. 7:7A-15.4(h) regarding contamination.

- (d) A mitigation proposal submitted as part of a settlement of an enforcement action shall provide for mitigation that is at least as ecologically valuable as mitigation that would be required under this chapter as a result of a permit. This may include an increase in the amount of mitigation to compensate for the time that has elapsed between the disturbance and the completion of mitigation, such as that required at N.J.A.C. 7:7A-15.3(b).
- (e) A mitigation proposal shall include as many copies of each item as required by the checklist.

#### 7:7A-15.12 Contents of a mitigation proposal

- (a) The application checklist for every mitigation proposal shall require the information listed at (b)1 through 8 below. In addition, each mitigation proposal will also require information specific to the mitigation alternative proposed, listed at (c) through (g) below.
- (b) The application checklist for every mitigation proposal shall require the following:
  1. Basic information regarding the applicant, the disturbance for which the mitigation is required, and the permit or other item which is the source of the mitigation requirement;
  2. Information to enable the Department to determine the loss of functions and values caused by the disturbance for which the mitigation is required, including scientific information such as scientific literature, models or other studies concerning wetlands, soils, vegetation, hydrology, wildlife habitat and any other factors relevant to the functions and values of the site of the disturbance for which mitigation is required; previous Department approvals or correspondence regarding the disturbance; maps, photographs; soil or vegetation samples; delineations and/or other visual materials relating to the site of the disturbance;
  3. Information demonstrating that the proposed mitigation alternative complies with N.J.A.C. 7:7A-15.5 or 15.6, as applicable, including information on the feasibility or practicability of other mitigation alternatives;
  4. The names and addresses of all consultants, engineers, and other persons providing technical assistance in preparing the mitigation proposal;
  5. Any letters, contracts, agreements, conservation restrictions, or other draft or executed documents necessary to ensure compliance with this subchapter;
  6. Any information necessary to ensure compliance with the Federal rules governing the Department's assumption of the Federal 404 program at 40 CFR 233.30; and
  7. A certification of truth and accuracy.
- (c) In addition to the basic information required for all mitigation proposals under (b) above, an application checklist for a proposal to purchase credits shall require information demonstrating that credit purchase is acceptable under N.J.A.C. 7:7A-15.5 or 15.6, and any information necessary for the Department to determine the mitigation bank from which appropriate credits must be purchased under N.J.A.C. 7:7A-15.5 or 15.6.

(d) In addition to the basic information required for all mitigation proposals under (b) above, an application checklist for a proposal to restore, create, or enhance wetlands; to preserve uplands; or to donate land; shall also require the following information:

1. Basic information regarding the proposed mitigation area, including but not limited to its location and size, ownership, and any legal or other restrictions on the property such as easements;
2. Unconditional written consent from the owner of the proposed mitigation area, as defined at N.J.A.C. 7:7A-15.1, for Department representatives to enter the proposed mitigation area to conduct inspections;
3. Visual materials, including but not limited to maps, plans, surveys, diagrams, or photographs showing the proposed mitigation area, existing conditions and features on the proposed mitigation area;
4. Written narrative information and/or reports describing the proposed mitigation area, existing conditions and features on the proposed mitigation area, and the mitigation alternative proposed;
5. Information and/or certifications regarding the presence or absence of endangered or threatened species habitat, historic or archaeological resources, or other features on the proposed mitigation area that are relevant to determining compliance with this chapter. Failure to provide all such information of which the applicant, its consultants, or agents is aware may result in denial or termination of the permit under N.J.A.C. 7:7A-14.5, and may subject the applicant to penalties for submittal of false information under N.J.A.C. 7:7A-16.9;
6. Information regarding whether the proposed mitigation activities, including any restriction or transfer of the mitigation area, require approval by other Federal, interstate, State and local agencies, and information on any approvals or denials received;
7. Information regarding relevant features of other properties in the vicinity of the mitigation area, such as whether they are publicly owned, contain preserved open space, contain significant natural resources, etc.;
8. Scientific information, including scientific literature, models or other studies concerning wetlands, soils, vegetation, hydrology, wildlife habitat, and any other factors relevant to the functions and values of the proposed mitigation area and mitigation activities;
9. Information to enable the Department to determine the functions and values of the proposed mitigation area, and its potential to be a successful mitigation area, including narrative information, maps, photographs, soil or vegetation samples, delineations and/or other visual materials, describing and/or showing the mitigation area;
10. All past correspondence between the Department and the applicant or permittee, and/or the owner(s) of the proposed mitigation area, regarding the mitigation activities and the mitigation area;

11. Schedules describing in detail the sequence of mitigation activities and estimated dates for completion for each mitigation activity. For example, this might include approximate dates for completing each legal transaction involved in a land donation, or this might include site preparation and planting dates for a wetlands creation project;
  12. Estimates of costs involved in performing the mitigation, and in maintaining the mitigation area after construction and/or transfer is completed;
  13. Draft documents for protection and transfer of the mitigation area after successful completion of mitigation, in accordance with N.J.A.C. 7:7A-15.14, 7:7A-15.17(c) and 7:7A-15.19(c); and
  14. If the Department determines that there is reason to suspect contamination on the proposed mitigation area, a No Further Action letter covering the proposed mitigation area, obtained from the Department's Site Remediation Program in accordance with N.J.A.C. 7:26C.
- (e) In addition to the basic information required for all mitigation proposals under (b) above, and the information required at (c) above, an application checklist for a proposal to restore, create, or enhance wetlands shall require the following information:
1. Visual materials, including but not limited to maps, plans, surveys, diagrams, or photographs showing all mitigation activities proposed;
  2. Written narrative information and/or reports describing in detail all mitigation activities proposed;
  3. A description of post-construction activities, including but not limited to schedules for monitoring, maintenance, and reporting;
  4. Contingency measures that will be followed if the mitigation project fails or shows indications of failing;
  5. A letter of credit or other financial assurance meeting the requirements of N.J.A.C. 7:7A-15.13; and
  6. A certification that the proposed mitigation will not adversely affect properties which are listed or are eligible for listing on the National Register of Historic Places. If the mitigator, before or during approved mitigation, encounters an historic property on the mitigation site that may be eligible for listing in the National Register, the mitigator shall immediately notify the Department and proceed as directed by the Department.
- (f) In addition to the basic information required for all mitigation proposals under (b) above, an application checklist for a proposal to make a monetary contribution shall require the following:
1. Information demonstrating to the Department that a monetary contribution is acceptable under N.J.A.C. 7:7A-15.5 or 15.6; and

2. Cost estimates, appraisals, and other information necessary to demonstrate compliance with the requirements for monetary contribution at N.J.A.C. 7:7A-15.21.
- (g) In addition to the basic information required for all mitigation proposals under (b) above, an application checklist for a proposal to make a land donation shall require the following:
1. Information demonstrating to the Department that a land donation is acceptable under N.J.A.C. 7:7A-15.5 or 15.6; and
  2. All information necessary to demonstrate to the Wetlands Mitigation Council that the parcel of land proposed for donation meets the requirements for land donation at N.J.A.C. 7:7A-15.22.

7:7A-15.13 Financial assurance for a proposal to restore, create, or enhance wetlands

- (a) The Department shall approve a proposal for restoration, creation, or enhancement only if the mitigator or mitigation bank operator provides a letter of credit or other financial assurance that meets the requirements of this section, except that this section does not apply to a mitigation proposal submitted by a government agency, as defined at N.J.A.C. 7:7A-1.4; or an entity that is exempt from this requirement under Federal law.
- (b) A letter of credit or other financial assurance under this section shall be obtained from a firm licensed to provide such services in New Jersey.
- (c) The letter of credit or other financial assurance shall be in an amount sufficient for the Department to hire an independent contractor to complete and maintain the mitigation project or mitigation bank should the mitigator default. At a minimum, the financial assurance shall be in the following amounts:
1. A construction assurance, equal to one hundred and fifteen percent of the estimated cost of completing the creation, restoration, or enhancement; and
  2. A maintenance assurance to assure the success of the mitigation through the completion of the monitoring period, equal to thirty percent of the estimated cost of completing the creation, restoration, or enhancement.
- (d) The Department will review the financial assurance annually and the mitigator shall adjust the financial assurance to reflect current economic factors, as direct by the Department.
- (e) The Department shall require additional financial assurance if additional construction and/or monitoring is required under N.J.A.C. 7:7A-15.23(h).
- (f) The portion of the financial assurance required under (c)1 above will be released upon the Department's determination that the construction and planting phase of the mitigation project or mitigation bank has been successfully completed in accordance with the approved mitigation proposal.
- (g) The portion of the financial assurance required under (c)2 above will be released upon the Department's declaration that a mitigation project is successful under N.J.A.C. 7:7A-

15.16(e), or upon the successful completion of a mitigation bank in accordance with N.J.A.C. 7:7A-15.23(h), as applicable.

7:7A-15.14 Protecting a mitigation area from future development

- (a) Every mitigation area, whether onsite or offsite, shall be permanently protected from any future development through one or more binding conservation restrictions, as defined at N.J.A.C. 7:7A-1.4, except if the mitigation is restoration of a temporary disturbance on the site of the disturbance.
- (b) The conservation restriction(s) shall require that the mitigation area be permanently preserved in its natural state, and shall prohibit any future regulated activities as described at N.J.A.C. 7:7A-2.3 and N.J.A.C. 7:7A-6.2.
- (c) The conservation restriction shall run with the land and shall be binding upon the mitigator, the landowner, and their successors in interest in the land or any part of the land on which the mitigation area is located. To ensure that notice of the restriction is provided to all present and future interested parties, the mitigator shall do all of the following:
  - 1. Record the conservation restriction(s) at the county clerk's office prior to completion of the mitigation;
  - 2. Ensure that a copy of the conservation restriction is provided to the municipal clerk with a request that it be placed in the property file for the land containing the mitigation area;
  - 3. Insert into the conservation restriction the following:
    - i. A requirement that each owner of the land notify the county and/or municipality of the conservation restriction whenever any application for a local approval involving the land is submitted;
    - ii. A requirement that each owner of the land notify the Department at least 30 days prior to any transfer of fee simple title or possessory interest in the land containing the mitigation area; and
    - iii. A requirement that each owner of the land insert notice of the conservation restriction into any subsequent deed or other legal instrument by which the owner divests either the fee simple title or possessory interest in the land.
- (d) A conservation restriction for preserved uplands or for donated land shall be enforceable by the Department, by a government agency, or by a charitable conservancy whose trustees have no other interest in the land.
- (e) If the mitigation area is donated land or a mitigation bank, the conservation restriction(s) shall require approval by both the Department and the Wetlands Mitigation Council.
- (f) The conservation restriction(s) shall describe and include all regulated features, including all wetlands and all transition areas and relevant site conditions such as encumbrances or contamination.

- (g) A conservation restriction shall include a survey and a metes and bounds description of the entire mitigation area, including any transition area required to be included under this subchapter.

7:7A-15.15 Department review of a mitigation proposal

- (a) The Department shall, within thirty days after receiving a mitigation proposal, review the proposal for completeness and:
  - 1. Request any necessary additional information; or
  - 2. Declare the mitigation proposal complete.
- (b) If a mitigation proposal is intended to compensate for a major discharge, as defined at N.J.A.C. 7:7A-1.4, the Department shall consult with USEPA prior to determining whether to approve the proposal.
- (c) The Department will approve a mitigation proposal only if it meets all of the applicable requirements of this subchapter.

7:7A-15.16 Requirements that apply after the Department approves restoration, creation, or enhancement

- (a) After the Department approves mitigation through restoration, creation, or enhancement, the mitigator shall execute and record a conservation restriction covering the mitigation area. The conservation restriction shall meet the requirements of N.J.A.C. 7:7A-15.14, and shall be executed and filed for recording prior to the start of mitigation activities.
- (b) Within 30 days after construction and planting of a restoration, creation, or enhancement project is completed, the mitigator shall submit a construction completion report to the Department. The Department may require a different schedule for submittal of the construction completion report if it determines that a different schedule would be more effective for assessing the progress and success of the mitigation. The construction completion report shall include:
  - 1. An as-built plan of the completed mitigation area, showing grading, plantings (species, densities, etc.), and any structures included in the approved mitigation proposal;
  - 2. Photographs of the completed mitigation;
  - 3. An explanation for any deviation from the approved mitigation proposal; and
  - 4. Any other information necessary for the Department to determine if the mitigation is successful under (d) below.
- (c) In addition to the construction completion report required under (b) above, the mitigator shall submit to the Department an annual post-planting monitoring report each year for five years after the completion of planting and construction, or for a different time period if

specified in the approved mitigation proposal. The Department may at any time modify the frequency and/or duration of reporting required. The post-planting monitoring report shall be submitted by November 15 of each year, and shall include:

1. An executive summary;
  2. A complete listing of the requirements and goals of the approved mitigation proposal; and
  3. A detailed explanation of the ways in which the mitigation has or has not achieved progress towards those goals. If the mitigation has not achieved progress, the report shall also include a list of remedial actions necessary to do so.
- (d) At the end of the post-planting monitoring period for a restoration, creation, or enhancement project, the mitigator shall demonstrate to the Department that the mitigation project is successful. To do so, the mitigator shall demonstrate that the mitigation satisfies all requirements of this subchapter, all requirements of the approved mitigation proposal, and any applicable permit conditions. At a minimum, the mitigator shall demonstrate that:
1. The post-planting monitoring period required by the approved mitigation proposal has been successfully completed and the monitoring data show that:
    - i. The vegetation in the mitigation area meets the requirements for the types of species, area of coverage, and survival rate, as set forth in the approved mitigation proposal;
    - ii. The soils in the mitigation area meet the requirements in the approved mitigation proposal; and
    - iii. The hydrologic regime in the mitigation area meets the requirements in the approved mitigation proposal, and will continue to do so; and
  2. The areas designated for freshwater wetlands, transition areas, and/or State open waters in the approved mitigation proposal are in fact freshwater wetlands, transition areas, or State open waters as defined at N.J.A.C. 7:7A-1.4; and
  3. The mitigation meets all applicable requirements of this subchapter, including:
    - i. Any requirements at N.J.A.C. 7:7A-15.2 that apply;
    - ii. The requirements for the amount of mitigation under N.J.A.C. 7:7A-15.8; and
    - iii. All restrictions, agreements, and other legal documents required by this subchapter have been executed.
- (e) If the mitigator makes the demonstrations required for a restoration, creation, or enhancement project at (d) above, the Department shall issue a declaration that the mitigation is successful.

- (f) If the mitigator does not make the demonstrations required at (d) above, the mitigator shall perform additional mitigation or other remedial action as directed by the Department, and shall monitor and report on the mitigation or action as directed by the Department.

7:7A-15.17 Requirements that apply after the Department approves credit purchase or uplands preservation

- (a) After the Department determines under N.J.A.C. 7:7A-15.5 or 7:7A-15.6 that mitigation through credit purchase or uplands preservation is the appropriate mitigation alternative, the mitigator shall prepare and execute all documents necessary to ensure that the mitigation will be carried out as approved by the Department.
- (b) The Department shall declare mitigation through credit purchase or uplands preservation successful upon:
  - 1. A demonstration that the completed mitigation satisfies all applicable permit conditions, requirements of this subchapter, and requirements of the approved mitigation proposal; and
  - 2. Submittal to the Department of documents demonstrating that the credit purchase or uplands preservation has occurred as required. Examples of such documents include, but are not limited to:
    - i. For credit purchase, written certifications from the mitigator and from the mitigation bank operator, stating that the credits were purchased; and
    - ii. For uplands preservation, a conservation restriction, documentation that the property has been transferred and a maintenance fund established in accordance with (c) below, and that the transfer and restriction have been recorded with the county or other appropriate agency.
- (c) No later than 60 days after the Department declares mitigation through uplands preservation successful under (b) above, a mitigator shall:
  - 1. Transfer the mitigation area in fee simple to a government agency or a charitable conservancy, as defined at N.J.A.C. 7:7A-1.4. The agency or conservancy shall first be determined suitable for this responsibility by the Department, and shall agree to preserve the mitigation area as a natural area in perpetuity; and
  - 2. Provide the government agency or charitable conservancy with a maintenance fund for maintenance and supervision of the mitigation area. The amount of the maintenance fund shall be determined by agreement between the mitigator and the agency or conservancy.

7:7A-15.18 Requirements that apply after the Department approves mitigation through a monetary contribution

- (a) After the Department determines under N.J.A.C. 7:7A-15.5 or 7:7A-15.6 that monetary contribution is the appropriate mitigation alternative, the mitigator shall apply to the

Wetlands Mitigation Council for approval of the amount of the monetary contribution under the standards at N.J.A.C. 7:7A-15.21.

- (b) The Department shall declare mitigation through a monetary contribution successful upon a demonstration that:
  - 1. The Wetlands Mitigation Council has approved the amount of the monetary contribution; and
  - 2. The monetary contribution has been completed in accordance with the Council resolution approving the contribution, all applicable permit conditions, requirements of this subchapter, and requirements of the approved mitigation proposal.

7:7A-15.19 Requirements that apply after the Department approves mitigation through a land donation

- (a) After the Department determines under N.J.A.C. 7:7A-15.5 or 7:7A-15.6 that land donation is the appropriate mitigation alternative, the mitigator shall apply to the Wetlands Mitigation Council for approval of the particular parcel of land to be donated under the standards at N.J.A.C. 7:7A-15.22.
- (b) The Department shall declare mitigation through a land donation successful upon a demonstration that:
  - 1. The Wetlands Mitigation Council has approved the parcel to be donated; and
  - 2. The land donation has been completed in accordance with the Council resolution approving the contribution, all applicable permit conditions, requirements of this subchapter, and requirements of the approved mitigation proposal.
- (c) Within 60 days after the Department declares mitigation through land donation successful under (b) above, a mitigator shall:
  - 1. Transfer the mitigation area in fee simple to a government agency or a charitable conservancy, as defined at N.J.A.C. 7:7A-1.4. The agency or conservancy shall first be determined suitable for the responsibility by the Department, and shall agree to preserve the mitigation area as a natural area in perpetuity;
  - 2. Provide the government agency or charitable conservancy with a maintenance fund for maintenance and supervision of the mitigation area. The amount of the maintenance fund shall be determined by agreement between the mitigator and the agency or conservancy; and
  - 3. Ensure that the transfer and restriction are recorded with the county or other appropriate agency.

7:7A-15.20 Wetlands Mitigation Council

- (a) The Wetlands Mitigation Council's duties and functions include:

1. Reviewing the following:
    - i. Proposed monetary contributions,
    - ii. Proposed land donations,
    - iii. Mitigation bank proposals; and
    - iv. Proposed county mitigation inventories;
  2. Advising the Department on mitigation issues;
  3. Buying land in order to conduct mitigation, or to preserve wetlands, transition areas, uplands, and/or State open waters;
  4. Contracting with a charitable conservancy or appropriate agency to carry out its responsibilities;
  5. Conducting research on mitigation;
  6. Enhancing or restoring wetlands on public lands; and
  7. Disbursing funds from the Wetlands Mitigation Fund to finance the activities listed at (a)3, 4, 5, and 6 above. To request funding for a mitigation project, contact the Council through the mitigation staff at the address in N.J.A.C. 7:7A-15.2(f).
- (b) If the Council transfers funds or land, the Council shall first execute and record a conservation restriction or other legally binding document that meets all applicable requirements at N.J.A.C. 7:7A-15.14, and that ensures that the funds or land will be used only for mitigation and freshwater wetlands conservation.
- (c) Council meetings are open to the public. A schedule of Council meetings can be obtained by contacting Council staff at the address in N.J.A.C. 7:7A-15.2(f).
- (d) The Wetlands Mitigation Fund shall not be used to aid a permittee or violator in locating a mitigation area required as a condition of a permit, or required in order to resolve a violation.
- (e) The Council may contract with a government agency, nonprofit organization, or other appropriate agency to carry out its responsibilities under this chapter. Any such contract shall be subject to review and approval by the USEPA.

7:7A-15.21 Council review of a proposed monetary contribution

- (a) For mitigation through a monetary contribution, the mitigator shall first obtain the Department's authorization under N.J.A.C. 7:7A-15.5 or 7:7A-15.6 to use monetary contribution as the mitigation alternative. The mitigator shall then obtain approval from the Wetlands Mitigation Council for the amount of the monetary contribution.

- (b) The Wetlands Mitigation Council shall approve the amount of a monetary contribution only if the contribution is equal to the lesser of the following:
1. The cost of buying and enhancing existing degraded freshwater wetlands and/or State open waters, resulting in an area that will provide equal functions and values to that disturbed; or
  2. The cost of buying uplands and creating freshwater wetlands, and/or State open waters, resulting in an area that will provide equal functions and values to that disturbed.
- (c) In determining the costs at (b)1 and 2 above, the Council may consider cost estimates submitted by the applicant and the Department, information obtained from experts in the field of mitigation (including Council members), and any other information available to the Council.

7:7A-15.22 Council review of a proposed land donation

- (a) For mitigation through a land donation, the mitigator shall first obtain the Department's authorization under N.J.A.C. 7:7A-15.5 or 7:7A-15.6 to use land donation as the mitigation alternative. The mitigator shall then obtain approval from the Wetlands Mitigation Council for the particular parcel of land to be donated.
- (b) The Council shall approve the proposed parcel of land to be donated only if the applicant demonstrates that the land has the potential to be a valuable component of a wetland or surface water ecosystem. The Council will evaluate each parcel to determine its potential on a case by case basis, taking into consideration the following:
1. The parcel shall be at least five acres in size, or shall be immediately adjacent to a protected natural area such as a State wildlife management area;
  2. The parcel shall not be adversely affected by solid waste; hazardous waste; or air, water, or soil pollution;
  3. A functional comparison between the impacted wetland system and the wetland system proposed for donation; and
  4. The parcel shall meet at least one, and preferably many, of the following criteria:
    - i. Contains exceptional resource value wetlands;
    - ii. Contains critical habitat for flora or fauna, as defined at N.J.A.C. 7:7A-1.4;
    - iii. Contains wetlands or waters draining to FW1 or category one waters, as defined at N.J.A.C. 7:9B, or into public drinking water sources;
    - iv. Contains wetlands or waters that connect one public open space or significant natural resource to another public open space or significant natural resource. For example, a parcel containing a stream that runs through two wildlife preserves that are not adjacent;

- v. Is adjacent to public lands containing wetland preserves, such as a Federal wildlife refuge, a State wildlife management area, a State park or forest, or a State, County or local wetland preservation area; or wetland preservation areas held by a charitable conservancy; or
  - vi. Has unique aspects or characteristics that contribute to its ecological value, such as an unusual or regionally rare type of wetland.
- (c) The Council shall approve the proposed parcel of land to be donated only if the amount of land to be donated is sufficient to ensure that the functions and values provided by the donated land will fully compensate for the loss of functions and values caused by the disturbance, in accordance with N.J.A.C. 7:7A-15.2(c). If a proposed parcel is affected by an easement or other encumbrance, the portion of the parcel affected by the encumbrance will not be considered in calculating the total amount of mitigation provided, unless the applicant demonstrates that the encumbrance will not inhibit compliance with the mitigation requirements of this chapter.
- (d) If a proposed parcel to be donated is also being donated or otherwise restricted in order to satisfy requirements of another government agency, the Council shall not approve the donation unless the applicant also enhances or restores wetlands on the parcel. For example, if land is required by a county to be preserved as open space, the Council shall only approve the parcel for a land donation if the applicant also performs wetlands restoration or enhancement in accordance with this subchapter. If restoration or enhancement cannot be performed on the parcel, the Council shall not accept the parcel as a land donation.

#### 7:7A-15.23 Mitigation banks

- (a) A mitigation bank requires approval by the Wetlands Mitigation Council prior to the sale of any mitigation credits. A mitigation bank may be approved by the Council prior to its construction, or after the bank is partially or completely constructed.
- (b) If creation of a mitigation bank involves regulated activities as described at N.J.A.C. 7:7A-2.2 or N.J.A.C. 7:7A-2.6, the bank operator shall also obtain from the Department a freshwater wetlands permit, open water fill permit, and/or transition area waiver, authorizing the regulated activities.
- (c) Once the Council has approved a mitigation bank, the bank operator shall carry out all requirements of the resolution approving the bank, regardless of whether or when credits are sold.
- (d) The Council shall determine how many mitigation credits each mitigation bank operator may sell, based on the increase in wetland values and functions created as a result of the proposed mitigation bank, as well as how the increase in functions and values will interact with the regional wetland and aquatic resources. The Council will evaluate each mitigation bank to determine its functions and values on a case by case basis, considering the following factors:

1. The functions and values provided by the bank site at the time the mitigation bank proposal is submitted, including but not limited to existing soil, vegetation, water quality functions, flood storage capacity, soil erosion and sediment control functions, and wildlife habitat functions;
  2. Whether the proposed mitigation activities will result in an increase in functions and values over the existing value of the mitigation bank site;
  3. The likelihood of long-term success of the proposed mitigation activities in creating functions and values similar to an undisturbed wetland and/or State open water;
  4. The amount of wetlands, transition area, and State open waters on the proposed bank site;
  5. The potential for the completed mitigation site to be a valuable component of the aquatic ecosystem;
  6. The size and scope of the bank;
  7. The types of resource losses that have occurred in the area;
  8. The similarity or dissimilarity of the bank to other existing aquatic and wetland resources in the area;
  9. Available scientific literature regarding credit ratios; and
  10. The Department's and other government agencies' experience with mitigation and mitigation banks.
- (e) The Council shall include in the resolution approving the bank a schedule under which a bank operator may sell credits. The schedule shall be as set forth at 1 through 6 below. The Council shall adjust the amount of credits within the ranges at 2 through 6 below to reflect the degree of progress the bank has shown toward meeting the goals and performance standards in the approved mitigation proposal:
1. Ten percent of the credits shall be released upon completion of both of the following:
    - i. Signing of the Council resolution approving the bank; and
    - ii. Compliance with all pre-release credit sale conditions in the resolution approving the bank, such as securing all construction permits, posting adequate and effective financial assurance in accordance with N.J.A.C. 7:7A-15.13, and completing the conservation restriction and the agreement providing for transfer of the bank site at completion;
  2. Up to twenty percent of the credits shall be released upon successful establishment of the approved hydrologic regime, so that this regime will remain over time under normal hydrologic conditions;

3. Up to ten percent of the credits shall be released upon completion of planting as required in the resolution approving the bank;
  4. Up to twenty percent of the credits shall be released when monitoring indicates that the performance standards in the resolution approving the bank have been met for an entire one-year period;
  5. Up to fifteen percent of the credits shall be released when monitoring indicates that the performance standards in the resolution approving the bank have been met for three consecutive years; and
  6. Up to twenty-five percent of the credits shall be released when monitoring in accordance with the resolution approving the bank indicates that the performance standards in the resolution have been met for five consecutive years.
- (f) The mitigation bank operator shall execute and record a conservation restriction on the mitigation bank site prior to the sale of any credits. The conservation restriction shall meet the requirements for protecting mitigation sites from future disturbance, set forth at N.J.A.C. 7:7A-15.14.
- (g) The mitigation bank operator shall monitor the bank during and after construction, in order to ensure its success. The bank operator shall submit progress reports to the Council at least annually during and after construction, and more often if required by the resolution approving the bank.
- (h) If the bank falls more than one year behind the schedule for completion specified in the resolution approving the bank, the Council may amend the resolution approving the bank, and may require remedial action to ensure the successful completion of the bank. The Council may reduce the number of credits that may be sold based on the approved remedial action, in order to reflect the change in wetlands values and functions that will result from the changes to the bank.
- (i) Upon completion of the monitoring period and all other requirements in the resolution approving the bank, the mitigation bank operator shall:
1. Demonstrate that the bank is successful, using the criteria for successful restoration, creation, or enhancement at N.J.A.C. 7:7A-15.16, or for successful upland preservation at N.J.A.C. 7:7A-15.17, as applicable; and
  2. Transfer the mitigation bank site in fee simple to a government agency or charitable conservancy;
  3. Provide the government agency or charitable conservancy to which the mitigation bank site is transferred with a maintenance fund. The maintenance fund shall support maintenance activities such as trash removal, maintenance of natural features, monitoring the site to ensure its upkeep, maintenance of water control structures, fences, or safety features, and any other activities necessary to ensure the site complies with this chapter and all applicable law. The amount of the maintenance fund shall be determined between the bank operator and the agency or conservancy to which the mitigation bank site is transferred; and

4. Ensure that the transfer, and the conservation restriction required under (h) above, are recorded with the county or other appropriate agency.
- (j) A mitigation bank approval shall be valid for five years, or until any Department permit required to conduct the bank activities expires. The Council shall approve a single one year extension only if the mitigation bank operator demonstrates that:
1. If extended, the bank will produce the increase in functions and values upon which the original mitigation bank approval was based;
  2. Bank construction was begun prior to expiration of the mitigation bank approval;
  3. Bank construction has continued uninterrupted in accordance with the resolution approving the bank;
  4. All permits required for the construction of the bank are valid; and
  5. No significant changes in the conditions on the mitigation bank site, as defined at N.J.A.C. 7:7A-15.1, have occurred.
- (k) If a bank approval expires and is not extended under (j) above, the Council shall determine whether the amount of mitigation completed at the bank site is commensurate with the number of credits already sold. If the Council determines that the amount of mitigation completed is not commensurate with the number of credits already sold, the banker shall be considered in default and the Council shall assert its rights to the financial assurance provided under this subchapter.

7:7A-15.24 Application for Wetlands Mitigation Council approval of a monetary contribution or land donation

- (a) An application for a proposal to make a monetary contribution or a land donation shall include the information required by the checklist described at N.J.A.C. 7:7A-15.12(f) or (g), respectively. The application checklist may be obtained from the Council staff at the address in N.J.A.C. 7:7A-15.2(f).
- (b) An application for approval of a monetary contribution or land donation shall first be submitted to Council staff at the address in N.J.A.C. 7:7A-15.2(f). Council staff shall notify the applicant of any additional information required to make the application complete and of the schedule for Council meetings. The applicant shall then submit ten copies of the complete application to the Council staff. These copies shall be submitted at least 30 days before the Council meeting at which the application will be discussed.
- (c) Each Council approval shall incorporate conditions as necessary to ensure that the requirements of this chapter are met.

7:7A-15.25 Application for Wetlands Mitigation Council approval of a mitigation bank

- (a) The Department recommends that a prospective mitigation bank operator obtain conceptual review of a proposed mitigation bank before investing in buying land or

preparing a detailed mitigation bank proposal. Through a conceptual review, Council staff will candidly discuss the apparent strengths and weaknesses of the proposed mitigation bank, but all guidance provided shall be non-binding on the Department. A Council decision on a proposed mitigation bank is binding only if it is incorporated into an approval obtained in accordance with this subchapter. A conceptual review does not grant any property or other rights, and does not authorize mitigation activities or sale of credits. To obtain conceptual review of a proposed mitigation bank, an applicant shall submit the following to the Council:

1. Information on the location, size, and environmental characteristics of the proposed mitigation bank site;
  2. Information on previous uses of the site, including possible contamination and/or historic or archaeological resources;
  3. The proposed mitigation alternative(s), for example, creation, restoration, and/or enhancement;
  4. Whether the credits generated by the bank will be used solely by the mitigation bank operator, or will be available for use by others;
  5. Maps, photographs, diagrams, delineations and/or other visual materials necessary for the Council to generally evaluate the proposed mitigation bank;
  6. The names and addresses of all owner(s) of the mitigation bank site, and any proposed owner(s), as of the date the request for conceptual review is submitted; and
  7. Unconditional written consent from the owner of the proposed mitigation bank site, allowing Council and Department representatives to enter the property and inspect the site.
- (b) To obtain final Council approval of a proposed mitigation bank, an applicant shall submit the information required by the application checklist, available from Council staff at the address in N.J.A.C. 7:7A15.2(f). The checklist will require the following types of information:
1. A letter of interpretation covering the entire proposed mitigation bank site, issued by the Department under N.J.A.C. 7:7A-3;
  2. All past correspondence between the mitigation bank operator and the Department and/or the Council regarding the proposed mitigation bank site, including any correspondence regarding conceptual review under (a) above;
  3. A functional assessment of the bank site prior to construction, and proposed site conditions after construction. The assessment shall include a discussion of how the proposed bank will interact with regional wetland and aquatic resources;
  4. Information on the following items, sufficient for the Council to determine if the mitigation bank is consistent with the Federal Guidance for the Establishment, Use

and Operation of Mitigation Banks, published jointly by EPA and other Federal agencies in the November 28, 1995 Federal Register at 60 Fed. Reg. 58605:

- i. Mitigation bank goals and objectives;
  - ii. Ownership of mitigation bank lands including disclosure of all leases, easements, and other encumbrances;
  - iii. Mitigation bank size, and classes of wetlands, transition areas, uplands, and/or other aquatic resources included in the mitigation bank;
  - iv. Description of baseline conditions on the mitigation bank site, including natural features and parameters, as well as pollutants, contamination, historic or cultural resources, and other relevant features;
  - v. The service area within which the mitigation bank credits may be used to compensate for a disturbance;
  - vi. Types of wetlands, transition areas, and/or State open waters for which credits from the bank could serve as suitable compensation;
  - vii. Method for determining credits and debits;
  - viii. Accounting procedures;
  - ix. Performance standards to enable the Council to determine when credits may be released under N.J.A.C. 7:7A-15.23(e);
  - x. Performance standards to enable the Council to determine if and when the mitigation bank is successful;
  - xi. Reporting protocols and a monitoring plan;
  - xii. Contingency and remedial actions that will be taken in case the bank fails, and who is responsible for each. For example, alternative sites, grading plans, or hydrologic manipulations;
  - xiii. Financial assurances meeting the requirements of N.J.A.C. 7:7A-15.13;
  - xiv. Proposed compensation ratios, that is, the number of credits the bank operator proposes to generate and sell, based on the type and amount of mitigation performed at the bank;
  - xv. Provisions for long-term management and maintenance of the mitigation bank site; and
5. Site plans, cost estimates and schedules for construction, completion, and transfer of the mitigation bank;

6. Draft legal instruments necessary to meet the requirements of this chapter, including a conservation restriction, financial assurance, property transfer, or agreement with a charitable conservancy to maintain the site; and
  7. Identification of the persons who will construct, operate (debit and credit) and maintain the mitigation bank and mitigation bank site.
- (c) An application for approval of a mitigation bank shall be submitted to Council staff at the address in N.J.A.C. 7:7A-15.2(f). Council staff shall notify the applicant of any additional information required to make the application complete and of the schedule for Council meetings. The applicant shall then submit ten copies of the complete application to the Council staff. These copies shall be submitted at least 60 days before the Council meeting at which the application will be discussed.
- (d) Each Council approval shall incorporate conditions as necessary to ensure that the requirements of this chapter are met.

## SUBCHAPTER 16 ENFORCEMENT

### 7:7A-16.1 General provisions

- (a) For the purposes of this subchapter (N.J.A.C. 7:7A-16), the term "applicable law and/or condition" means one or more applicable provisions or conditions of the Freshwater Wetlands Protection Act, N.J.S.A. 13:9B-1 et seq.; the New Jersey Water Pollution Control Act, N.J.S.A. 5:10A-1 et seq.; and/or any permit, waiver, order, exemption letter, mitigation proposal, or rule promulgated or approved pursuant thereto.
- (b) The burden of proof and degrees of knowledge or intent required to establish a violation of the Freshwater Wetlands Protection Act or of any permit, order, rule or regulation promulgated pursuant thereto shall be no greater than the burden of proof or degree of knowledge or intent which USEPA must meet in establishing a violation of the Federal Act or implementing regulations.
- (c) If the Department finds that a person is or has been violating any applicable law and/or condition, the Department may take one or more of the following actions:
1. Issue an administrative order under N.J.A.C. 7:7A-16.3;
  2. Bring a civil action under N.J.A.C. 7:7A-16.4;
  3. Assess a civil administrative penalty under N.J.A.C. 7:7A-16.5 through 7:7A-16.12;
  4. Bring an action for a civil penalty under N.J.A.C. 7:7A-16.13; and/or
  5. Bring a criminal action under N.J.A.C. 7:7A-16.14.
- (d) For all violations under this subchapter, each day during which each violation continues shall constitute an additional, separate, and distinct violation for which a separate penalty may be assessed.

- (e) Each violation of any applicable law and/or condition shall constitute an additional, separate, and distinct violation for which a separate penalty may be assessed.
- (f) The Department's pursuit of any of the remedies available under this subchapter shall not preclude the Department's pursuit of any of the other remedies for the same or another violation. Compliance with any Department enforcement order, including payment of a penalty, shall not preclude the Department from pursuing any of the other remedies available under this subchapter in connection with the violation for which the order was issued.

7:7A-16.2 USEPA review

The Department shall make available without restriction any information obtained or used in the implementation of the Freshwater Wetlands Protection Act, the Water Pollution Control Act, and/or this chapter, to USEPA upon request.

7:7A-16.3 Administrative order

- (a) Whenever, on the basis of available information, the Department finds a person in violation of any applicable law and/or condition, the Department may issue an order:
  1. Specifying each provision of the applicable law and/or condition which has been, or is being violated;
  2. Citing the action which constituted the violation;
  3. Requiring immediate compliance with the provision or provisions violated;
  4. Requiring the restoration or rehabilitation of the freshwater wetlands, State open waters or transition area which is the site of the violation; and
  5. Providing notice of the right to a hearing on the matters contained in the order.

7:7A-16.4 Civil action

- (a) Whenever, on the basis of available information, the Department finds a person in violation of any applicable law and/or condition, the Department may institute a civil action in Superior Court for appropriate relief. Such relief may include, singly or in combination:
  1. A temporary or permanent injunction;
  2. Assessment of the violator for the costs of any investigation, inspection, or monitoring survey which led to the establishment of the violation, and for the reasonable costs of preparing and bringing legal action under this section;
  3. Assessment of the violator for any costs incurred by the State in removing, correcting, or terminating the adverse effects upon the freshwater wetlands, State open waters or transition areas resulting from any unauthorized regulated activity for which legal action under this section may have been brought;

4. Assessment against the violator for compensatory damages for any loss or destruction of wildlife, fish or aquatic life, and for any other actual damages caused by an unauthorized regulated activity. Assessments under this section shall be paid to the State Treasurer except that compensatory damages shall be paid by specific order of the court to any persons who have been aggrieved by the unauthorized regulated activity; and/or
5. A requirement that the violator restore or rehabilitate the site of the violation to the maximum extent practicable, as defined in N.J.A.C. 7:7A-1.4. If the violator does not do so, the Department may take corrective action, and will assess the violator pursuant to this chapter.

#### 7:7A-16.5 Civil administrative penalty

- (a) Whenever, on the basis of available information, the Department finds a person in violation of any provision of the Freshwater Wetlands Protection Act, or of any permit, waiver, order, exemption letter, mitigation proposal, or rule promulgated or approved pursuant thereto, the Department may assess a civil administrative penalty of no more than \$10,000 for each violation. The amount of the civil administrative penalty for a violation of the Freshwater Wetlands Protection Act shall be determined under N.J.A.C. 7:7A-16.8 through 7:7A-16.12.
- (b) Whenever, on the basis of available information, the Department finds a person in violation of any provision of the Water Pollution Control Act, or of any permit, approval, waiver, order, exemption, or rule promulgated or approved pursuant thereto, the Department may assess a civil administrative penalty of no more than \$50,000 for each violation. The amount of the civil administrative penalty for a violation of the Water Pollution Control Act shall be determined under the Department's rules implementing the enforcement provisions of that law at N.J.A.C. 7:14-8.
- (c) The Department may, in its discretion, settle a civil administrative penalty assessed under this subchapter, in accordance with N.J.A.C. 7:7A-16.6(c). However, if the Department settles a penalty for a violation of the Water Pollution Control Act, the settlement is subject to N.J.A.C. 7:14-8.

#### 7:7A-16.6 Assessment, settlement and payment of a civil administrative penalty

- (a) To assess a civil administrative penalty, the Department shall notify the violator by certified mail (return receipt requested) or by personal service. This notice of civil administrative penalty assessment shall:
  1. Identify each section of the applicable law and/or condition violated;
  2. Concisely state the facts alleged to constitute the violation;
  3. Specify the amount of the civil administrative penalty; and
  4. Advise the violator of the right to request an adjudicatory hearing under N.J.A.C. 7:7A-16.7.

(b) The violator shall pay a civil administrative penalty immediately upon receipt of the Department's final order in a contested case, or as soon as a notice of civil administrative penalty assessment becomes a final order as follows:

1. If no hearing is requested under N.J.A.C. 7:7A-16.7, a notice of civil administrative penalty assessment becomes a final order on the 21st day after the violator receives the notice of civil administrative penalty assessment;
2. If the Department denies a hearing request under N.J.A.C. 7:7A-16.7(c) or (d), a notice of civil administrative penalty assessment becomes a final order upon the violator's receipt of the denial; or
3. If the Department grants a hearing, a notice of civil administrative penalty assessment becomes a final order upon the violator's receipt of a final order in the contested case.

(c) The Department may, in its discretion, settle any civil administrative penalty assessed under this subchapter, based on an evaluation of the factors at 1 through 4 below. As provided at N.J.A.C. 7:7A-16.5(c), this subsection does not apply to penalties assessed for violations of the Water Pollution Control Act:

1. Mitigating or extenuating circumstances not previously considered in the assessment of penalties;
2. The violator's timely implementation of measures leading to compliance, which measures were not previously considered in the assessment of penalties, including measures to clean up, reverse or repair environmental damage caused by the violation, or to remove the violation;
3. The violator's full payment of a specified part of a civil administrative penalty, if payment is made within a time period established by the Department in an administrative order, and if the violator waives the right to request an adjudicatory hearing on the civil administrative penalty; or
4. Any other terms or conditions acceptable to the Department.

7:7A-16.7 Appeal of an administrative order and/or notice of civil administrative penalty assessment

(a) A violator may request an adjudicatory hearing to contest an administrative order, and/or a notice of civil administrative penalty assessment issued under this chapter. To request an adjudicatory hearing, the violator shall submit the following information in writing to the Department at the address in (b) below:

1. The name, address, and telephone number of the violator and its authorized representative;
2. The violator's defenses to each of the findings of fact in the administrative order and/or notice of civil administrative penalty assessment, stated in short and plain terms;

3. An admission or denial of each of the findings of fact. If the violator is without knowledge or information sufficient to form a belief as to the truth of a finding, the violator shall state this and this shall have the effect of a denial. A denial shall fairly meet the substance of the findings denied. When the violator intends in good faith to deny only a part or a qualification of a finding, the violator shall specify so much of it as is true and material and deny only the remainder. The violator may not generally deny all the findings but shall make all denials as specific denials of designated findings. For each finding the violator denies, the violator shall allege the fact or facts as the violator believes it or them to be;
  4. Information supporting the request and copies of other written documents relied upon to support the request;
  5. An estimate of the time required for the hearing (in days and/or hours); and
  6. A request, if necessary, for a barrier-free hearing location accessible to physically disabled persons.
- (b) A request for an adjudicatory hearing under this subchapter shall be addressed to:
- Office of Legal Affairs  
ATTENTION: Adjudicatory Hearing Requests  
Department of Environmental Protection  
P.O. Box 402  
Trenton, New Jersey 08625-402
- (c) If the Department does not receive the hearing request within 20 days after the violator receives the notice of civil administrative penalty assessment and/or the administrative order which is being contested, the Department shall deny the hearing request.
- (d) If the violator fails to include all of the information required by (a) above, the Department may deny the hearing request.
- (e) Any adjudicatory hearing shall be conducted in accordance with the Administrative Procedure Act, N.J.S.A. 52:14B-1 et seq., and the Uniform Administrative Procedure Rules, N.J.A.C. 1:1.

7:7A-16.8 Civil administrative penalty amount

- (a) When the Department assesses a civil administrative penalty, the Department shall use the procedures in this section to determine the amount of the penalty if the violation pertains to wetlands and transition areas, except if the violation is listed at N.J.A.C. 7:7A-16.9, 7:7A-16.10, or 7:7A-16.11, in which case the penalty amount shall be determined under whichever of those sections applies.
- (b) If a violation of this chapter pertains to State open waters, the Department shall not determine the amount of the civil administrative penalty under this subchapter, but shall determine the penalty under the Department's rules implementing the enforcement provisions of the Water Pollution Control Act at N.J.A.C. 7:14-8.

- (c) The Department shall use the three factors described below to determine the amount of a civil administrative penalty under this section. Using the standards below, the Department assigns each violation a point value for each factor. The total number of points is used in Table D at (d) below to determine the penalty amount per day for each violation. The factors, and the point values assigned to them, are as follows:
1. The conduct factor of the violation shall be classified as major, moderate or minor and assigned points as follows:
    - i. Major conduct shall include an intentional, deliberate, purposeful, knowing or willful act or omission by the violator and is assigned three points;
    - ii. Moderate conduct shall include any unintentional but foreseeable act or omission by the violator and is assigned two points; and
    - iii. Minor conduct shall include any conduct not identified in (c)1i or ii above and is assigned one point.
  2. The acreage of wetlands impacted factor shall be assigned points as follows:
    - i. A violation impacting more than three acres of wetlands is assigned three points;
    - ii. A violation impacting one to three acres of wetlands is assigned two points; and
    - iii. A violation impacting less than one acre of wetlands is assigned one point; and
  3. The resource value classification factor shall be assigned points as follows:
    - i. A violation impacting exceptional resource classification wetlands is assigned three points;
    - ii. A violation impacting intermediate resource classification wetlands is assigned two points; and
    - iii. A violation impacting ordinary resource classification wetlands is assigned one point.
- (d) The Department shall sum the total points assigned according to the three factors in (c) above, and shall determine the penalty amount per day using the following table:

Table D  
Penalty points table

| Total Points | Penalty Amount<br>Per Day |
|--------------|---------------------------|
| 9            | \$10,000.00               |
| 8            | 9,000.00                  |
| 7            | 7,500.00                  |
| 6            | 6,000.00                  |
| 5            | 4,500.00                  |
| 4            | 3,000.00                  |
| 3            | 1,500.00                  |

7:7A-16.9 Civil administrative penalty amount for submitting inaccurate or false information

- (a) When the Department assesses a civil administrative penalty for submittal of inaccurate information or submittal of a false statement, representation, or certification in an application, record, or other document required to be submitted or maintained under the Freshwater Wetlands Protection Act or under a permit, waiver, order, exemption letter, mitigation proposal, or rule promulgated or approved pursuant thereto, the Department shall use the procedures in this section to determine the amount of the civil administrative penalty.
- (b) If a violation described in this section pertains to State open waters, the Department shall not determine the amount of the civil administrative penalty under this section, but shall determine the penalty under the Department's rules implementing the enforcement provisions of the Water Pollution Control Act at N.J.A.C. 7:14-8.
- (c) Each day, from the day that a violator submits inaccurate or false information to the Department, to the day the Department receives a written correction from the violator, shall be an additional, separate, and distinct violation.
- (d) The daily civil administrative penalty for each intentional, deliberate, purposeful, knowing, or willful act or omission under this section shall be assessed at the midpoint between \$10,000 and \$8,000 unless adjusted under (f) below.
- (e) The daily civil administrative penalty for each violation under this section that is not listed in (d) above shall be assessed at the midpoint between \$1,000 and \$0 unless adjusted under (f) below.
- (f) For a violation under this section, the Department may adjust the civil administrative penalty amount from the midpoint within the range listed in (d) or (e) above, based on the following factors:
  1. The violator's compliance history;
  2. The nature, timing and effectiveness of measures the violator takes to mitigate the effects of the violation;

3. The nature, timing and effectiveness of measures the violator takes to prevent future similar violations;
4. Any unusual or extraordinary costs or impacts directly or indirectly imposed on the public or the environment as a result of the violation; and/or
5. Other specific circumstances of the violator or violation.

7:7A-16.10 Civil administrative penalty amount for failure to allow entry and inspection

- (a) When the Department assesses a civil administrative penalty under the FWPA against a person who refuses, inhibits or prohibits immediate lawful entry and inspection of any premises, building or place by any authorized Department representative, the Department shall use the procedures in this section to determine the amount of the civil administrative penalty. The amount of a civil administrative penalty for refusal of entry and inspection under the WPCA shall be determined under N.J.A.C. 7:14-8.7.
- (b) Each day that a person refuses, inhibits or prohibits immediate lawful entry and inspection shall be an additional, separate, and distinct violation.
- (c) The daily civil administrative penalty for a violation under this section shall be assessed at the midpoint of the following ranges, except as adjusted under (d) below:
  1. For refusing, inhibiting or prohibiting immediate lawful entry and inspection of any premises, building or place for which the Department has issued an administrative order, freshwater wetlands permit, transition area waiver, approved mitigation proposal or general permit authorization, the civil administrative penalty shall be no more than \$10,000 nor less than \$7,000; and
  2. For any other refusal, inhibition or prohibition of immediate lawful entry and inspection, the civil administrative penalty shall be no more than \$7,000 nor less than \$1,500.
- (d) The Department may adjust the daily civil administrative penalty amount, within the applicable range at (c) above, based on the following factors:
  1. The violator's compliance history;
  2. The nature, timing and effectiveness of measures the violator takes to remedy the effects of the violation;
  3. The nature, timing and effectiveness of measures the violator takes to prevent future similar violations;
  4. Any unusual or extraordinary costs or impacts directly or indirectly imposed on the public or the environment as a result of the violation; and/or
  5. Other specific circumstances of the violator or violation.

7:7A-16.11 Civil administrative penalty for failure to pay a civil administrative penalty

- (a) The Department may assess a civil administrative penalty under this section against each violator who fails to pay a civil administrative penalty when due under this chapter.
- (b) The daily civil administrative penalty amount assessed under this section shall be equal to the unpaid civil administrative penalty, but shall not exceed the maximum allowed at N.J.A.C. 7:7A-16.5(a) and (b).
- (c) Each day that a civil administrative penalty assessed under this subchapter is not paid after it is due shall constitute an additional, separate and distinct violation.

7:7A-16.12 Economic benefit factor

- (a) The Department may add to a civil administrative penalty assessed under this subchapter the amount of economic benefit in dollars that the violator has realized as the result of not complying, or by delaying compliance with, an applicable law and/or condition.
- (b) The Department may use the economic benefit factor to increase a civil administrative penalty to an amount no greater than the maximum allowed at N.J.A.C. 7:7A-16.5(a) and (b).
- (c) If the total economic benefit was derived from more than one violation, the Department may apportion the total economic benefit amount among the violations from which it was derived, so as to increase each civil administrative penalty to an amount no greater than the maximum allowed at N.J.A.C. 7:7A-16.5(a) and (b).

7:7A-16.13 Civil penalty

- (a) Each person who does any of the following shall be subject, upon the order of a court, to a civil penalty:
  - 1. Violates the Freshwater Wetlands Protection Act, the Water Pollution Control Act, or this chapter;
  - 2. Violates an administrative order or a court order issued pursuant to the Freshwater Wetlands Protection Act, the Water Pollution Control Act, or this chapter; or
  - 3. Fails to pay in full a civil administrative penalty assessed under this chapter.
- (b) A civil penalty imposed under this section shall not exceed the maximum allowed at N.J.A.C. 7:7A-16.5(a) and (b).
- (c) A civil penalty imposed under this section may be collected, with costs, in a summary proceeding pursuant to the Penalty Enforcement Law, N.J.S.A. 2A:58-1 et seq. The Superior Court shall have jurisdiction to enforce the penalty enforcement law in conjunction with the Freshwater Wetlands Protection Act, the Water Pollution Control Act, and this chapter.

7:7A-16.14 Criminal action

- (a) The Department, upon petition to the Attorney General, may bring a criminal action in court for certain violations of the Freshwater Wetlands Protection Act, or of a permit, waiver, order, exemption letter, mitigation proposal, or rule promulgated or approved pursuant thereto.
- (b) If a violation described in this section pertains to State open waters, the criminal penalty shall not be governed by this section, but shall be governed by the Water Pollution Control Act at N.J.S.A. 58:10A-10(f).
- (c) A person who willfully or negligently violates the Freshwater Wetlands Protection Act, or any permit, approval, waiver, order, exemption, or rule promulgated or approved pursuant thereto, shall be guilty, upon conviction, of a crime of the fourth degree and shall be subject to a fine of no less than \$2,500 nor more than \$25,000 per day of violation.
- (d) A second offense under this section shall subject the violator to a fine of no less than \$5,000 nor more than \$50,000 per day of violation.
- (e) A person shall, upon conviction, be subject to a fine of no more than \$10,000 if the person:
  - 1. Knowingly makes a false statement, representation, or certification in any application, record, or other document filed or required to be maintained under the Freshwater Wetlands Protection Act, or under a permit, waiver, order, exemption letter, mitigation proposal, or rule promulgated or approved pursuant thereto; or
  - 2. Falsifies, tampers with or knowingly renders inaccurate, any monitoring device or method required to be maintained under the Freshwater Wetlands Protection Act, or a permit, waiver, order, exemption letter, mitigation proposal, or rule promulgated or approved pursuant thereto.

7:7A-16.15 Forfeiture of conveyances

All conveyances used or intended for use in the purposeful or knowing discharge into State open waters of any pollutant or toxic pollutant, in violation of the Water Pollution Control Act, are subject to forfeiture to the State under N.J.S.A. 58:10A-10(g) and N.J.S.A. 13:1K-1 et seq. A hearing will be held prior to any forfeiture under this section. For the purposes of this section, the term "conveyance" means an aircraft, vessel, vehicle, or other equipment or container.

7:7A-16.16 Notice of violation recorded on deed to property

- (a) On order of the Commissioner:
  - 1. The clerk or register of deeds and mortgages of the county containing the property upon which the violation occurred shall record a notice of violation of the Freshwater Wetlands Protection Act on the deed of the property; and/or

2. The clerk of the Superior Court shall record a notice of violation of the Freshwater Wetlands Protection Act.
- (b) The notice of violation shall remain attached to the property deed and shall remain recorded at the Superior Court until the violation has been remedied and the Commissioner has ordered the clerk to remove the notice of violation.

7:7A-16.17 "After the fact" permit

- (a) The Department may issue an "after the fact" permit for a regulated or prohibited activity that has already occurred and that does not meet the standards for approval in this chapter only if all of the following are true:
1. The Department has determined that the restoration of the site to its pre-violation condition would increase the harm to a freshwater wetland, transition area, and/or State open water, or its ecology;
  2. The Department has assessed and collected the costs or damages enumerated in N.J.A.C. 7:7A-16.4 from the violator;
  3. The Department has required the violator to create or restore freshwater wetlands or State open waters at another location;
  4. An opportunity has been afforded for public hearing and comment; and
  5. The reasons for the issuance of the "after the fact" permit are published in the DEP Bulletin and in a newspaper of general circulation in the geographic area of the violation.
- (b) The issuance of an "after the fact" permit or waiver under this section shall not limit the Department's ability to pursue any other enforcement action for the violation that is the subject of the "after the fact" permit or waiver.
- (c) Any person violating an "after the fact" permit issued under this section shall be subject to enforcement under this chapter.

7:7A-16.18 Public participation

- (a) To provide for public participation in the Department's enforcement process, the Department shall:
1. Investigate and provide responses to all citizen complaints submitted under Department procedures;
  2. Not oppose intervention by any citizen when permissive intervention may be authorized by statute, rule, or regulation; and
  3. Publish notice of any proposed settlement of a Department enforcement action in the DEP Bulletin and provide at least 30 days for public comment on the settlement.

SUBCHAPTER 17 RECONSIDERATION BY DEPARTMENT OF ITS ACTION OR INACTION CONCERNING A PERMIT

7:7A-17.1 Reconsideration by Department of its action or inaction concerning a permit

- (a) If the issuance, modification, or denial of an individual freshwater wetlands permit would constitute a taking without just compensation, and provided the conditions at (b) below are met, the Department may do any one or more of the following:
1. Compensate the property owner for the lost value of the property;
  2. Condemn the affected property pursuant to the Eminent Domain Act of 1971, N.J.S.A. 20:3-1 et seq.; and/or
  3. Reconsider and modify its action or inaction concerning a permit so as to minimize the detrimental effect to the value of the property.
- (b) The Department may reconsider and modify its action or inaction concerning a permit so as to minimize the detrimental effect to the value of the property, provided:
1. The Department has rendered a decision on a permit application under the rules in this chapter as strictly applied;
  2. All administrative and judicial appeals of the permit decision have been concluded; and
  3. Either of the following requirements is met:
    - i. A court has determined that the issuance, modification, or denial of an individual freshwater wetlands permit would constitute a taking of property, and the property owner thereupon submits a request for a reconsideration and modification of the permit action or inaction; or
    - ii. A takings complaint has been filed with the court or the court has determined that the issuance, modification or denial of a individual freshwater wetlands permit would constitute a taking of property, and the Department initiates the reconsideration.
- (c) In making the determination to reconsider and modify its action or inaction concerning a permit so as to minimize the detrimental effect to the value of the property under (a) above, the Department shall prepare a written analysis that evaluates three factors:
1. The investments the property owner made in the property that is the subject of the individual freshwater wetlands permit application and whether the investments were reasonable, and reflected reasonable expectations, in accordance with (d) below;
  2. The minimum beneficial economically viable use of the property, in accordance with (e) below; and

3. The environmental impacts of the minimum beneficial economically viable use for the property, and their consistency with the goals of the FWPA, in accordance with (f) below.
- (d) In determining whether the property owner's investments in the property as a whole were reasonable, and reflected reasonable expectations, the Department shall evaluate the following information:
1. Conditions at the time of the investment. That is, the investment shall have been made in pursuit of development that would likely have been legally and practically possible on the property, considering all constraints existing and reasonably ascertainable at the time of the investment. For example, if a property owner bought property containing freshwater wetlands regulated under this chapter, it would not be reasonable to expect that the property could be developed without constraints. In determining conditions at the time of the investment, the Department shall consider, at a minimum, the following:
    - i. Existing zoning and other regulatory requirements and conditions;
    - ii. Historic landmarks or other historic or cultural resources;
    - iii. The likelihood of obtaining other necessary approvals such as wastewater treatment approvals or approvals from other local, state or Federal agencies;
    - iv. Terrain and other site conditions, and/or environmental constraints, which could affect the potential uses of the property as a whole;
    - v. The existence of, or likelihood of obtaining, services to the property such as sewers or electricity;
    - vi. Land uses on adjacent properties and in the area where the property is located;
  2. Costs actually incurred in pursuit of development of the property as a whole;
  3. Costs incurred in furtherance of a lawful action. For example, if the property owner began the project without the necessary permits, the cost of defending against an enforcement action for this violation would not constitute a reasonable investment that reflects reasonable expectations;
  4. Costs relating only to the specific property as a whole that is the subject of the individual freshwater wetlands permit application, and not including costs related to other properties; and
  5. Any other factor affecting the property or the property owner, which is related to the reasonableness of the investments, the expectations, and/or the proposed use of the property.
- (e) In determining the minimum beneficial economically viable use of the property, the Department shall consider existing legal precedent at the time of the determination. A use

shall not be excluded from consideration as a minimum beneficial economically viable use merely because it diminishes the value of the property as a whole, does not result in a profit, reduces the marketability of the property as a whole, or does not allow the property owner to recoup all reasonable investments identified under (c) above.

(f) In determining the environmental impacts of any minimum beneficial economically viable uses of the property and the consistency of those impacts with the goals of the FWPA, in accordance with (c) above, the Department shall evaluate whether the minimum beneficial economically viable use would:

1. Adversely affect the quality and resource value classification of the wetland, pursuant to N.J.A.C. 7:7A-2.5, and the quantity of freshwater wetlands, transition areas, and/or State open waters to be disturbed;
2. Adversely affect other protected resources, for example, historic or cultural resources, ecologically unique areas or critical wildlife habitat;
3. Result in irreversible losses of values and functions provided by freshwater wetlands, transition areas, and/or State open waters, for example, flood control, endangered species habitat, or water quality and whether such losses could be mitigated; and
4. Adversely affect public health, safety and welfare, and fish and wildlife.

(g) The Department shall not modify its action or inaction concerning a permit and approve a minimum beneficial economically viable use as the result of a reconsideration under this section if that use would cause any one of the following:

1. Irreversible losses of values and functions provided by freshwater wetlands, transition areas and/or State open waters that provide essential breeding, spawning, nesting, feeding, resting, or wintering habitats for fish and wildlife, including migratory birds, endangered species, and commercially and recreationally important wildlife. For the purposes of this section, "irreversible losses" means an alteration to the wetland, transition area or State open water that would eliminate one or more of the essential characteristics which provides the breeding, spawning, nesting, feeding, resting or wintering habitat for the species in question, and that could not be mitigated;
2. Irreversible losses in water quality of FW-1 or FW-2 trout production waters and their tributaries, resulting in degradation of ground or surface waters, in violation of Federal, State or local water quality standards; or
3. Irreversible losses of wetlands and/or State open waters, providing essential flood and storm damage protection by absorption, the storage of water during high runoff periods and the reduction of flood crests, resulting in creation of a public nuisance.

(h) A property owner may request that the Department reconsider and modify its action or inaction concerning a permit under (a) above only after:

1. The conclusion of any administrative and/or judicial appeal of the permit decision; and

2. A court has determined that the issuance, modification, or denial of an individual freshwater wetlands permit without reconsideration would result in a taking of property without just compensation.
- (i) A complete request for the Department to reconsider and modify its action or inaction concerning a permit under (a) above shall include the following items:
1. A completed LURP application form, indicating a request for reconsideration and the type of permit being requested;
  2. Unconditional written consent from the owner of the site, as defined at N.J.A.C. 7:7A-1.4, for Department representatives to enter the site to conduct site inspections;
  3. Documentation that public notice has been given pursuant to the requirements at N.J.A.C. 7:7A-10.9(c), (d), (e) and (g). This notice may be combined with the offer to sell the property required under (i)7 below;
  4. Document(s) showing when the property as a whole, as defined at N.J.A.C. 7:7A-1.4, was acquired, the purchase price of the property as a whole and the instrument which documents the applicant's real property interest;
  5. Document(s) showing the amount, nature, and date of any investments made to maintain and/or develop the property as a whole, other than the purchase price;
  6. The language of a proposed conservation restriction that meets the requirements of (m)2 below;
  7. Documentation that the property has been offered for sale in a letter, following the form provided by the Department, to all owners of property within 200 feet of the property as a whole, and to the land conservancies, environmental organizations, and government agencies on a list supplied by the Department; and that no reasonable offer to purchase, that assumes a minimum beneficial economically viable use, has been received. This documentation shall include the following:
    - i. A copy of each letter that the property owner sends under this subsection;
    - ii. All responses the property owner receives to the letters sent under this subsection. Each response shall be submitted to the Department within 15 days after the property owner's receipt of the response; and
    - iii. A list, certified by the municipality, of all owners of real property within 200 feet of the property as a whole, including owners of easements as shown on the tax duplicate;
  8. The written offer of sale required under (i)7 above shall be sent by certified mail and shall:
    - i. Indicate that the offer is open for a period of at least 90 calendar days;

- ii. Include a copy of a fair market value appraisal, performed by a State-licensed appraiser, that assumes that a minimum beneficial economically viable use of the property will be allowed;
    - iii. Include full disclosure of the location on the property of any freshwater wetlands, transition areas, and/or State open waters; and
    - iv. Indicate that the property owner has requested a reconsideration of the Department's action or inaction concerning a permit under this section; and
  - 9. A development plan showing the project that is proposed in order to provide a minimum beneficial economically viable use;
  - 10. Information and/or certifications regarding the presence or absence of endangered or threatened species habitat, historic or archaeological resources, or other features on the site relevant to determining compliance with the requirements of this chapter;
  - 11. A mitigation proposal that complies with N.J.A.C. 7:7A-15, to offset the impacts of the project on freshwater wetlands, transition areas, and/or State open waters;
  - 12. Documentation that the proposed project will cause the least environmental impact possible, while still providing a minimum beneficial economically viable use of the property consistent with constitutional standards;
  - 13. A copy of the court determination that the Department's issuance, modification, or denial of an individual freshwater wetlands permit would constitute a taking without just compensation; and
  - 14. Documents showing that the property owner has concluded all administrative and judicial appeals of the Department's decision on the application for an individual freshwater wetlands permit. Such documentation shall include the last of the following (submitted after the appeal period for the applicable decision has expired):
    - i. A Department decision on the application for an individual freshwater wetlands permit, made in accordance with the rules as strictly applied;
    - ii. A final decision issued by the Commissioner regarding the Department's decision on the application for an individual permit; and
    - iii. Documentation that all appeals of any final decision issued by the Commissioner under (i)14ii above have been concluded; and
  - 15. The names and addresses of all consultants, engineers, and other persons providing technical assistance in preparing the request for reconsideration.
- (j) In the case where the Department initiates the reconsideration of whether to modify its action or inaction concerning a permit under (a) above, the Department shall, upon initiation of the reconsideration process:
- 1. Provide the following notifications:

- i. Publication in the DEP Bulletin;
    - ii. In accordance with the requirements at N.J.A.C. 7:7A-10.9(c)(d)(e)1-4, and 6; and
    - iii. To those who provided comments on the previous application that is the subject of the reconsideration.
  - 2. Include in the notice the applicant's name; project name, if applicable; project number; county and municipality of the project; and an executive summary describing the development that is the subject of the reconsideration.
  - 3. Provide a 15-day comment period, commencing from the date of publication of the notice in the DEP Bulletin.
- (k) If the Department determines to approve a development upon reconsideration under this section, the Department shall provide notice of the development that the Department proposes to allow under the reconsideration following the same procedure described at (j) above except that the Department shall provide a 30-day comment period commencing from the date of notice in the DEP Bulletin.
- (l) The Department shall complete the written analysis required under (c) above, which shall incorporate its decision on the request for reconsideration and modification of its action or inaction concerning a permit, as follows:
- 1. For a request for reconsideration under (b) and (h) above, no later than 180 days from the Department's receipt of a complete request under (h) above; or
  - 2. For a reconsideration initiated by the Department under (b) above, no later than 180 days from the publication of notice in the DEP Bulletin under (j) above.
- (m) If the Department approves a development upon reconsideration and modification of its action or inaction concerning a permit under (a) above, the approval shall, at a minimum:
- 1. Be the minimum relief necessary to enable the property owner to realize a minimum beneficial economically viable use of the property as a whole, consistent with constitutional standards; and
  - 2. Ensure that any part of the property as a whole that the Department does not allow to be developed upon reconsideration and modification of its action or inaction concerning a permit will be protected from future development by a recorded conservation restriction.

Appendix 1: Obligate and facultative fauna species found in vernal habitats

Obligate Species

Marbled Salamander  
Blue-spotted Salamander\*  
Jefferson Salamander  
Eastern Tiger Salamander\*  
Wood Frog  
Spotted Salamander  
Eastern Spadefoot Toad  
Jefferson x Blue-spotted Salamander\*

Facultative Species

Snapping Turtle  
Eastern Mud Turtle  
Spotted Turtle  
Eastern Painted Turtle  
Red-spotted Newt  
American Toad  
Fowler's Toad  
Pine Barrens Treefrog\*  
Northern Gray Treefrog  
Southern Gray Treefrog  
Upland Chorus Frog  
Northern Cricket Frog  
New Jersey Chorus Frog  
Green Frog  
Southern Leopard Frog  
Four-toed Salamander  
Northern Spring Peeper  
Long-tailed Salamander\*\*  
Wood Turtle\*\*

\* Listed as a New Jersey state endangered species

\*\* Listed as a New Jersey state threatened species

(END of document)

NJDEP Freshwater Wetlands Rules N.J.A.C. 7:7A Effective 10/20/03

Note: this is a courtesy copy of the freshwater wetlands rules. The official version is in the New Jersey Administrative Code (N.J.A.C.). Should there be any discrepancies between this courtesy copy and the official version, the official version will govern.

## **Appendix C – 4**

### **State Legal Authorities**

### **Pinelands Protection Act**

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# PINELANDS PROTECTION ACT



**DISCLAIMER:** This a "courtesy copy" of the Pinelands Protection Act. The Pinelands Commission has made every effort to ensure that the text of the law provided through this web page is identical to the official, legally effective version of law, set forth in the N.J.S.A. However, should there be any discrepancies between the text on this web site and the official version of the law, the official version will govern.

**For more information:  
Pinelands Commission  
P.O. Box 7  
New Lisbon, NJ 08064  
<http://www.nj.gov/pinelands>**

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## **TITLE 13 CONSERVATION AND DEVELOPMENT – PARKS AND RESERVATIONS**

### **13:18A-1. Short title**

This act shall be known and may be cited as the “Pinelands Protection Act.”

L.1979, c. 111, s. 1, eff. June 28, 1979.

### **13:18A-2. Legislative findings and declarations**

The Legislature hereby finds and declares that the pinelands area comprises pine-oak forests, cedar swamps, and extensive surface and ground water resources of high quality which provide a unique habitat for a wide diversity of rare, threatened and endangered plant and animal species and contains many other significant and unique natural, ecological, agricultural, scenic, cultural and recreational resources; that the continued viability of such area and resources is threatened by pressures for residential, commercial and industrial development; that the protection of such area and resources is in the interests of the people of this State and of the Nation; that such protection will require the coordinated efforts of all relevant municipal, county, State and Federal agencies; that the Congress and President of the United States have demonstrated a recognition of these facts through the enactment of section 502 of the “National Parks and Recreation Act of 1978” (PL 95-625); and, that it is now necessary to implement the afore-cited Federal Act and insure the realization of pinelands protection through the establishment of a regional planning and management commission empowered to prepare and oversee the implementation of a comprehensive management plan for the pinelands area.

The Legislature further finds and declares that a certain portion of the pinelands area is especially vulnerable to the environmental degradation of surface and ground waters which would be occasioned by the improper development or use thereof; that the degradation of such waters would result in a severe adverse impact upon the entire pinelands area; that it is necessary to designate this portion as a preservation area, wherein more stringent restrictions on the development and use of land should be utilized and public acquisition of land or interests therein should be concentrated; and, that in order to facilitate such acquisition, and otherwise to effectuate the provisions of this act and the Federal Act, it is further necessary to establish certain notice requirements and procedures for the purchase of land or interests therein in such area.

The Legislature further finds and declares that the current pace of random and uncoordinated development and construction in the pinelands area poses an immediate threat to the resources thereof, especially to the survival of rare, threatened and endangered plant and animal species and the habitat thereof, and to the maintenance of the existing high quality of surface and ground waters; that such development and construction increase the risk and extent of destruction of life and property which could be caused by the natural cycle of forest fires in this unique area; and, that, in order to effectuate the purposes and provisions of this act and the Federal Act, it is necessary to impose

certain interim limitations upon the local approval of applications for development in the preservation area, and upon certain State and local approvals in the pinelands area, all as hereinafter provided.

L.1979, c. 111, s. 2, eff. June 28, 1979.

### **13:18A-3. Definitions**

As used in this act:

a. “Agricultural or horticultural purposes” or “agricultural or horticultural use” means any production of plants or animals useful to man, including but not limited to: forages or sod crops; grains and feed crops; dairy animals and dairy products; poultry and poultry products; livestock, including beef cattle, sheep, swine, horses, ponies, mules or goats, and including the breeding and grazing of any or all of such animals; bees and apiary products; fur animals; aquatic organisms as part of aquaculture; trees and forest products; fruits of all kinds, including grapes, nuts and berries; vegetables; nursery, floral, ornamental and greenhouse products; or any land devoted to and meeting the requirements and qualifications for payments or other compensation pursuant to a soil conservation program under an agency of the Federal Government;

b. “Application for development” means the application form and all accompanying documents required by municipal ordinance for approval of a subdivision plat, site plan, planned development, conditional use, zoning variance or other permit as provided in the “Municipal Land Use Law,” P.L.1975, c. 291 (C. 40:55D-1 et seq.), for any use, development or construction other than the improvement, expansion or reconstruction of any single-family dwelling unit or appurtenance thereto, or the improvement, expansion, construction or reconstruction of any structure used exclusively for agricultural or horticultural purposes;

c. “Commission” means the Pinelands Commission created by section 4 of this act;

d. “Comprehensive management plan” means the plan prepared and adopted by the commission pursuant to section 7 of this act;

e. “Council” means the Pinelands Municipal Council created by section 6.1 of this act;

f. “Federal Act” means section 502 of the “National Parks and Recreation Act of 1978” (Pub. L. 95-625);

g. “Major development” means any division or subdivision of land into five or more parcels; any construction or expansion of any housing development of five or more dwelling units; any construction or expansion of any commercial or industrial use or structure on a site of more than 3 acres; or any grading, clearing or disturbance of any area in excess of 5,000 square feet for other than

agricultural or horticultural purposes;

h. "Pinelands area" means that area so designated by subsection a. of section 10 of this act;

i. "Pinelands National Reserve" means the approximately 1,000,000 acre area so designated by the Federal Act and generally depicted on the map entitled "Pinelands National Reserve Boundary Map" numbered NPS/80,011A and dated September, 1978;

j. "Preservation area" means that portion of the pinelands area so designated by subsection b. of section 10 of this act;

k. "Protection area" means that portion of the pinelands area not included within the preservation area.

l. "Aquaculture" means the propagation, rearing, and subsequent harvesting of aquatic organisms in controlled or selected environments, and the subsequent processing, packaging and marketing and shall include but need not be limited to, activities to intervene in the rearing process to increase production such as stocking, feeding, transplanting and providing for protection from predators. "Aquaculture" shall not include the construction of facilities and appurtenant structures that might otherwise be regulated pursuant to any other State or federal law or regulation;

m. "Aquatic organism" means and includes, but need not be limited to, finfish, mollusks, crustaceans, and aquatic plants which are the property of a person engaged in aquaculture.

L.1979, c. 111, s. 3, eff. June 28, 1979. Amended by L. 1997, c. 236, s. 35, eff. Aug. 31, 1997.

#### **13:18A-4. Pinelands commission; establishment; allocation within department of environmental protection**

a. There is hereby established a public body corporate and politic, with corporate succession, to be known as the "Pinelands Commission." The commission shall constitute a political subdivision of the State established as an instrumentality exercising public and essential governmental functions, and the exercise by the commission of the powers and duties conferred by this act and by the Federal Act shall be deemed and held to be an essential governmental function of the State. For the purpose of complying with the provisions of Article V, Section IV, paragraph 1 of the New Jersey Constitution, the commission is hereby allocated within the Department of Environmental Protection, but, notwithstanding said allocation, the commission shall be independent of any supervision or control by such department or by the commissioner or any officer or employee thereof.

b. In addition to the powers and duties herein provided, the Pinelands Commission shall

constitute the planning entity authorized in the Federal Act and shall exercise all the powers and duties as may be necessary in order to effectuate the purposes and provisions thereof.

c. Any action taken prior to the effective date of this act by the planning entity established pursuant to the Federal Act shall continue with full force and effect as an action of the commission established hereunder.

L.1979, c. 111, s. 4, eff. June 28, 1979.

**13:18A-5. Members; appointment; qualifications; terms of office; vacancies; removal; oath; reimbursement of expenses; vote necessary; chairman; executive director; veto by Governor**

a. The commission shall consist of 15 members to be appointed and qualified as follows:

(1) Seven residents of the State, appointed by the Governor, with the advice and consent of the Senate, except as otherwise provided herein;

(2) Seven residents of the State, one resident each of the counties of Atlantic, Burlington, Camden, Cape May, Cumberland, Gloucester and Ocean, appointed by the board of chosen freeholders of each such county; provided, however, that in any county operating under the county executive plan or county supervisor plan pursuant to the provisions of the "Optional County Charter Law," P.L.1972, c. 154 (C. 40:41A-1 et seq.), such appointment shall be made by the county executive or the county supervisor, as the case may be;

(3) One member to be appointed by the Secretary of the United States Department of the Interior.

Any appointments made prior to the effective date of this act by the Governor or by any of the respective counties to the planning entity established pursuant to the Federal Act shall be considered appointments made to the commission, and no such gubernatorial appointment shall be subject to the advice and consent of the Senate.

b. Commission members shall serve for terms of 3 years; provided, however, that of the first members appointed by the Governor, two shall serve 3 year terms, two shall serve 2 year terms and three shall serve 1 year terms; and provided further, however, that of the first members appointed by the respective counties, such members appointed from Atlantic and Burlington counties shall serve 1 year terms, such members appointed from Camden and Cape May counties shall serve 2 year terms, and such members appointed from Cumberland, Gloucester and Ocean counties shall serve 3 year terms. Each member shall serve for the term of his appointment and until his successor shall have been appointed and qualified. Any vacancy shall be filled in the same manner as the original appointment for the unexpired term only. The membership of the entire commission shall include residents of the pinelands area who represent economic activities, such as agriculture, in the area, as well as residents of the State who represent conservation interests.

c. Any member of the commission may be removed by the appointing authority, for cause, after a public hearing.

d. Each member of the commission, before entering upon his duties, shall take and subscribe an oath to perform the duties of his office faithfully, impartially, and justly to the best of his ability. A record of such oaths shall be filed in the Office of the Secretary of State.

e. The members of the commission shall serve without compensation, but the commission may, within the limits or funds appropriated or otherwise made available for such purposes, reimburse its members for necessary expenses incurred in the discharge of their official duties.

f. The powers of the commission shall be vested in the members thereof in office, and a majority of the total authorized membership of the commission shall be required to exercise its powers at any meeting thereof. No alternate or designee of any commission member shall exercise any power to vote on any matter pending before the commission.

g. The Governor shall designate one of the members of the commission as chairman. The commission shall appoint an executive director, who shall be the chief administrative officer thereof. The executive director shall serve at the pleasure of the commission, and shall be a person qualified by training and experience to perform the duties of his office.

h. A true copy of the minutes of every meeting of the commission shall be prepared and forthwith delivered to the Governor. No action taken at such meeting by the commission shall have force or effect until 10 days, exclusive of Saturdays, Sundays and public holidays, after such copy of the minutes shall have been so delivered; provided, however, that no action taken with respect to the adoption of the comprehensive management plan, or any portion thereof, shall have force or effect until 30 days, exclusive of Saturdays, Sundays and public holidays, after such copy of the minutes shall have been so delivered. If, in said 10-day period, or 30-day period, as the case may be, the Governor returns such copy of the minutes with a veto of any action taken by the commission at such meeting, such action shall be null and void and of no force and effect.

L.1979, c. 111, s. 5, eff. June 28, 1979. Amended by L.1980, c. 65, s. 1, eff. July 10, 1980.

### **13:18A-5.1. Exemption from approval for certain dwellings**

a. Except for the development of an historic resource as designated by the Pinelands Commission, a person shall be exempt from the Pinelands Commission approval of an application for development pursuant to section 14 of P.L. 1979, c. 111 (C. 13:18A-15) for the improvement, expansion or reconstruction within five years of destruction or demolition of a single family dwelling or appurtenance thereto.

b. The Pinelands Commission, in reviewing any application for development for the improvement or reconstruction of a single family dwelling or appurtenance thereto five years or

more after destruction or demolition of the single family dwelling, shall determine that such improvement or reconstruction is in conformance with the comprehensive management plan adopted pursuant to section 7 of P.L. 1979, c. 111 (C.13:18A-8) if the person submitting the application for development for the improvement or reconstruction demonstrates:

(1) the improvement or reconstruction does not involve an historic resource as designated by the Pinelands Commission;

(2) the improvement or reconstruction is performed within 25 years of the destruction or demolition of a single family dwelling unit or appurtenance thereto;

(3) the foundation of the demolished or destroyed single family dwelling unit is intact, will be used for the development and will constitute the footprint of the improvement or reconstruction; and

(4) the destroyed or demolished building was a single family dwelling.

The Pinelands Commission shall transmit any determination made pursuant to this subsection, in writing, to the person who submitted the application.

L. 1999, c. 289, s. 1.

### **13:18A-6. Powers**

The Pinelands Commission shall have the following powers:

a. To adopt and from time to time amend and repeal suitable by-laws for the management of its affairs;

b. To adopt and use an official seal and alter the same at its pleasure;

c. To maintain an office at such place or places in the pinelands area as it may designate;

d. To sue and be sued in its own name;

e. To appoint, retain and employ, without regard to the provisions of Title 11A of the New Jersey Statutes but within the limits of funds appropriated or otherwise made available for such purposes, such officers, agents, employees and experts as it may require, and to determine the qualifications, terms of office, duties, services and compensation therefor;

f. To apply for, receive, and accept, from any Federal, State, or other public or private source, grants or loans for, or in aid of, the commission's authorized purposes;

g. To enter into any and all agreements or contracts, execute any and all instruments, and do and perform any and all acts or things necessary, convenient, or desirable for the purposes of

the commission or to carry out any power expressly given in this act;

h. To conduct examinations and investigations, to hear testimony, taken under oath at public or private hearings, on any material matter, and to require attendance of witnesses and the production of books and papers;

i. To prepare and transmit to the Commissioner of Environmental Protection such recommendations for water quality standards for surface and ground waters in the pinelands area, or in tributaries and watersheds thereof, as the commission deems appropriate;

j. To prepare, promulgate, adopt, amend or repeal, pursuant to the provisions of the "Administrative Procedure Act," P.L.1968, c. 410 (C. 52:14B-1 et seq.), such rules and regulations as are necessary in order to implement the provisions of this act;

k. To appoint advisory boards, commissions, or panels to assist in its activities;

l. To identify any lands in which the public acquisition of a fee simple or lesser interest therein is necessary or desirable in order to insure the preservation thereof, or to provide sites for public recreation, as well as any lands the beneficial use of which are so adversely affected by the restrictions imposed pursuant to this act as to require a guarantee of just compensation therefor, and to transmit such identifications to the affected local governments, the Commissioner of Environmental Protection and to the Secretary of the United States Department of Interior;

m. To call to its assistance and avail itself of the services of such employees of any State, county or municipal department, board, commission or agency as may be required and made available for such purposes.

n. To establish and change, in accordance with a fee schedule to be set forth by regulation adopted pursuant to the "Administrative Procedure Act", P.L. 1968, c. 410 (C.52:14B-1 et seq.), reasonable fees for services performed relating to development review applications filed with the commission as required by the Comprehensive Management Plan.

L.1979, c. 111, s. 6, eff. June 28, 1979. Amended by L. 2003, c. 117, s. 30, eff. July 1, 2003.

### **13:18A-7. Pinelands municipal council**

a. There is hereby established a Pinelands Municipal Council, the membership of which shall consist of the mayor, or his designee, of each municipality located, in whole or in part, within the pinelands area.

b. (1) Fifteen members of the council shall constitute a quorum for the transaction of council business. Action may be taken and motions and resolutions adopted by the council at any meeting thereof by the affirmative vote of a majority of those members of the council in

attendance.

(2) The council shall draft and adopt bylaws to govern the proceedings of the council.

c. (1) The council shall meet at the call of the chairperson of the council or upon the concurrence of a majority of the full membership of the council.

(2) Notice of the agenda for each meeting shall be mailed by the chairperson to all members of the council at least seven calendar days in advance of the date of the meeting.

d. The council shall appoint a chairperson from among its members and such other officers as may be necessary until such time as elections may be held therefor as provided pursuant to section 2 of P.L.1995, c. 272 (C.13:18A-7.1).

e. (1) Members of the council shall serve without compensation, and each member shall serve only as long as he is the mayor or the designee of the mayor of the municipality he represents. The council may, within the limits of funds appropriated or otherwise made available for such purposes, reimburse its members for necessary expenses incurred in the discharge of their official duties.

(2) The council may, within the limits of funds appropriated or otherwise made available for such purposes, appoint such staff or hire such experts as it may require.

f. The commission shall submit to the council, for review, prior to final commission action thereon, the comprehensive management plan, and any revisions thereto, including the minimum standards for the adoption of municipal and county plans and ordinances concerning the development and use of land in the pinelands area. The commission may also submit to the council any other matter that the commission deems advisable.

g. The council shall review all matters submitted to it by the commission and shall state its position to the commission and to all members of the council within 60 days of the submission thereof.

h. The council may make recommendations to the commission on any matters it deems advisable whether or not the matter was submitted to the council by the commission. The council shall mail to all members of the council any recommendations made to the commission at the time that the recommendations are submitted to the commission. Members of the council may provide comments to the commission regarding the recommendations.

L.1979, c. 111, s. 6.1, eff. June 28, 1979; amended by L.1995, c. 272, s. 1, eff. Dec. 8, 1995.

**13:18A-7.1. Election of council officers; procedure**

a. The council shall annually elect from among its members a chairperson, vice-chairperson, secretary, and treasurer. The term of office for each of those offices shall be one year, commencing April 1st and extending to March 31st of the following year. If for any reason an officer of the council is no longer a member of the council as defined pursuant to subsection a. of section 6.1 of P.L. 1979, c. 111 (C. 13:1 8A-7), the officer shall be deemed to have resigned from the office as of the date of loss of membership and the office shall be deemed vacant. In the event of a vacancy in the office of the chairperson, the vice-chairperson shall assume the duties of the office of chairperson until the next annual election as provided in subsection b. of this section. An incumbent officer shall be eligible for reelection to the same or a different office, if nominated.

b. Elections for the offices of chairperson, vice-chairperson, secretary, and treasurer of the council shall be conducted each year in the following manner:

(1) Between January 15th and January 25th, the chairperson of the council shall notify by mail all members of the council that they may submit nominations for the various offices on the council. Nominations shall be accepted if received at the address specified on the notice by February 10th.

(2) Ballots shall be prepared listing the nominations submitted for the various offices and shall be mailed to all members of the council by February 15th. Members of the council shall submit their marked ballots by mail to the address specified on the ballot. Only ballots postmarked by March 1st shall be accepted. The ballots shall be counted, and the results of the election announced, at a meeting of the council held not later than March 10th. For each office, the nominee on the ballot receiving the most votes after all properly submitted marked ballots have been counted shall be declared the winner.

(3) Notwithstanding the provisions of paragraphs (1) and (2) of this subsection to the contrary, the election of officers first held pursuant to the requirements of this section shall be conducted on behalf of the council, and the ballots counted and results of the election announced, by the Secretary of State; thereafter, each such annual election shall be conducted by the council through its officers as prescribed in this section.

L. 1995, c. 272, s. 2, eff. Jan. 1, 1996.

### **13:18A-8. Comprehensive management plan; preparation and adoption; contents**

The commission shall, on or before August 8, 1980, and after public hearings held in the pinelands area and in other areas of the State at places of its choosing, prepare and adopt a comprehensive management plan for the pinelands area. The portion or portions of the comprehensive management plan applicable to the preservation area shall be adopted on or before August 8, 1980. The portion or portions of the comprehensive management plan applicable to the protection area shall be adopted on or after November 14, 1980, but in no case later than December 15, 1980, and shall take effect on the thirty-first day following adoption, except as

otherwise expressly provided in subsection h. of section 5 of P.L.1979, c. 111 (C. 13:18A-5). Such plan shall be periodically revised and updated, after public hearings, and shall include, but need not necessarily be limited to:

a. A resource assessment which:

(1) Determines the amount and type of human development and activity which the ecosystem of the pinelands area can sustain while still maintaining the overall ecological values thereof, with special reference to ground and surface water supply and quality; natural hazards, including fire; endangered, unique, and unusual plants and animals and biotic communities; ecological factors relating to the protection and enhancement of blueberry, cranberry and other agricultural production or activity; air quality; and other appropriate considerations affecting the ecological integrity of the pinelands area;

(2) Includes an assessment of scenic, aesthetic, cultural, open space, and outdoor recreation resources of the area, together with a determination of overall policies required to maintain and enhance such resources; and

(3) Utilizes soil resources information from the National Co-operative Soil Survey and the soil conservation districts in the pinelands area.

b. A map showing the detailed boundary of the Pinelands National Reserve, such map to delineate:

(1) Major areas within the boundary which are of critical ecological importance;

(2) Major areas and resources adjacent to the boundary that have significance to the ecological integrity of the Pinelands National Reserve; and

(3) Areas of scenic, open space, cultural, and recreational significance.

c. The map prepared pursuant to subsection c. of section 10 of this act.

d. A land use capability map and a comprehensive statement of policies for planning and managing the development and use of land in the pinelands area, which policies shall:

(1) Consider and detail the application of a variety of land and water protection and management techniques, including but not limited to, zoning and regulation derived from State and local police powers, development and use standards, permit systems, acquisition of conservation easements and other interest in land, public access agreements with private landowners, purchase of land for resale or lease-back, fee acquisition of public recreation sites and ecologically sensitive areas, transfer of development rights, dedication of private lands for recreation or conservation purposes and any other appropriate method of land and water protection and management which will help meet the goals and carry out the policies of the management plan;

(2) Include a policy for the use of State and local police power responsibilities to the

greatest extent practicable to regulate the use of land and water resources in a manner consistent with the purposes and provisions of this act and the Federal Act; and

(3) Recognize existing economic activities within the area and provide for the protection and enhancement of such activities as farming, forestry, proprietary recreational facilities, and those indigenous industries and commercial and residential developments which are consistent with such purposes and provisions.

e. A coordination and consistency component which details the ways in which local, State, and Federal programs and policies may best be coordinated to promote the goals and policies of the management plan, and which details how land, water, and structures managed by governmental or non-governmental entities in the public interest within the pinelands area may be integrated into the management plan.

f. A public use component including, but not limited to, a detailed program to inform the public of appropriate uses of the pinelands area.

g. A financial component, together with a cash flow timetable which:

(1) Details the cost of implementing the management plan, including, but not limited to, payments in lieu-of-taxes, acquisition, within 5 years of the effective date of this act, of fee simple or other interests in lands for preservation or recreation purposes, compensation guarantees, general administrative costs, and any anticipated extraordinary or continuing costs; and

(2) Details the sources of revenue for covering such costs, including, but not limited to, grants, donations, and loans from local, State, and Federal departments and agencies, and from the private sector.

h. A program to provide for the maximum feasible local government and public participation in the management of the pinelands area.

i. A program for State and local governmental implementation of the comprehensive management plan and the various elements thereof in a manner that will insure the continued, uniform, and consistent protection of the pinelands area in accord with the purposes and provisions of this act and the Federal Act, including:

(1) Minimum standards for the adoption, as required in section 11 of this act, of municipal and county plans and ordinances concerning the development and use of land in the pinelands area, including, but not limited to, standards for minimum lot sizes and stream setbacks, maximum appropriate population densities, and regulated or prohibited uses for specific portions of the pinelands area; and

(2) Such guidelines for any State or local agencies as may be prepared by the commission pursuant to section 12 hereof.

j. In conjunction with existing State programs and planning processes, a plan to implement the provisions of the “Clean Water Act” (P.L. 95-217) and the “Safe Drinking Water Act” (P.L. 93-523) which pertain to the surface and ground water of the Pinelands National Reserve;

k. The report transmitted to the commission by the Department of Environmental Protection pursuant to section 22 of this act.

L.1979, c. 111, s.7, eff. June 28, 1979. Amended by L.1980, c. 65, s. 2, eff. July 10, 1980.

### **13:18A-9. Goals of comprehensive management plan**

a. The goal of the comprehensive management plan with respect to the entire pinelands area shall be to protect, preserve and enhance the significant values of the resources thereof in a manner which is consistent with the purposes and provisions of this act and the Federal Act.

b. The goals of the comprehensive management plan with respect to the protection area shall be to:

(1) Preserve and maintain the essential character of the existing pinelands environment, including the plant and animal species indigenous thereto and the habitat therefor;

(2) Protect and maintain the quality of surface and ground waters;

(3) Promote the continuation and expansion of agricultural and horticultural uses;

(4) Discourage piecemeal and scattered development; and

(5) Encourage appropriate patterns of compatible residential, commercial and industrial development, in or adjacent to areas already utilized for such purposes, in order to accommodate regional growth influences in an orderly way while protecting the pinelands environment from the individual and cumulative adverse impacts thereof.

c. The goals of the comprehensive management plan with respect to the preservation area shall be to:

(1) Preserve an extensive and contiguous area of land in its natural state, thereby insuring the continuation of a pinelands environment which contains the unique and significant ecological and other resources representative of the pinelands area;

(2) Promote compatible agricultural, horticultural and recreational uses, including hunting, fishing and trapping, within the framework of maintaining a pinelands environment;

(3) Prohibit any construction or development which is incompatible with the preservation of this unique area;

(4) Provide a sufficient amount of undeveloped land to accommodate specific wilderness management practices, such as selective burning, which are necessary to maintain the special ecology of the preservation area; and

(5) Protect and preserve the quantity and quality of existing surface and ground waters.

L. 1979, c. 111, s. 8, eff. June 28, 1979.

**13:18A-10. Consultations; adoption; submission of plan; development, construction or disturbance of land; conformance to plan; waiver; rules and regulations**

a. During the development of the comprehensive management plan, the commission shall consult with appropriate officials of local governments, including the council, and State or Federal agencies with jurisdiction over lands, waters and natural resources within the pinelands area, with interested professional, scientific, and citizen organizations, and with any citizens advisory committee which may be established by the Governor. The commission shall review all relevant existing information and studies on the pinelands area including, but not limited to, the report of the committee created pursuant to Executive Order 56, issued May 28, 1977.

b. Upon the adoption thereof, the comprehensive management plan shall be submitted to the Governor and to the Legislature. The commission shall further submit such plan to the Secretary of the United States Department of Interior, as provided in the Federal Act.

c. Subsequent to the adoption of the comprehensive management plan, the provisions of any other law, ordinance, rule or regulation to the contrary notwithstanding, no application for development within the pinelands area shall be approved by any municipality, county or agency thereof, and no State approval, certificate, license, consent, permit, or financial assistance for the construction of any structure or the disturbance of any land within such area shall be granted, unless such approval or grant conforms to the provisions of such comprehensive management plan; provided, however, that the commission is hereby authorized to waive strict compliance with such plan or with any element or standard contained therein, upon finding that such waiver is necessary to alleviate extraordinary hardship or to satisfy a compelling public need, is consistent with the purposes and provisions of this act and the Federal Act, and would not result in substantial impairment of the resources of the pinelands area; and provided further, however, that the commission shall, within 90 days of the effective date of this act, and after public hearing thereon, adopt rules and regulations which specify the standards for determining such extraordinary hardship, compelling public need, consistency and substantial impairment.

L. 1979, c. 111, s. 9, eff. June 28, 1979.

**13:18A-11. Boundaries of pinelands and preservation areas; official state planning maps of Pinelands National Reserve, and pinelands, protection and preservation areas**

a. The pinelands area shall consist of all that area within the boundaries described herein:

Beginning at the intersection of the abandoned-right-of-way of the Pennsylvania Railroad and the Garden State Parkway near south Toms River; thence southerly along the Garden State Parkway to its intersection with the boundary of the Bass River State Forest; thence southerly, and then westerly, along the Bass River State Forest boundary to its intersection with the Garden State Parkway; thence southerly along the Garden State Parkway to its intersection with Atlantic County Alternate Route 559; thence northwesterly along Atlantic County Alternate Route 559 to its intersection with Atlantic County Route 559 at Gravelly Run; thence northwesterly along Atlantic County Route 559 to its intersection with U.S. 40 and N.J. Route 50 at Mays Landing; thence westerly along U.S. 40 and N.J. Route 50 to their intersection with N.J. Route 50; thence southerly on N.J. Route 50 to its intersection with Buck Hill Road near Buck Hill; thence westerly along Buck Hill Road (River Road) to its intersection with N.J. Route 49; thence southeasterly along N.J. Route 49 to its intersection with N.J. Route 50; thence southeasterly along N.J. Route 50 to its intersection with Cape May County Route 610; thence southwestward along Cape May County Route 610 to its intersection with N.J. Route 47 at Dennisville; thence northwesterly along N.J. Route 47 to its intersection with the east bank of the Manamuskin River; thence northerly along the east bank of the Manamuskin River to N.J. Route 49; thence northwesterly along N.J. Route 49 to its intersection with Cumberland County Route 671; thence northerly along Cumberland County Route 671 and then Atlantic County Route 671 (both known as Union Road) to Atlantic County Route 557; thence northwesterly along Atlantic County Route 557 to its intersection with U.S. Route 40; thence northwesterly along U.S. Route 40 to its intersection with Gloucester County Route 555; thence northerly along Gloucester County Route 555 to its intersection with U.S. Route 322 and Gloucester County Route 536; thence easterly along Gloucester County Route 536 (known as New Brooklyn Road) to its intersection with Camden County Route 705 at New Brooklyn Lake; thence northerly along the western shoreline of New Brooklyn Lake to the east bank of the main stem of the Great Egg Harbor River; thence northerly along the east bank of the main stem of the Great Egg Harbor River to its intersection with the east bank of Tinkers Branch; thence northeasterly along the east bank of Tinkers Branch to its intersection with the corporate boundary of Berlin Borough; thence easterly along the Berlin Borough corporate boundary to its intersection with the boundary of that area designated as the critical area for sewerage purposes pursuant to the provisions of P.L. 1954, c.199 (C. 58:1 1-23 et seq.), as amended, and as implemented by N.J.A.C. 7:9-10.1 et seq.; thence northerly and then easterly along such critical area boundary to its intersection with the Burlington County-Camden County boundary; thence northerly along the Burlington County-Camden County boundary to its intersection with N.J. Route 73; thence northerly along N.J. Route 73 to its intersection with Braddock Mill Road; thence easterly along Braddock Mill Road to its intersection with Tomlinson Mill Road; thence northeasterly along Tomlinson Mill Road to its intersection with Kettle Run Road; thence northerly along Kettle Run Road, then along Willow Corner-Tomlinson Mill Road, to its intersection with South Elmwood Road; thence easterly, then northerly along South Elmwood Road to its intersection with East Main Street; thence easterly along East Main Street

to its intersection with Marlton Pike; thence northeasterly along Marlton Pike to its intersection with N.J. Route 70; thence easterly along N.J. Route 70 to its intersection with U.S. Route 206; thence northerly along U.S. Route 206 to its intersection with Burlington County Route 530; thence easterly along Burlington County Route 530 to the corporate boundary of Pemberton Borough; thence southerly, then easterly, then northerly, and then westerly, along the Pemberton Borough corporate boundary to its intersection with Burlington County Route 616; thence northerly along Burlington County Route 616 to its intersection with Burlington County Route 663; thence northerly along Burlington County Route 663 to its intersection with the corporate boundary of Springfield Township; thence easterly along the Springfield Township corporate boundary to its intersection with the boundary of the Fort Dix Military Reservation/McGuire Air Force Base; thence easterly along the boundary of the Fort Dix Military Reservation/McGuire Air Force Base to its intersection with Ocean County Route 539; thence northwesterly along Ocean County Route 539 to its intersection with Ocean County Route 528; thence northeasterly along Ocean County Route 528 to its intersection with Ocean County Route 547; thence southerly along Ocean County Route 547 to its intersection with Ocean County Route 527; thence southeasterly along Ocean County Route 527 to its intersection with the Central Railroad of New Jersey tracks; thence southwesterly along the tracks of the Central Railroad of New Jersey to the junction with the abandoned right-of-way of the Pennsylvania Railroad near Whiting; thence easterly along the abandoned Pennsylvania Railroad right-of-way to its intersection with the Garden State Parkway near South Toms River, at the point of origin.

b. The preservation area shall consist of all that area within the boundaries described herein:

Beginning at the crossing of the Mullica River and the Garden State Parkway; thence southerly along the Garden State Parkway to its intersection with Atlantic County Route 624; thence northwesterly along Atlantic County Route 624 to its intersection with Atlantic County Route 563; thence northwesterly along Atlantic County Route 563 to its intersection with Elwood-Weekstown Road at Weekstown; thence westerly along Elwood-Weekstown Road to its intersection with Atlantic County Route 643; thence northwesterly along Atlantic County Route 643 to an unnamed local road south of Nescochague Lake; thence westerly along such unnamed local road to its intersection with Atlantic County Route 542; thence northeasterly along Atlantic County Route 542 to its intersection with the boundary of Wharton State Forest; thence northwesterly along the Wharton State Forest boundary to its intersection with the Mullica River; thence westerly along the Mullica River to its intersection with the corporate boundary of Medford Township; thence northerly along the Medford Township corporate boundary to its intersection with the boundary of that area designated as the critical area for sewerage purposes pursuant to the provisions of P.L.1954, c. 199 (C. 58:11-23 et seq.), as amended, and as implemented by N.J.A.C. 7:9-10.1 et seq.; thence northeasterly along such critical area boundary to its intersection with the boundary of Wharton State Forest; thence easterly along the Wharton State Forest boundary to its intersection with Medford-Atsion Road, south of Dellette; thence northerly along Medford-Atsion Road to its intersection with Willow Grove Road; thence northeasterly along Willow Grove Road to its intersection with Stokes Road; thence southerly along Stokes Road to its intersection with Burnt House Road; thence northeasterly along Burnt House Road to its

intersection with Fork Neck Road; thence southerly, then easterly along Fork Neck Road to its intersection with Dingtletown Road; thence northeasterly along Dingtletown Road to its intersection with Hampton Gate-Carranza Road; thence northwesterly along Hampton Gate-Carranza Road to its intersection with Burlington County Route 532; thence easterly on Burlington County Route 532 to its intersection with Patty Bowker Road and Trick's Causeway Road; thence northeasterly along Trick's Causeway Road to its intersection with Vincentown-South Park Road; thence southeasterly along Vincentown-South Park Road to its intersection with Sooy Place Road; thence easterly along Sooy Place Road to its intersection with the corporate boundary of Woodland Township; thence northwesterly, then northeasterly, along the Woodland Township corporate boundary to its intersection with the boundary of Lebanon State Forest and Burlington County Route 644 at Four Mile Circle; thence northwesterly, then northeasterly, then southeasterly, along the Lebanon State Forest boundary to its intersection with N.J. Route 70; thence northeasterly along N.J. Route 70 to its intersection with the Lebanon State Forest boundary at a point approximately one-half mile west of the intersection of N.J. Route 70 and Burlington County Route 530; thence westerly, and then northerly, along the Lebanon State Forest boundary to its intersection with the boundary of the Fort Dix Military Reservation near South Boundary Road; thence northwesterly along the Fort Dix Military Reservation boundary to its intersection with Burlington County Route 667; thence northerly along Burlington County Route 667 to its intersection with the northern boundary of the Fort Dix Military Reservation; thence easterly along the Fort Dix Military Reservation boundary to its intersection with the boundary of the Colliers Mills Fish and Wildlife Management Area; thence northerly along the Colliers Mills Fish and Wildlife Management Area boundary to its intersection with Ocean County Route 528; thence northeasterly along Ocean County Route 528 to its easternmost intersection with the Colliers Mills Fish and Wildlife Management Area boundary; thence southerly along the Colliers Mills Fish and Wildlife Management Area boundary to its intersection with the boundary of the Lakehurst Naval Air Station; thence easterly, then southerly, and then westerly along the Lakehurst Naval Air Station boundary to its intersection with an unnamed local road at the northeastern corner of the boundary of the Manchester Fish and Wildlife Management Area; thence southerly along such unnamed local road, then along Beckerville Road, to its intersection with N.J. Route 70; thence southwestly along N.J. Route 70 to its intersection with the boundary of the Fort Dix Military Reservation; thence southerly, and then northwesterly, along the Fort Dix Military Reservation boundary to its intersection with the boundary of the Lebanon State Forest; thence southerly along the Lebanon State Forest Boundary to its intersection with the boundary of the Pasadena Fish and Wildlife Management Area; thence southeasterly along the Pasadena Fish and Wildlife Management Area boundary to its intersection with the northern ridge line of the Cedar Creek Drainage Basin; thence northeasterly along the northern ridge line of the Cedar Creek Drainage Basin to its intersection with the Garden State Parkway; thence southerly along the Garden State Parkway to its intersection with the southern ridge line of the Cedar Creek Drainage Basin; thence southwestly along the southern ridge line of the Cedar Creek Drainage Basin to its intersection with the boundary of the Greenwood Forest Fish and Wildlife Management Area; thence southeasterly along the Greenwood Forest Fish and Wildlife Management Area to its intersection with N.J. Route 72; thence northwesterly along N.J. Route 72 to its intersection with the East Branch of the Oswego River; thence southerly along the East Branch of the Oswego River to its

intersection with Ocean County Route 539; thence southerly along Ocean County Route 539 to its intersection with the boundary of the Stafford Forge Fish and Wildlife Management Area; thence southeasterly along the Stafford Forge Fish and Wildlife Management Area to its intersection with the north bank of Governors Branch Creek; thence easterly along the north bank of Governors Branch Creek to its intersection with the boundary of the Stafford Forge Fish and Wildlife Management Area; thence easterly along the Stafford Forge Fish and Wildlife Management Area boundary to its intersection with the Garden State Parkway; thence southerly along the Garden State Parkway to its intersection with the boundary of Bass River State Forest; thence southerly, and then westerly, along the Bass River State Forest boundary to its intersection with the Garden State Parkway; thence southerly along the Garden State Parkway to its intersection with the east bank of the Bass River; thence northerly along the east bank of the Bass River to its intersection with the east bank of the East Branch of the Bass River; thence northerly along the east bank of the East Branch of the Bass River to its intersection with the Atlantic City Electric Company transmission line; thence westerly, and then southwesterly, along the Atlantic City Electric Company transmission line to its intersection with Burlington County Route 542; thence easterly along Burlington County Route 524 to its intersection with Burlington County Route 167; thence southerly along Burlington County Route 167 to its intersection with the Garden State Parkway at exit 50S; thence southerly along the Garden State Parkway to the crossing of the Mullica River, at the point of origin.

c. The commission shall, within 120 days of the effective date of this act, prepare a detailed map of the Pinelands National Reserve, the pinelands area, the protection area and the preservation area. Such map shall include, but need not be limited to, the location of all major waterways, roads, and publicly-owned lands in such areas, as well as a depiction of the boundaries of every county and municipality which is located in whole or in part within such areas. Such map shall be transmitted to the governing body of every such county and municipality, shall be published in the New Jersey Register and in at least two newspapers circulating within the affected areas, within 150 days of said effective date, and shall be submitted to the Governor and the Legislature as the official State planning maps of the Pinelands National Reserve, the pinelands area, the protection area and the preservation area.

L.1979, c. 111, s. 10, eff. June 28, 1979.

**13:18A-12. Revisions of county and municipal master plans and local land use ordinances to conform with minimum standards of plan; approval; failure to adopt or enforce; remedies; developments; approval in violation of section; nullity**

a. The provisions of any other law, ordinance, rule or regulation to the contrary notwithstanding, within one year of the date of the adoption of the comprehensive management plan, or any revision thereof, each county located in whole or in part in the pinelands area shall submit to the commission such revisions of the county master plan as may be necessary in order to implement the objectives of the comprehensive management plan and conform with the minimum standards contained therein. After receiving and reviewing such revisions, as applicable

to the development and use of land in the pinelands area, the commission shall approve, reject, or approve with conditions said revised plans, as it deems appropriate, after public hearing, within 60 days of the submission thereof.

Upon rejecting or conditionally approving any such revised plan, the commission shall identify such changes therein that it deems necessary for commission approval thereof, and the relevant county shall adopt and enforce such plan, as so changed.

b. Within one year of the date of the adoption of the comprehensive management plan, or any revision thereof, each municipality located in whole or in part in the pinelands area shall submit to the commission such revisions of the municipal master plan and local land use ordinances as may be necessary in order to implement the objectives of the comprehensive management plan and conform with the minimum standards contained therein. After receiving and reviewing such revisions, as applicable to the development and use of land in the pinelands area, the commission shall approve, reject, or approve with conditions said revised plans and ordinances, as it deems appropriate, after public hearing, within 120 days of the date of the submission thereof. The number of low or moderate income housing units provided for in the revised plan shall not be used by the commission as a criterion for the approval, rejection, or conditional approval of the revised plan.

Upon rejecting or conditionally approving any such revised plan or ordinance, the commission shall identify such changes therein that it deems necessary for commission approval thereof, and the relevant municipality shall adopt and enforce such plan or ordinance, as so changed.

The commission may, as herein provided, delegate the review of any municipal master plan or land use ordinance to the planning board of the county wherein such municipality is located. Any such delegation shall be made only: (1) upon a finding by the commission that such delegation is consistent with the purposes and provisions of this act and the Federal Act; (2) if the commission has approved the master plan for such county; and (3) at the request of the governing body of such county. The results of any such county planning board review shall be transmitted to the commission prior to the commission's review and approval of any such municipal master plan or ordinance.

c. In the event that any county or municipality fails to adopt or enforce an approved revised master plan or implementing land use ordinances, as the case may be, including any condition thereto imposed by the commission, the commission shall adopt and enforce such rules and regulations as may be necessary to implement the minimum standards contained in the comprehensive management plan as applicable to any such county or municipality.

d. Any approval of any application for development granted by any municipality, county, or agency thereof in violation of the provisions of this section shall be null and void and of no force and effect at law or equity.

L. 1979, c. 111, s. 11, eff. June 28, 1979; amended by L.1987, c. 267, s. 1, eff. Sept. 11, 1987.

**13:18A-13. Guidelines for location and construction; periodic revision and transmittal to state, county and municipal agencies**

In order to assure that the actions, decisions, determinations and rulings of the State, county and municipal governments shall, to the maximum extent practicable and feasible, conform with the comprehensive management plan adopted by the commission pursuant to section 7 of this act, the commission shall prepare, periodically revise and transmit to all State, county or municipal agencies empowered to finance or construct any capital project within the pinelands area, and to all State agencies empowered to grant or deny any approval, certificate, license, consent, or permit for the construction of any structure or the disturbance of land therein, such guidelines for the location and construction of such capital projects or for the granting of any such approval, certificate, license, consent, permit, or financial assistance, as the case may be, as the commission deems necessary and appropriate.

L.1979, c. 111, s. 12, eff. June 28, 1979.

**13:18A-14. Approvals, certificates, licenses, consents, permits or financial assistance for construction of structure or disturbance of land; prohibition prior to adoption of plan and revisions; exceptions**

Subsequent to the effective date of this act, the provisions of any other law, ordinance, rule or regulation to the contrary notwithstanding:

a. No State department, division, commission, authority, council, agency or board shall grant any approval, certificate, license, consent, permit or financial assistance for the construction of any structure or the disturbance of any land within the pinelands area, for other than agricultural or horticultural purposes prior to the adoption of the comprehensive management plan; provided, however, that such grant may be made for such construction or disturbance within the protection area prior to such adoption if the commission finds that such grant is necessary to alleviate extraordinary hardship, or to satisfy a compelling public need, or is consistent with the purposes and provisions of this act and the Federal Act, and would not result in substantial impairment of the resources of the pinelands area; and provided further, however, that such grant may be made for such construction or disturbance within the preservation area if the commission finds that such grant is necessary to alleviate extraordinary hardship or to satisfy a compelling public need, and is consistent with the purposes and provisions of this act and the Federal Act, and would not result in substantial impairment of the resources of the pinelands area.

b. No application for a major development in the protection area shall be approved by any municipality, county or agency thereof, prior to the adoption of the comprehensive management plan; provided, however, that such an application may be approved if the commission finds that

such approval is necessary to alleviate extraordinary hardship or to satisfy a compelling public need, or is consistent with the purposes and provisions of this act and the Federal Act, and would not result in substantial impairment of the resources of the pinelands area.

c. No application for development in the preservation area shall be approved by any municipality, county, or agency thereof prior to the adoption of the comprehensive management plan and the approval, pursuant to section 11 of this act, of the master plan and land use ordinances applicable to any such municipality, county, or agency thereof; provided, however, that such an application may be approved prior to such adoption and approval if the commission finds that such approval is necessary to alleviate extraordinary hardship or to satisfy a compelling public need, and is consistent with the purposes and provisions of this act and the Federal Act, and would not result in substantial impairment of the resources of the pinelands area.

d. Any approval, certificate, license, consent, permit, or financial assistance granted in violation of this section shall be null and void and of no force and effect at law or equity.

e. The commission shall, within 90 days of the effective date of this act, and after public hearing thereon, adopt rules and regulations which specify the standards for determining such extraordinary hardship, compelling public need, consistency and substantial impairment for the purposes of this section.

f. The executive director is hereby authorized and directed to review all requests or applications for a commission finding pursuant to this section and to make such recommendations thereon to the commission as he shall deem appropriate; provided, however, that the commission shall take final action on all such requests or applications.

g. Nothing in this section shall prohibit the granting of any State, county or municipal approval, certificate, license, consent or permit for the construction of any single family residence upon any existing lot in the protection area, provided that (1) the lot upon which such residence would be constructed was owned, as of February 7, 1979, by the person who would occupy such residence; and (2) that sewage treatment facilities, within the capacity of an existing sewage treatment plant, are available to service such residence, or, where no such facilities are available, that such residence would be constructed upon a lot greater than one acre.

L.1979, c. 111, s. 13, eff. June 28, 1979.

### **13:18A-15. Application for development in Pinelands area; notice and hearing; approval, rejection or conditional approval**

Subsequent to the adoption of the comprehensive management plan, the commission is hereby authorized to commence a review, within 15 days after any final municipal or county approval thereof, of any application for development in the pinelands area. Upon determining to exercise such authority, the commission shall transmit, by certified mail, written notice thereof to

the person who submitted such application. The commission shall, after public hearing thereon, approve, reject, or approve with conditions any such application within 45 days of transmitting such notice; provided, however, that such application shall not be rejected or conditionally approved unless the commission determines that such development does not conform with the comprehensive management plan or the minimum standards contained therein, as applicable to the county or municipality wherein such development is located, or that such development could result in substantial impairment of the resources of the pinelands area. Such approval, rejection or conditional approval shall be binding upon the person who submitted such application, shall supersede any municipal or county approval of any such development, and shall be subject only to judicial review as provided in section 19 of this act.

The number of low or moderate income housing units provided for in the application for development shall not be used as a criterion for the approval or rejection of the application.

L. 1979, c. 111, s.14, eff. June 29, 1979. Amended by L.1987, c. 267, s.2, eff. Sept. 11, 1987.

### **13:18A-16. Grants to municipalities and counties for revisions**

The commission is hereby authorized to make grants to municipalities and counties for any revision of local master plans or the implementing ordinances thereto which is designed to bring such plans and ordinances into conformance with the comprehensive management plan prepared by the commission. The commission may make such grants from any State, Federal or other funds which may be appropriated or otherwise made available to it for such purpose.

L.1979, c. 111, s. 15, eff. June 28, 1979.

### **13:18A-17. Conflict of interest of member, officer, employee or agent of commission; violations; action voidable; penalties**

a. No member, officer, employee, or agent of the commission shall take any official action on any matter in which he has a direct or indirect financial interest; provided, however, that the ownership of, or tenancy in, one's own private residence shall not be considered a financial interest for the purposes of this section; and provided further, however, that nothing in this section shall be construed so as to prohibit any such member from participating in the preparation and approval of the comprehensive management plan;

b. Any commission action taken or approval granted in violation of this section is voidable;

c. Any person who shall willfully violate any provision of this section shall forfeit his office or employment and shall be guilty of a misdemeanor and be punished by a fine of not more than \$7,500.00 or by imprisonment for not more than 18 months, or both such fine and imprisonment.

L. 1979, c.111, s. 16, eff. June 28, 1979.

**13:18A-18. Annual audit**

The State Auditor shall conduct an annual audit of the commission's activities pursuant to the provisions of chapter 24 of Title 52 of the Revised Statutes.

L. 1979, c. 111, s. 17, eff. June 28, 1979.

**13:18A-19. Annual report**

On or before March 31 in each year the commission shall make an annual report of its activities for the preceding calendar year to the Governor, the Legislature and to the Secretary of the United States Department of Interior. Each such report shall set forth a complete operating and financial statement covering its operations during the year.

L. 1979, c. 111, s. 18, eff. June 28, 1979.

**13:18A-20. Judicial review**

Any person aggrieved by any decision rendered by the commission pursuant to subsection c. of section 9 and sections 13 and 14 of this act may obtain judicial review thereof by the filing of a petition in the Appellate Division of the Superior Court of New Jersey within 45 days after the issuance of such decision. The court shall have the power to grant such relief as it deems just and proper, and to make and enter an order enforcing, modifying and enforcing as so modified, remanding for further specific evidence or findings, or setting aside in whole or in part, such decision of the commission. The findings of fact on which such decision is based shall be conclusive if supported by substantial evidence on the record considered as a whole.

L. 1979, c. 111, s. 19, eff. June 28, 1979.

**13:18A-21. Report on state payments in lieu of taxes to municipalities**

The commission shall, within 1 year of the effective date of this act, prepare and submit to the Governor and Legislature a report concerning State payments in lieu of taxes to municipalities in the pinelands area wherein the State owns any land or interests therein. Such report shall include an evaluation of the manner of calculation and amount of such payments made or to be made pursuant to the provisions of the "New Jersey Green Acres and Recreation Opportunities Bond Act of 1974," P.L.1974, c. 102; P.L.1977, c. 272 (C. 54:4-2.2a et seq.); and the "New Jersey Green Acres Bond Act of 1978," P.L.1978, c. 118, as well as the

recommendations of the commission for executive and legislative action on additional or alternative proposals for such payments, including the fiscal implications of any such proposal and potential sources of funding therefor.

L. 1979, c. 111, s. 20, eff .June 28, 1979.

**13:18A-22. Sale of land within preservation area; written notice of intention; exceptions; transmittal and publication of provisions of section; violations; voidability of contract; corporations**

a. No person shall contract to sell any land within the preservation area, or any interest therein or option therefor, until such person has transmitted to the Commissioner of Environmental Protection, by certified mail, a written notice of intention to sell such land, interest, or option at least 60 days prior to entering into any such contract; provided, however, that the provisions of this subsection shall not be applicable to any contract of sale for any structure which is located on any lot less than 10 acres, nor to any contract of sale between or among husband and wife, parent and child, brother and sister, or grandparent and grandchild.

b. The Commissioner of Environmental Protection shall, within 30 days of the effective date of this act, transmit, by certified mail, written notice of the provisions of this section to the governing body of every county and municipality located in whole or in part in the preservation area, and publish such notice in the New Jersey Register and in at least two newspapers circulating within the affected areas.

c. Any contract made in violation of subsection a. of this section is voidable.

d. Any corporation which owns any land, or interest therein, within the preservation area shall transmit, by certified mail, within 10 days of the occurrence thereof, a written notice to the Commissioner of Environmental Protection of any change or series of changes in the ownership of more than 10% of the stockholdings in such corporation.

e. Nothing in this section shall be construed so as to limit any authority granted the commissioner, pursuant to law, to acquire any lands, or interests therein or options therefor, in such manner as may be provided in such law.

L. 1979, c. 111, s. 21, eff. June 28, 1979.

**13:18A-23. Coastal area; revision of environmental design**

In addition to the functions required pursuant to the “Coastal Area Facility Review Act,” P.L.1973, c. 185 (C. 13:19-1 et seq.), the Department of Environmental Protection shall, in

consultation with the commission and within 18 months of the effective date of this act, review the environmental design for the coastal area as it affects the planning and management of the development and use of any land in the coastal area which is also within the boundaries of the Pinelands National Reserve, make any necessary revisions to such environmental design as may be necessary in order to effectuate the purposes of this act and the Federal Act, and prepare and transmit to the commission a report detailing the provisions of the environmental design as so revised and as applicable to such land.

L. 1979, c. 111, s. 22, eff. June 28, 1979.

**13:18A-24. Power vessels and motor vehicles; operation within pinelands area; litter; violations; penalty**

a. No person shall operate any power vessel which utilizes any engine in excess of 10 horse power upon any of the waters of this State within the pinelands area, except upon that portion of the Mullica River downstream from Burlington County Route 542, upon that portion of the Great Egg Harbor River downstream from its confluence with Mare Run, or upon that portion of the Wading River downstream from its confluence with the Oswego River. As used in this subsection, "power vessel" means any vessel temporarily or permanently equipped with machinery for propulsion, not including a vessel propelled wholly by sails or by muscular power.

b. No person shall operate any motor vehicle upon any public land within the pinelands area other than upon public highways, except in such areas designated by the commission for such purposes. As used in this subsection, "motor vehicle" means all vehicles propelled other than by muscular power, but not including those vehicles run only upon rails or tracks, police, fire or emergency vehicles, or those vehicles utilized for the administration or maintenance of any public land.

c. No person shall throw, drop, discard or otherwise place any litter upon any land or water within the pinelands area. As used in this subsection, "litter" means any paper, bottle, can, trash, garbage, refuse or debris of any nature.

d. Any person who violates any provision of this section shall be liable to a penalty of not more than \$500.00 for each offense, which penalty shall be imposed in addition to any other penalty otherwise provided by P.L. 1954, c.38 (C.23:7-9), R.S.39:4-64, or by any other law. Such penalty shall be collected by the Department of Environmental Protection pursuant to the provisions of "the penalty enforcement law" (N.J.S. 2A:58-1 et seq.).

L. 1979, c. 111, s. 23, eff. June 28, 1979. Amended by L.1992, c. 69, s. 1, eff. July 30, 1992.

**13:18A-25. Inapplicability of act to exportation of waters or to regulation of fish and game**

### **activities or other recreational activities in pinelands area**

a. Nothing in this act shall be construed to authorize or permit the exportation of any ground or surface waters from the pinelands area.

b. Nothing in this act shall be construed to authorize any regulation of hunting, fishing, trapping or possession of wildlife, or other recreational activities in the pinelands area, except as otherwise provided in section 23 of this act or by Title 13 or Title 23 of the Revised Statutes.

L. 1979, c. 111, s. 24, eff. June 28, 1979.

### **13:18A-26. Surcharge on fees; pinelands fund; disposition**

The commission is hereby authorized to adopt rules and regulations which impose a surcharge of up to \$1.00 upon any fee currently levied and collected, pursuant to law, for the use of State-owned lands within the pinelands area. All of the sums collected as a result of any such surcharge shall be deposited in a fund to be known as the "Pinelands Fund," which fund shall be kept separate from all other State receipts. There shall be appropriated annually from such fund, in accordance with a formula adopted by the commission, such revenue as may be available to defray the costs of payments in lieu-of-taxes, as herein provided, to municipalities located in whole or in part in the pinelands area.

L. 1979, c. 111, s. 25, eff. June 28, 1979.

### **13:18A-27. Enforcement of provisions of this act over inconsistent or conflicting acts**

It is the intent of the Legislature that, except as otherwise specifically provided in this act, in the event of any conflict or inconsistency in the provisions of this act and any other acts pertaining to matters herein established or provided for or in any rules and regulations adopted under this act or said other acts, to the extent of such conflict or inconsistency, the provisions of this act and the rules and regulations adopted hereunder shall be enforced and the provisions of such other acts and rules and regulations adopted thereunder shall be of no force and effect.

L. 1979, c. 111, s. 26, eff. June 28, 1979.

### **13:18A-28. Severability**

If any section, part, phrase, or provision of this act or the application thereof to any person be adjudged invalid by any court of competent jurisdiction, such judgment shall be confined in its operation to the section, part, phrase, provision, or application directly involved in the controversy

in which such judgment shall have been rendered and it shall not affect or impair the validity of the remainder of this act or the application thereof to other persons.

L. 1979, c. 111, s. 27, eff. June 28, 1979.

**13:18A-29. Liberal construction**

The object, design and purpose of this act being the protection of the pinelands area and the resources thereof, this act shall be liberally construed.

L. 1979, c. 111, s. 28, eff. June 28, 1979.

**13:18A-30. “Pinelands Development Credit Bank Act”; short title**

This act shall be known and may be cited as the “Pinelands Development Credit Bank Act.”

L. 1985, c. 310, s. 1, eff. Aug. 28, 1985.

**13:18A-31. Legislative findings**

The Legislature finds and declares that, pursuant to the provisions of P.L. 1979, c. 111 (C. 13:18A-1 et seq.), the comprehensive management plan for the pinelands area has been adopted and is now being implemented; that this plan includes a program for the allocation and transfer of pinelands development credits; and that the intent of the pinelands development credit program is to provide a mechanism to facilitate both the preservation of the resources of this area and the accommodation of regional growth influences in an orderly fashion.

The Legislature further finds and declares that the concept of transferable development credits is innovative and, as yet, unprecedented on a regional scale; that in order to realize the full measure of the benefits of such a program, steps must be taken to assure the marketability of these credits; and that the best means of providing this assurance is through the establishment of a Pinelands Development Credit Bank empowered to purchase and sell pinelands development credits and to guarantee loans secured thereby, all as hereinafter provided.

L. 1985, c. 310, s. 2, eff. Aug. 28, 1985.

**13:18A-32. Definitions**

As used in this act:

a. "Applicant" means a person applying for, or in receipt of, a loan secured pursuant to the provisions of this act;

b. "Bank" means the Pinelands Development Credit Bank established pursuant to section 4 of this act;

c. "Board" means the Board of Directors of the Pinelands Development Credit Bank;

d. "County bank" means a public body established pursuant to section 14 of this act;

e. "County board" means the board of directors of the county development credit bank;

f. "Lender" means any bank or trust company, savings bank, national banking association, savings and loan association, or building and loan association maintaining an office in the State, or any insurance company authorized to transact business in the State;

g. "Pinelands development credit guarantee" means a guarantee extended pursuant to section 9 of this act;

h. "Pinelands development credit" means a transferable development right created pursuant to the comprehensive management plan.

L. 1985, c. 310, s. 3, eff. Aug. 28, 1985.

### **13:18A-33. Pinelands development credit bank; establishment; board of directors**

a. There is established in the Executive Branch of the State Government a public body corporate and politic, with corporate succession, to be known as the Pinelands Development Credit Bank. For the purpose of complying with the provisions of Article V, Section IV, paragraph 1 of the New Jersey Constitution, the bank is allocated within the Department of Banking, but notwithstanding that allocation, the bank shall be independent of any supervision or control by the department or by an officer or employee thereof, except as otherwise expressly provided in this act. The bank is constituted as an instrumentality of the State exercising public and essential governmental functions, and the exercise by the bank of the powers conferred by this act shall be deemed and held to be an essential governmental function of the State.

b. The bank shall be governed by a board of directors consisting of five ex officio members, or the designees thereof, as follows: the Commissioner of Banking, who shall serve as chairman; the Secretary of Agriculture; the Attorney General; the Commissioner of Environmental Protection; and the Chairman of the Pinelands Commission; and four members, each of whom shall be a resident of counties in the pinelands area, two to be appointed by the Governor upon the

recommendation of the President of the Senate, and two to be appointed by the Governor upon the recommendation of the Speaker of the General Assembly. Designees of the five ex officio members shall have the power to vote in the absence of members.

L. 1985, c. 310, s. 4, eff. Aug. 28, 1985.

### **13:18A-34. Powers of board**

The board shall have the following powers:

a. To adopt and, from time to time, amend and repeal suitable bylaws for the management of its affairs;

b. To adopt and use an official seal and alter the same at its pleasure;

c. To apply for, receive, and accept, from any federal, State, or other public or private source, grants or loans for, or in aid of, the board's authorized purposes;

d. To enter into any agreement or contract, execute any instrument, and perform any act or thing necessary, convenient, or desirable for the purposes of the board or to carry out any power expressly given in this act;

e. To adopt, pursuant to the "Administrative Procedure Act," P.L. 1968, c. 410 (C. 52:14B-1 et seq.), rules and regulations necessary to implement the provisions of this act;

f. To call to its assistance and avail itself of the services of the employees of any State, county or municipal department, board, commission or agency as may be required and made available for these purposes;

g. To purchase pinelands development credits to further the objectives of P.L. 1979, c. 111 (C. 13:18A- 1 et seq.) or when necessary to alleviate hardship, as determined pursuant to rules and regulations adopted by the board. The purchase price in these cases shall be not less than \$10,000.00 per credit, or a fraction of that amount which reflects that portion of a pinelands development credit allocated to the applicant pursuant to the provisions of the comprehensive management plan. The board may periodically increase the purchase price; provided that its action does not substantially impair the private sale of pinelands development credits. In no case shall the purchase price be greater than 80% of the market value of pinelands development credits, as determined by the board.

L. 1985, c. 310, s. 5, eff. Aug. 28, 1985.

### **13:18A-35. Pinelands development credit certificates**

The board shall, upon application of the appropriate landowner, and certification by the commission, issue Pinelands Development Credit Certificates for all pinelands development credits allocated pursuant to the comprehensive management plan. These certificates shall be issued to the current owner of record of the land with marketable title, verified by a 60 year search, who is legally empowered to restrict the use of the property in conformance with the comprehensive management plan, as indicated in the index of deeds recorded in the office of the recording officer of the appropriate county, subsequent to the recording of deed restrictions imposed on the use of that land pursuant to the comprehensive management plan.

L. 1985, c. 310, s. 6, eff. Aug. 28, 1985.

### **13:1 8A-36. Registry of Pinelands Development Credits**

a. The board shall establish and maintain a Registry of Pinelands Development Credits, which shall include:

(1) The name and address of every owner to whom a pinelands development credit certificate is issued pursuant to section 6 of this act, the date of its issuance, the municipal tax lot and block identification of the parcels of land to which the pinelands development credit has been assigned, the number of pinelands development credits or fraction thereof assigned to each parcel, the total number of pinelands development credits assigned, and the total acreage to which pinelands development credits have been assigned;

(2) The name and address of every person to whom a pinelands development credit is sold or otherwise conveyed, the date of the conveyance, and the consideration, if any, received therefor;

(3) The name and address of any person who has pledged a pinelands development credit as security on any loan or other obligation, the name and address of the lender, and the date, amount and term of the loan or obligation;

(4) The name and address of any person who has redeemed a pinelands development credit, the location of the land to which the credit was transferred, and the date this redemption was made; and

(5) An annual enumeration of the total number of pinelands development credits purchased and transferred, listing the municipality in which the land for which each pinelands development credit was issued is located, and the municipality to which the pinelands development credit was transferred.

b. No person shall purchase or otherwise acquire, encumber, or redeem any pinelands development credit without recording that fact, within 10 business days thereof, with the bank.

c. The board shall make available in the form of an annual report the information included

in the registry to each county and municipality located in whole or in part in the pinelands area, and, upon request, pertinent information to any other person. The first annual report shall be submitted to the Governor and Legislature and shall be made available to the public on the first anniversary of the effective date of this act.

L. 1985, c. 310, s. 7, eff. Aug. 28, 1985.

### **13:18A-37. Pinelands development credit as collateral**

Any person desiring to secure a loan using a pinelands development credit as collateral may apply to the board for determination of eligibility for a pinelands development credit guarantee. The board shall notify the applicant of its decision within 30 days of its receipt of the application.

L. 1985, c. 310, s. 8, eff. Aug. 28, 1985.

### **13:18A-38. Pinelands development credit guarantee; conditions for securing loans**

a. The board may extend a pinelands development credit guarantee with respect to any loan secured pursuant to the provisions of this act if:

(1) Adequate funds are available in reserve to fulfill the guarantee in the event of a default; and

(2) The applicant can demonstrate that he holds marketable title to the property and that the property has been certified by the commission as eligible for issuance of pinelands development credit certificates pursuant to the provisions of this act, that the owner is legally empowered to restrict the use of the property in conformance with the comprehensive management plan, that this credit has not been otherwise encumbered, transferred or redeemed, and that the credit shall be pledged as security for the guarantee.

b. If the application is denied, the board shall return it to the applicant with a written statement of the reasons for denial.

c. If the application is approved, the board shall retain the original and transmit copies of the application to the applicant and the lender. The applicant and the lender may then complete the transaction for the loan. Nothing herein contained shall be construed to require a lender to approve or deny any loan applied for pursuant to this act, regardless of the approval or disapproval by the board of any application for a pinelands development credit guarantee.

L. 1985, c. 310, s. 9, eff. Aug. 28, 1985.

### **13:18A-39. Amount of guarantee**

The bank is authorized to guarantee the value of a pinelands development credit in an amount not less than \$10,000.00, or a fraction of that amount which reflects that portion of a pinelands development credit allocated to the applicant pursuant to the provisions of the comprehensive management plan, provided that the value upon which the guarantee is made may be adjusted in accordance with the provisions of section 5 of this act. Nothing herein contained shall be construed to establish or limit fair market value of any pinelands development credit or to preclude the extension of a pinelands development credit guarantee for any loan of less than \$10,000.00.

L. 1985, c. 310, s. 10, eff. Aug. 28, 1985.

### **13:18A-40. Default on secured loan; notice; agreements**

a. Following the 31st day of a default on any loan secured, in whole or in part, by a pinelands development credit guarantee, the lender shall send notice by certified mail to the applicant and the board, stating the consequences of his default. The applicant and the lender may, within 90 days of the initial default, agree to take any reasonable steps to assure the fulfillment of the loan obligation.

b. In the event the applicant and the lender have not made arrangements for the continuation of the loan obligation within 90 days of the initial default, the lender shall file a claim with the board, identifying the loan and the nature of the default and shall: (1) assign the security interest in the pinelands development credit to the board in exchange for payment according to the terms of pinelands development credit guarantee; or (2) retain the security interest in the pinelands development credit and waive any claim to payment pursuant to the terms of the pinelands development credit guarantee.

L. 1985, c. 310, s. 11, eff. Aug. 28, 1985.

### **13:18A-41. Default after assignment of security interest by lender**

In the event a default occurs on any loan secured, in whole or in part, by a pinelands development credit guarantee and the lender has assigned the security interest in the pinelands development credit to the board, the board shall authorize payment to the lender up to the limits of the pinelands development credit guarantee, and shall notify the defaulting party. The board shall, in these cases, take all appropriate action to secure its interest in the pinelands development credit.

L. 1985, c. 310, s. 12, eff. Aug. 28, 1985.

**13:18A-42. Sale, exchange or retirement of pinelands development credit by board**

a. The board may sell, exchange, or otherwise convey or retire any pinelands development credit which is purchased or otherwise acquired pursuant to the provisions of this act. All sales, exchanges, conveyances or retirements shall be made prior to the expiration of this act. The provisions of any other law to the contrary notwithstanding, no such sale, exchange, conveyance or retirement shall be subject to approval of the State House Commission.

b. When the board sells, exchanges, or otherwise conveys or retires a pinelands development credit, it shall do so in a manner which shall not substantially impair the private sale of pinelands development credits. The board may convey a pinelands development credit without remuneration for use in projects that satisfy a compelling public purpose only by an affirmative vote of two-thirds of its members.

L. 1985, c. 310, s. 13, eff. Aug. 28, 1985.

**13:18A-43. County entity carrying out function of pinelands credit bank**

a. The governing body of any county located in whole or in part within the pinelands area may, by resolution duly adopted, create a public body to carry out the functions of the bank created herein within the jurisdiction of the county with all or any significant part of the name of the county inserted. The county bank shall be governed by a board of directors consisting of five members, appointed by the board of chosen freeholders, or, in the counties operating under the county executive plan or county supervisor plan pursuant to the provisions of the “Optional County Charter Law,” P.L. 1972, c. 154 (C. 40:41A-1 et seq.), by the county executive or the county supervisor, as the case may be, with the advice and consent of the board of chosen freeholders.

b. The members of the county board shall be appointed from among residents of the county with substantive experience in agriculture, banking and finance, land use regulation, and the law. Nothing contained herein shall be construed to preempt a county from carrying out functions substantially similar to those described and authorized herein exclusive of any State assistance.

L. 1985, c. 310, s. 14, eff. Aug. 28, 1985.

**13:18A-44. Delegation of authority to county**

The board may delegate any authority granted it by this act to any county which creates a county board pursuant to the provisions of this act if:

a. The commission has approved the master plan for the county;

b. The governing body of the county has requested that this delegation be made; and

c. The governing body of the county can demonstrate that it has the financial resources necessary to meet the obligations of this delegation.

L. 1985, c. 310, s. 15, eff. Aug. 28, 1985.

**13:18A-45. Matching county grants; delegation to county entity**

If the board has delegated its authority pursuant to the provisions of section 15 of this act, it may provide, upon application therefor and approval thereof, matching grants to the county bank for the purpose of meeting the obligation of this delegation. These grants may be applied retroactively to January 14, 1981.

L. 1985, c. 310, s. 16, eff. Aug.28, 1985.

**13:18A-46. Rules and regulations for county delegated powers**

The county board shall exercise the authority delegated to it by the board in a manner prescribed by rules and regulations adopted by the board.

L. 1985, c. 310, s. 17, eff. Aug. 28, 1985.

**13:18A-47. Appropriation; transfer of funds**

a. There is appropriated to the bank, from the General Fund, the sum of \$5,000,000.00. This sum shall be used for the purchase of pinelands development credits and to extend pinelands development credit guarantees, as herein provided.

b. The proceeds from the sale of pinelands development credits by the board or a county board shall remain available to the board or county board for the purposes of this act. Within 60 days after December 31, 2005 the board shall transfer to the General Fund all funds remaining on deposit in the bank. The board may transfer part or all of the funds on deposit in the bank to the General Fund prior to this date upon the affirmative vote of two-thirds of the members of the board.

c. Within 30 days after December 31, 2005 a county board shall transfer to the board that percentage of the funds remaining on deposit in the county bank which reflects the percentage of the matching grant made by the board to the county board pursuant to section 16 of this act.

L. 1985, c. 310, s. 18, eff. Aug. 28, 1985. Amended by L. 1997, c. 282, s. 1, eff. Jan. 6, 1998.

**13:18A-48. Terms of credit guarantees**

Notwithstanding any other provisions of this act to the contrary:

- a. No pinelands development credit guarantee shall be extended for a period of time in excess of five years;
- b. No pinelands development credit guarantee shall be extended after December 31, 2005;
- c. No pinelands development credit shall be purchased by the bank after December 31, 2005.

L.1985, c. 310, s. 19, eff. Aug. 28, 1985. Amended by L. 1991, c. 24, s. 1, eff. Feb. 19, 1991; L. 1994, c. 141, s. 1, eff. Nov. 14, 1994; L. 1997, c. 282, s. 2, eff. Jan. 6, 1998.

**13:18A-49. County functions exclusive of state financial assistance; effect of act**

Nothing in this act shall be construed to prohibit or in any other way interfere with any county carrying out functions substantially similar to those described and authorized herein, exclusive of State financial assistance.

L. 1985, c. 310, s. 20, eff. Aug. 28, 1985.

**13:18A-50. Limited practical use program acquisitions**

a. The Commissioner of Environmental Protection, utilizing any monies that may be made available from any source for the purpose, may acquire on behalf of the State from willing sellers any land or interest therein that qualifies for acquisition pursuant to the limited practical use program for the pinelands area as set forth in section 502(k)(2)(C) of the “National Parks and Recreation Act of 1978,” Pub.L.95-625 (16 U.S.C. s.471i(k)(2)(C)), and pay any necessary costs associated with those acquisitions. The Commissioner may not expend more than \$100,000 on any single acquisition pursuant to this subsection without the approval of the Joint Budget Oversight Committee or its successor.

For the purposes of this act, “limited practical use” means the designation given to any land or interest therein that has limited practical use because it is located in the pinelands area and is held by a landowner who both owns less than 50 acres in the pinelands area and has exhausted existing remedies to secure relief, or has such meaning as may be otherwise provided by federal

law.

b. Notwithstanding any law, rule, or regulation to the contrary, if the commissioner determines that the costs for surveys, appraisals, or other technical or administrative processes, procedures, or matters associated with the proposed acquisition of any land or interest therein pursuant to subsection a. of this section are disproportionate to the estimated cost of the land or interest therein to be acquired, the commissioner may waive the surveys, appraisals, or other technical or administrative processes, procedures, or matters to the extent necessary to ensure that the transaction shall be cost effective; provided, however, that the current owner of record has marketable title to the land or interest therein at issue, as verified by a 60-year search.

L.1995, c. 232, s. 1, eff. Aug. 16, 1995.

### **13:18A-51. Sale, exchange, conveyance or transfer of land or interest**

a. If the commissioner determines that any land or interest therein acquired pursuant to subsection a. of section 1 of this act is not useful to be retained by the State, or any agency, authority or entity thereof, for recreation and conservation purposes as defined pursuant to section 3 of P.L. 1992, c. 88, or for farmland preservation, historic preservation, water supply protection, or other public purposes, the commissioner may sell, exchange, or otherwise convey or transfer that land or interest therein to: (1) any public entity, including the federal government or a local government unit, or any agency, authority, or entity thereof, or any private nonprofit organization that agrees to retain and maintain the land for public purposes, at no cost or at such cost as may be established by the commissioner; or (2) any private party as set forth in subsection b. of this section.

b. If the commissioner determines that any land or interest therein acquired pursuant to subsection a. of section 1 of this act should be sold, exchanged, or otherwise conveyed or transferred to a private party, the commissioner may offer the land or interest therein first for private sale to any owner of land contiguous thereto acting either individually or jointly with another such owner, at a price to be established by the commissioner. The minimum price for which the land or interest therein may be offered for private sale shall be the same as the cost of acquisition of that land or interest therein by the commissioner pursuant to subsection a. of section 1 of this act, or, if the private sale involves an exchange, a value equivalent to the cost of acquisition; except that, if the land or interest therein offered for private sale includes a deed restriction imposed by the commissioner, the minimum price shall be the same as the cost of acquisition less the value of that deed restriction. If more than one such owner of contiguous land indicates interest in obtaining the land or interest therein at issue at the established price, it shall be sold, exchanged, or otherwise conveyed or transferred to the highest bidder from among all such landowners. If no owner of contiguous land indicates interest in obtaining the land or interest therein at issue, it may be offered for public sale at auction to the highest bidder.

c. Notwithstanding the provisions of any other law, rule, or regulation to the contrary, no sale, exchange, conveyance, or transfer of any land or interest therein as authorized pursuant to this section shall be subject to the approval of the State House Commission or the requirements of P.L. 1993, c.38 (C. 13:1D-51 et al.).

L. 1995, c. 232, s. 2, eff. Aug. 16, 1995

### **13:18A-52. Use of monetary proceeds**

a. Any monetary proceeds realized from the sale, exchange, conveyance, or transfer of any land or interest therein pursuant to section 2 of this act may be used by the commissioner to acquire additional lands or interests therein deemed to be of limited practical use as authorized pursuant to subsection a. of section 1 of this act.

b. Any monetary proceeds realized from the sale, exchange, conveyance, or transfer of any land or interest therein pursuant to section 2 of this act and not expended as authorized pursuant to subsection a. of this section shall be deposited into the applicable fund from which the State share of the monies used to acquire the land or interest therein pursuant to subsection a. of section 1 of this act was drawn.

L.1995, c. 232, s. 3, eff. Aug. 16, 1995.

### **13:18A-53 Actions, conformity with law**

No action may be taken pursuant to this act unless it is consistent with section 502 of the "National Parks and Recreation Act of 1978" and conforms with, and furthers the purposes of, the comprehensive management plan for the pinelands area adopted pursuant to section 7 of P.L.1979, c. 111 (C. 13:18A-8).

L. 1995, C. 232, s. 4, eff. Aug. 16, 1995.

### **13:18A-54. Rules and regulations**

The commissioner, in consultation with the Pinelands Commission, may adopt, pursuant to the "Administrative Procedure Act," P.L.1968, c. 410 (C. 52:14B-1 et seq.), such rules and regulations as may be necessary to implement this act.

L.1995, c. 232, s. 5, eff. Aug. 16, 1995.

### **13:18A-55. Pinelands preservation fund**

a. There is created in the Department of the Treasury a non-lapsing, revolving fund to be known as the "Pinelands Preservation Fund." The fund shall be the depository of the fees collected pursuant to subsection b. of section 1 of P.L.1996, c. 147 (C. 39:3-27.85). Interest or other income earned on monies deposited into the Pinelands Preservation Fund shall be credited to the fund.

b. Moneys in the Pinelands Preservation Fund shall be appropriated and distributed exclusively: (1) to reimburse the Division of Motor Vehicles for all costs incurred by that division, as stipulated by the director of that division, in producing, issuing, renewing, making computer programming changes in connection with and publicizing the Pinelands preservation license plates; (2) to pay for the costs of surveys and appraisals and other necessary costs incurred by the Department of Environmental Protection to acquire lands in the Pinelands National Reserve that have limited practical use because of their location and that are held by landowners who both own less than 50 acres in the reserve and have exhausted existing remedies to secure relief; and (3) to pay for Pinelands acquisition projects approved by the Commissioner of Environmental Protection in accordance with applicable State and federal laws relating to the protection of the Pinelands National Reserve and the pinelands area.

Of the initial fees collected from the issuance of Pinelands preservation license plates, an amount not to exceed \$100,000 shall be allocated to the Division of Motor Vehicles to pay the cost of any computer programming changes that may be necessary to implement the Pinelands preservation license plates program established by this act.

L. 1996, c. 147, s. 2, eff. June 18, 1997.

### **13:18A-56. Legislative findings and declarations**

The Legislature find and declares that the Pinelands comprehensive management plan and its accompanying land use regulations place a number of restrictions on opportunities for economic development in portions of the region in which growth is restricted and which are largely devoted to conservation and agriculture; that within these areas, there is potential for limited development that may be undertaken in a manner that does not detract from ecological protection goals; and that certain types of economic development can be identified that are compatible with the environmentally sensitive and rural character of the region.

The Legislature further finds and declares that small villages exist in non-growth portions of the region that include areas zoned for commercial and other uses but are isolated in the rural municipalities and lack the staff and resources for planning and economic development; that economic development of a certain type, such as ecotourism, retail sales and services, recreation, and light manufacturing, may be viable alternatives for these areas; and that in order to promote opportunities for these areas, it is necessary to create a program to research and test viable

economic development opportunities and to design implementation strategies to bring development to these areas compatible with the ecologically sensitive nature of the region.

L. 1997, c. 233, s. 1, eff. Aug. 30, 1997.

**13:18A-57. Pinelands Commission; rural economic development opportunities; pilot program**

a. The Pinelands Commission shall develop a pilot program to assist rural Pinelands municipalities in non-growth regions in the Pinelands area in identifying economic development opportunities that complement regional requirements for resource protection and in attracting such development to the area. The pilot program shall be developed by the Pinelands Commission, together with several rural municipalities within non-growth areas in the Pinelands area chosen by the commission, to enable similarly situated municipalities to match local conditions with compatible economic development opportunities. The commission shall choose municipalities to participate in the program based on the extent to which: the entire municipality or large portions thereof are located in an environmentally sensitive area; limited sites are available for development; sewer service is unavailable in most of the municipality; large portions of the municipality are owned by the State; and no local resources are available for economic development planning.

b. The Pinelands Commission shall establish a partnership with each municipality participating in the program. The municipality shall be given technical and other assistance in developing a local economic development entity. Each local economic development entity shall, together with the commission, perform a community assessment to determine community interests and opportunities for development, and to identify sites for development that are compatible with resource protection and that take into account constraints on the scale of allowable development. The commission, together with the local economic development entities shall develop strategies for attracting development and shall develop links with the county and regional economic development entities. The commission shall develop strategies for the expedited review of development applications and permits for such projects.

L. 1997, c. 233, s. 2, eff. Aug. 30, 1997.

**13:18A-58. Pilot program; report to Legislature and Governor**

Not later than two years after the effective date of this act, the Pinelands Commission shall prepare and submit a report to the Governor and Legislature describing the pilot program developed pursuant to this act, evaluating its effectiveness, detailing the expenditure of the funds appropriated pursuant to section 4 of P.L.1997, c. 233, and discussing its applicability to other regions of the State. The commission shall also make the report available, upon request, to any municipality in the State.

L. 1997, c. 233, s. 3, eff. Aug. 30, 1997.

# **Appendix D – 1**

## **Memorandum of Understanding**

**NOAA- Rutgers, The State  
University of New Jersey**

Memorandum of Agreement  
Between the  
National Oceanic and Atmospheric Administration  
And  
Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences  
Detailing the state-federal roles in the  
Management of the Jacques Cousteau National Estuarine Research Reserve

This Memorandum of Agreement states the provisions for the cooperative management of the Jacques Cousteau National Estuarine Research Reserve in the state of New Jersey, between Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences and the National Oceanic and Atmospheric Administration's Office of Ocean and Coastal Resource Management.

WHEREAS, this Memorandum of Agreement supercedes the previous "Memorandum of Understanding Between NOAA and Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences regarding the Jacques Cousteau National Estuarine Research Reserve dated February 27, 1998.

WHEREAS, the state of New Jersey has determined that the waters and related coastal habitats of the Mullica River-Great Bay watershed provide unique opportunities for study of natural and human processes occurring within the estuarine ecosystems of the state to contribute to the science of estuarine ecosystem processes, enhance environmental education opportunities, and provide scientific information for effective coastal zone management in state of New Jersey; and

WHEREAS, the state of New Jersey has determined that the resources of the Jacques Cousteau National Estuarine Research Reserve and the values they represent to the citizens of New Jersey and the United States will benefit from the management of these resources as part of the National Estuarine Research Reserve System; and

WHEREAS, the National Oceanic and Atmospheric Administration has concurred with that finding and pursuant to its authority under section 315 of the Coastal Zone Management Act of 1972, as amended (CZMA, 16 U.S.C. 1461) and in accordance with implementing regulations at 15 CFR 921.30 has designated the Jacques Cousteau National Estuarine Research Reserve; and

WHEREAS, Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences, as the agency designated by the NJ Department of Environmental Protection is responsible for managing the Jacques Cousteau National Estuarine Research Reserve and acknowledges the value of state-federal cooperation for the long-term management of the reserve in a manner consistent with the purpose of their designation; and

WHEREAS, the management plan describes the goals, objectives, strategies/actions, administrative structure, and institutional arrangements for the reserve, including this MOA and others;

NOW THEREFORE, in consideration of the mutual agreements herein, NOAA and Rutgers, The

State University of New Jersey, Institute of Marine and Coastal Sciences agree to the following:

#### ARTICLE I: STATE-FEDERAL ROLES IN RESERVE MANAGEMENT

##### A. Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences Role in Reserve Management

Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences shall:

1. be responsible for compliance with all federal laws and regulations, and ensure that the Jacques Cousteau National Estuarine Research Reserve management plan is consistent with the provisions of the CZMA and implementing regulations;
2. ensure protection of the natural and cultural resources of the reserve, and ensure enforcement of the provisions of state law, including rules and regulations of the New Jersey Department of Environmental Protection;
3. ensure adequate, long-term protection and management of lands included within the reserve boundary;
4. annually apply for, budget, and allocate funds received for reserve operations, research and monitoring, education and stewardship; and as necessary, land acquisition and reserve facility construction;
5. conduct and coordinate research and monitoring programs that encourage scientists from a variety of institutions to work together to understand the ecology of the reserve ecosystem to improve coastal management;
6. conduct and maintain programs that disseminate research results via materials, activities, workshops, and conferences to resource users, state and local agencies, school systems, general public, and other interested parties;
7. provide staff, and endeavor to secure state funding for the manager, education coordinator and research coordinator;
8. secure facilities and equipment required to implement the provisions within the reserve management plan;
9. ensure adequate funding for facilities operation and maintenance;
10. maintain effective liaison with local, regional, state, and federal policy makers, regulators and the general public;
11. serve as principal contact for issues involving proposed boundary changes and/or amendments to the reserve management plan;

12. respond to NOAA's requests for information, particularly cooperative agreement and grant progress reports and evaluation findings, including necessary actions and recommendations, made pursuant to Section 312 of the CZMA; and
13. expend funds in accordance with federal and state laws, the reserve management plan, and annual funding guidance from NOAA.

#### B. Federal Role in Reserve Management

NOAA's Office of Ocean and Coastal Resource Management shall:

1. administer the provisions of the Sections 315 and 312 of the CZMA to ensure that the reserve operates in accordance with goals of the reserve system and the Jacques Cousteau National Estuarine Research Reserve management plan;
2. review and process applications for financial assistance from Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences, consistent with 15 CFR 921, for management and operation, and as appropriate, land acquisition and facility construction;
3. advise Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences of existing and emerging national and regional issues that have bearing on the reserve and reserve system;
4. maintain an information exchange network among reserves, including available research and monitoring data and educational materials developed within the reserve system;
5. to the extent possible, facilitate NOAA resources and capabilities in support of reserve goals and programs.

#### C. General Provisions

1. Nothing in this agreement or subsequent financial assistance awards shall obligate either party in the expenditure of funds, or for future payments of money, in excess of appropriations authorized by law.
2. Upon termination of this agreement or any subsequent financial assistance awards to Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences, any equipment purchased for studies to further this agreement will be disposed of in accordance with 15 CFR 24.32.
3. A free exchange of research and assessment data between the parties is encouraged and is necessary to ensure success of cooperative studies.

#### D. Other Provisions

1. Nothing in this agreement diminishes the independent authority or coordination responsibility of either party in administering its respective statutory obligations. Nothing in this agreement is intended to conflict with current written directives or policies of either party. If the terms of this agreement are inconsistent with existing written directives or policies of either party entering this agreement, then those portions of the agreement which are determined to be inconsistent with such written directives and policies shall be invalid; but the remaining terms not affected by the inconsistency shall remain in full force and effect. At the first opportunity for revision of this agreement, all necessary changes shall be made by either an amendment to this agreement or by entering in a new superseding agreement, which ever is deemed expedient to the interested parties. Should disagreement arise on the interpretation of the provisions and/or amendments of this agreement that cannot be resolved by negotiations at the operating level of each party, the area(s) of disagreement shall be stated in writing by each party and promptly presented to a mutually approved mediator for non-binding mediation. If the parties cannot agree on the choice of a mediator or if the mediation does not resolve the dispute to the mutual approval of the parties, the parties are free to pursue any other legal remedies that are available.

#### ARTICLE II: REAL PROPERTY ACQUIRED FOR PURPOSE OF THE RESERVE

As well as acknowledging the rest of the requirements set forth at 15 CFR 921, Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences specifically acknowledges and will fully comply with conditions set forth at 15 CFR 921.21 (e), which specify the legal documentation requirements concerning the use and disposition of real property acquired for reserve purposes with federal funds under Section 315 of the CZMA.

#### ARTICLE III: PROGRAM EVALUATION

The Office of Ocean and Coastal Resource Management Division of NOAA will schedule periodic evaluations of Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences' performance in meeting the terms of this agreement, financial assistance awards, and the reserve management plan. Where findings of deficiency occur, NOAA may initiate action in accordance with the designation withdrawal or interim sanctions procedures established by the CZMA and applicable regulations at 15 CFR 921.40-41.

#### ARTICLE IV: EFFECTIVE DATE, REVIEW, AMENDMENT AND TERMINATION

- A. This agreement is effective on the date of the last signature on this agreement and shall be in effect until terminated by either party.
- B. This agreement will be reviewed periodically by both parties and may only be amended by the mutual written consent of both parties.
- C. This agreement may be terminated by mutual consent of both parties, or by NOAA if NOAA

withdraws designation of the reserve within the reserve system, pursuant to applicable provisions of the CZMA and its implementing regulations as described under 15 CFR 923 Subpart L, or if NOAA finds that Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences fails to comply with this MOA. The agreement may be terminated by Rutgers, The State University of New Jersey, Institute of Marine and Coastal Sciences with or without cause. Should this agreement be terminated, reimbursement of unexpended funds from financial assistance awards shall be determined on a pro rata basis according to the amount of work done by the parties at the time of termination. Additionally, reimbursement for land purchased and facilities constructed with NOAA funds shall be consistent with terms and special award conditions of financial assistance awards.

- D. If any clause, sentence or other portion of this MOA shall become illegal, null or void for any reason, the remaining portions of this MOA shall remain in full force and effect.
- E. No waiver of right by either party of any provision of this MOA shall be binding unless expressly confirmed in writing by the party giving the waiver.

IN WITNESS THEREOF, the parties have caused this agreement to be executed.

  
Name: David Kennedy  
Director  
Office of Ocean and Coastal  
Resource Management  
National Ocean Service  
National Oceanic and  
Atmospheric Administration  
U.S. Department of Commerce  
12/18/08  
Date

  
Name: Francisco E. Werner  
Director  
Rutgers, The State University of  
New Jersey  
Institute of Marine and Coastal  
Sciences  
9/16/08  
Date

## **Appendix D – 2**

### **Memorandum of Understanding**

### **Tuckerton Seaport**

**Memorandum of Understanding between Rutgers, the State University and Tuckerton Seaport Regarding the Operation of the Jacques Cousteau National Estuarine Research Reserve Visitor Center and the “Life on the Edge” Exhibit**

Given the mutual benefit to Rutgers, the State University (hereinafter “Rutgers”) through its Institute of Marine and Coastal Sciences, as owner and operator of the “Life on the Edge” public exhibit (hereinafter “the Exhibit”) at the Jacques Cousteau National Estuarine Research Reserve (hereinafter “JCNERR”) Visitor Center (hereinafter “the Exhibit Space”), and to the Tuckerton Seaport, 120 West Main Street, Tuckerton, New Jersey (hereinafter “Seaport”), owner and operator of the Tuckerton Yacht Club building at Seaport in Tuckerton, New Jersey, a joint partner with Rutgers in JCNERR, Rutgers and Seaport hereby enter into this Memorandum of Understanding for the operation of the Exhibit and the Exhibit Space in the Tuckerton Yacht Club building. Rutgers, the State University is an instrumentality of the State of New Jersey. Tuckerton Seaport is a project of the Barnegat Bay Decoy and Baymen’s Museum, a 501(c)(3) non-profit organization.

It is mutually agreed between Rutgers and Seaport that the following terms and conditions shall govern the operation of the Exhibit and the Exhibit Space at the Tuckerton Yacht Club building:

1. Provision of Space. Seaport shall provide the entire third floor, including the closet, of the Tuckerton Yacht Club building of Seaport without charge

to Rutgers for the purpose of accommodating the Exhibit Space, and the Exhibit and Exhibit Space staff. The public will be informed by Seaport of free access to the Exhibit Space and the Exhibit all times Seaport is open, and it will be promoted as an integral part of Seaport experience.

2. Staffing of Exhibit and the Exhibit Space. Rutgers will provide an Exhibit interpreter tasked with education and outreach tours of the Exhibit and the Exhibit Space, as determined by Rutgers.
  
3. Cooperation to ensure Maximum Use of Both Facilities. The Exhibit interpreter will refer all interested persons and groups to the Seaport program director or education coordinator should they wish to schedule a combined tour/program to Seaport with a tour/program at the Exhibit and the Exhibit Space. Similarly, Seaport personnel in regular contact with the public will refer all interested persons and groups to the Exhibit interpreter should they wish to combine a visit to the Exhibit and Exhibit Space with a visit to Seaport. When special requests are made to visit the Exhibit during times when Seaport is ordinarily closed, Seaport will endeavor to arrange access for the Exhibit interpreter and the visitor(s) to the Tuckerton Yacht Club building for the duration of the visit. To further enhance the joint use of the facility, Rutgers and Seaport will

cooperate in developing and delivering themed programs that promote the commonality of Seaport and JCNERR missions.

4. Maintenance. Rutgers will provide periodic cleaning of the Exhibit and the Exhibit Space by a professional cleaning service. Light cleaning of the Exhibit and Exhibit Space (removal of finger prints, touch-up of Exhibit paint, etc.) shall be the responsibility of Rutgers. Repair or replacement of any part of the Exhibit will be the responsibility of Rutgers. Repair or replacement of any part of the structural elements, fixtures and permanent appurtenances of the Exhibit Space including but not limited to the heat, ventilation and air conditioning systems, windows, doors, floors and flooring will be the responsibility of Seaport.
  
5. Insurance and Indemnification. Throughout the term of this agreement, Rutgers will maintain the following insurance:
  - A. Property insurance covering against physical loss or damage to its exhibit and the components thereof to the extent that such physical loss or damage is not attributable to the Seaport.
  
  - B. Commercial general liability insurance with minimum combined single limit of liability of \$1,000,000 per occurrence for bodily injury, death or property damage caused by Rutgers operation and maintenance of the exhibit.

Throughout the term of this agreement Seaport agrees to maintain commercial general liability insurance with minimum limits of \$1,000,000 per occurrence covering liability arising out of its ownership and maintenance of the Tuckerton Yacht Club premises.

Rutgers agrees to hold harmless and indemnify Seaport from and against claims for bodily injury, death or property damage directly resulting from its operation and maintenance of the "Life on the Edge" exhibit.

6. Utilities. All utilities for the Exhibit Space (gas, electric, telephone and internet access) shall be provided without charge by Seaport to Rutgers.
7. Signage. All signage in the Exhibit Space must be approved by Rutgers. All signage pertaining to the Exhibit and Exhibit Space on Seaport Property must be approved by Seaport. [See signage addendum].
8. Control of Exhibit and Exhibit Space. Rutgers shall control the use of the Exhibit and the Exhibit Space, including the usage and settings of all Exhibit equipment (e.g., projectors.)
9. Use of JCNERR Logo. All usage of the JCNERR logo by Seaport must receive prior written approval by Rutgers.

10. Advertising of Exhibit and Exhibit Space. Efforts should be made to include the Exhibit and Exhibit Space in Seaport advertising. All advertising of the Exhibit and Exhibit Space by Seaport must receive the prior approval of Rutgers. In particular, all mention of the Exhibit and Exhibit Space must prominently include a notice that admittance to the Exhibit and Exhibit Space is free at all times. Value added programs may charge a nominal fee to offset costs and the fee should be included in any related advertisement.
11. Funding. Funding to offset costs for value added programs as amended to this MOU will be determined on a case-by-case basis.
12. Termination. This MOU is effective as of the date of signatures of all parties, and will continue in full force until termination. Either party may terminate this agreement upon six (6) months written notice to the other party.
13. Modifications. Proposals to modify the terms of the MOU can be initiated in writing by either of the parties and are subject to written approval by each of the parties. Education, outreach, or research themes may be introduced at any time by agreement of all parties and will be addenda to this MOU.

Agreed:

Rutgers, the State University  
Institute of Marine and Coastal Sciences

Tuckerton Seaport

By:   
J. Frederick Grassle  
Director

By:   
George Kurtz  
President

Date: 10/18/06

Date: 10/26/06

## **Appendix D – 3**

### **Memorandum of Understanding**

#### **Land Managers**

**MEMORANDUM OF UNDERSTANDING**  
**Among**  
**Institute of Marine & Coastal Sciences at**  
**Rutgers, The State University of New Jersey**  
**and**  
**U.S. Fish and Wildlife Service**  
**and**  
**New Jersey Department of Environmental Protection**  
**and**  
**New Jersey Pinelands Commission**

I. PURPOSE

This Memorandum of Understanding (MOU) serves to establish the framework for coordination, cooperation and communication among the Institute of Marine and Coastal Sciences (“IMCS”) at Rutgers, The State University of New Jersey, U.S. Fish and Wildlife Service (“USFWS”), the New Jersey Pinelands Commission (“Pinelands Commission”) and the New Jersey Department of Environmental Protection (“NJDEP”) (hereinafter referred to collectively as the “Cooperators” and individually referred to as “ a Cooperating Party”) for the purposes of research, education and outreach, training and stewardship concerning the Jacques Cousteau National Estuarine Research Reserve (“JCNERR”). Specifically, the purpose of this MOU is to provide for advancement of estuarine conservation and organization and implementation of research, education, outreach and training concerning the importance and stewardship of the estuarine resources within the JC NERR.

Recitals

WHEREAS, the pristine waters and related coastal habitats of the Mullica River and the Great Bay estuary provide representative opportunities to study natural estuarine and human processes occurring within an estuarine ecosystem; and

WHEREAS, the resources of the Mullica River and the Great Bay estuary and the values they represent to the citizens of New Jersey and the United States will benefit from the management of this area as part of the National Estuarine Research Reserve System; and

WHEREAS, the National Estuarine Research Reserve System is a partnership program between the National Oceanic and Atmospheric Administration and the coastal states established by the federal Coastal Zone Management Act; and

WHEREAS, the Mullica River-Great Bay has been designated a National Estuarine Research Reserve in New Jersey, known as the JCNERR; and

WHEREAS, the Institute of Marine and Coastal Sciences at Rutgers, The State University of New Jersey, is the agency designated pursuant to JC NERR Management Plan as being responsible for managing the JC NERR and acknowledges the need and requirement for

continuing State-Federal cooperation in the long-term management of the JCNERR in a manner consistent with the purposes supporting its designation; and

WHEREAS, the majority of the JC NERR is located in the Pinelands National Reserve;

NOW THEREFORE, in consideration of the mutual agreements contained herein, the Cooperators hereby agree as follows:

II. OBJECTIVES OF THIS MOU

- A. To stimulate public awareness of the Mullica River-Great Bay ecosystem and its cultural history through research, education, public information and long-term protection of JC NERR resources.
- B. To address significant coastal management issues through coordination of estuarine research, education and public information activities in the JC NERR.
- C. To promote use of the JC NERR by Federal, State, public and private entities for research relevant to coastal management needs and education regarding estuarine resources.
- D. To provide research and education training opportunities at the graduate, undergraduate and pre-collegiate levels across a broad base of scientific fields that focus on the patterns and processes governing change and stability in estuarine systems in the JC NERR.
- E. To make recent findings, discoveries, facts, literature and research results available to resource managers, land owners, other researchers, outdoor recreationalists, educators, Federal, State and local agencies, and other interested members of the public.
- F. To disseminate research findings through the publication of reports, bulletins, circulars, films, journal and magazine articles, public information exhibits and programs. These may include scientific and popular media.
- G. Research and education activities will be designated to meet priorities defined in the JC NERR Management Plan and the Environmental Impact Statement prepared for the JC NERR.

III. AUTHORITY

- A. Rutgers University – Institute of Marine and Coastal Sciences

Rutgers IMCS is responsible for the implementation of the JC NERR Management Plan and serves as the principle contact with NOAA for the State of New Jersey in all matters concerning the JC NERR. IMCS is authorized by the

laws of the State of New Jersey to enter into agreements with the Federal and State Governments or agencies thereof, in order to promote the research and educational objectives of the University.

B. U.S. Fish and Wildlife Service

The USFWS has trust responsibility for fish, wildlife and plants, many of which are endangered species, migratory birds, and anadromous and inter jurisdictional fish species, which are concentrated in, or heavily dependent on coastal land and marine habitats. The USFWS is responsible for managing about 500 National Wildlife Refuges including the Edwin B. Forsythe National Wildlife Refuge. The USFWS is authorized pursuant to 16 USC 753(a) to enter into cooperative agreements with colleges and universities, states and private organizations for the purpose of developing adequate, coordinated, cooperative research and training programs for fish and wildlife services.

C. New Jersey Department of Environmental Protection

The NJDEP administers comprehensive environmental protection and management programs and large tracts of public lands dedicated for recreational and resource management purposes. DEP has authority to regulate development within tidally flowed waters, coastal and freshwater wetlands and uplands within and surrounding the JC NERR. The NJDEP is authorized by the laws of the State of New Jersey to enter into agreements to investigate questions relating to natural resources, to initiate and conduct inquiries concerning these resources and to conduct or sponsor research to manage, conserve, improve and enhance the status of natural resources in the State of New Jersey. NJDEP is the designated lead agency for the federally approved New Jersey Coastal Management Program.

D. New Jersey Pinelands Commission

The Pinelands Commission is an independent political subdivision of the State of New Jersey created pursuant to Section 4 of the Pinelands Protection Act, N.J.S.A. 13:18A-1 et seq., and charged with implementing the requirements of the Act. The Pinelands Commission is also the planning entity authorized in Section 502 of the "National Parks and Recreation Act of 1978" (Federal Act). The Comprehensive Management Plan sets for the policies adopted by the Pinelands Commission to protect, preserve and enhance the significant values of the land and resources of the Pinelands Area. Development within the Pinelands National Reserve must be consistent with the intent, policies and objectives of the Federal Act and the Pinelands Protection Act as articulated in the Pinelands Comprehensive Management Plan. The Pinelands Commission is authorized by the Pinelands Protection Act at N.J.S.A. 13:18A-6.g. to enter into any and all agreements or contract, execute any and all instruments, and do and perform any and all acts or things necessary, convenient, or desirable for the purposes of the Pinelands Commission or to carry out any power expressly given in the Act.

IV. COOPERATORS MUTUALLY AGREE:

- A. Contingent upon available financial and staffing support, the Cooperators shall:
- i. Coordinate programs, especially those which require the assistance of volunteers or volunteer groups;
  - ii. Assist with the collection of materials for the coastal research repository at the Jacques Cousteau Coastal Center;
  - iii. Cooperate in the planning, development and execution of research, education, training, and the preparation of publications, demonstration programs and public information programs;
  - iv. Provide access to publication channels, museum facilities, library facilities, utilities and other personnel and facilities as may be mutually agreed upon for the efficient conduct of activities under this MOU.
- B. Each Cooperator shall have complete responsibility for injury to its own personnel and damage to its own property occurring incidental to the conduct of the Cooperators. Each Cooperator will be responsible for any injury or property damage to third parties caused by negligence of its own employees, students or agents acting legitimately within the scope of their employment, studies or activities. Any responsibility/liability pursuant to this paragraph shall be limited and governed by the New Jersey Tort Claims Act (N.J.S.A. 59:1-1 et seq.; and
- C. All equipment purchased by or for the use of the Cooperators shall be the property of the contributing agency in the event of dissolution of the MOU, unless otherwise agreed. An equipment inventory indicating ownership, costs and condition of each item under the auspices of the Cooperators shall be maintained by the purchasing agency and made available annually to the Cooperators activities as provided by applicable federal and/or State law.

IV. IMCS' Obligations:

- A. Contingent upon the availability of sufficient financial resources as a result of its appropriation from the State Legislature, IMCS agrees to:
1. Oversee the management responsibilities of the JC NERR with the advice of the JC NERR Advisory Board which is comprised of representatives from each of the Cooperators.
  2. Make available such personnel and facilities, including equipment, buildings and land under its control, as may be mutually agreed upon for implementation of activities conducted under the terms of this MOU.

V. USFWS' Obligations:

- A. Contingent upon the availability of sufficient financial resources as a result of its appropriation from the U.S. Congress and sufficient staffing support, USFWS agrees to:
  - 1. Make available such personnel and facilities, including equipment, buildings and land under its control, as may be mutually agreed upon for implementation of activities conducted under the terms of this MOU. The USFWS will not make funding available to cooperators under the MOU.

VI. THE NJDEP's Obligations:

- A. Contingent upon the availability of sufficient financial resources as a result of its appropriation from the State Legislature and sufficient staffing support, NJDEP agrees to:
  - 1. Make available such personnel and facilities, including equipment, buildings and land under its control, as may be mutually agreed upon for implementation of activities conducted under the terms of this MOU.

VII. THE NEW JERSEY PINELANDS COMMISSION's Obligations:

- A. Contingent upon the availability of sufficient financial resources as a result of its appropriation from the State Legislature and sufficient staffing support, the Pinelands Commission agrees to:
  - 1. Make available such personnel and facilities, including equipment, buildings and land under its control, as may be mutually agreed upon for implementation of activities conducted under the terms of this MOU.

IX. PUBLICATIONS

- A. The principal investigator (PI) designated for the conduct of a specific project being supported by the Cooperators shall have the primary responsibility for the quality of work being submitted for publication, as well as for adherence to the publication guidelines of the cooperating agency supporting the project. Each Cooperator shall be given the opportunity to review, prior to publication, all publications arising from work sponsored or coordinated under this MOU with that time limited to 30 days. Publication restrictions that may be incorporated into grant or contract research will be observed recognizing that IMCS does not accept grants that prohibit publication of results. Upon request, any PI working under the terms and conditions of this MOU will provide to any cooperating

agency, prior to publication, a copy of any manuscript resulting from JC NERR activities; Publications may be independent or joint as agreed upon always giving credit for cooperation of the Cooperators and contributing agencies yet recognizing, within proper limits, the rights of the individual(s) doing the work.

- B. In case of failure to agree as to the manner of publication or interpretation of results, each party may publish data after due notice and submission of the proposed manuscripts to the other parties. In such instances, the party publishing the data will give credit to the Cooperators, but will assume full responsibility for any statements on which there is a difference of opinion.

X. OFFICIALS NOT TO BENEFIT

- A. As provided in applicable Federal and State statutes, no person prohibited from doing so shall be admitted to any share or part of this agreement or to any benefit that may arise therefrom.

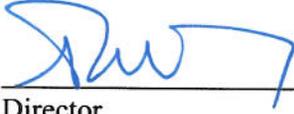
XI. NONDISCRIMINATION IN EMPLOYMENT

- A. In connection with the performance of work under this agreement the Cooperators agree not to discriminate against any employee or applicant for employment because of ancestry, age, sexual orientation, physical or mental disability, marital, military or veteran status, gender, race, religion or national origin. This provision shall include but not be limited to the following: employment, promotion, demotion or transfer, recruitment or recruitment advertising, lay-off or termination, rates of pay or other forms of compensation, and selection for training or apprenticeship.

XII. EFFECTIVE DATE AND TERMINATION

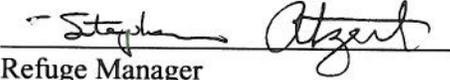
- A. This agreement shall become effective on the date of last signature and shall continue in force for five (5) years from its effective date unless extended by mutual consent in writing by all Cooperators 90 day in advance of such termination or terminated at any time by any or all of the Cooperator(s) in accordance with Paragraph XII.B below. The terms and conditions of this agreement may be amended by mutual consent in writing by all of the Cooperators.
- B. This agreement may be terminated at any time through mutual agreement of all Cooperators in writing 90 days prior to the effective date of the termination or by any Cooperator following 90 days written notice to the other Cooperators in advance of the effective date of such termination.

IN WITNESS WHEREOF, the parties hereto have caused this Memorandum of Understanding to be executed this 10<sup>th</sup> day of March, 2009.



Director  
Institute of Marine and Coastal Sciences  
Rutgers – The State University

Date: 3/16/09



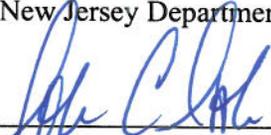
Refuge Manager  
Edwin B. Forsythe National Wildlife Refuge  
U.S. Fish and Wildlife Service

Date: 3/20/2009



Commissioner  
New Jersey Department of Environmental Protection

Date: 4/8/09



Executive Director  
New Jersey Pinelands Commission

Date: 3/24/09

# Appendix E

## Letter of Agreement

### New Jersey Conservation Foundation

**A Land Management Agreement  
Between  
The New Jersey Conservation Foundation  
And  
The Jacques Cousteau National Estuarine Research Reserve**

**I. Purpose**

This agreement establishes a framework for coordination, cooperation and communication between the New Jersey Conservation Foundation (hereinafter referred to as NJCF) and the Jacques Cousteau National Estuarine Research Reserve (hereinafter referred to as JC NERR) for acquiring and managing lands within the boundaries of the JC NERR.

**II. Justification**

WHEREAS, NJCF owns and administers property within the JC NERR, located in Ocean, Burlington and Atlantic Counties, New Jersey; and

WHEREAS, the JC NERR has been recognized as a natural area of interest to NJCF;

WHEREAS, the NJCF is willing to have properties included in the core area of the JC NERR for purposes and in the manner set forth below and in the Management Plan for the JC NERR; and

WHEREAS, NJCF recognizes that inclusion of conservation lands in the JC NERR acknowledges the Reserve as a natural field laboratory that enables, research and data collection on natural processes and human impacts occurring within the JC NERR, provides a basis for increased public awareness and understanding of the complex nature of estuarine systems, their values, benefits and management challenges, and that these uses and values reflect the goals of the National Estuarine Research Reserve System (NERRS); and

WHEREAS, NJCF and the JC NERR agree that both organizations share mutual goals and objectives, and that NJCF and the JC NERR enter into this agreement to incorporate regionally relevant properties into the Reserve;

**III. Collaboration**

THEREFORE and in consideration of the mutual agreements contained herein, NJCF and JC NERR do hereby agree to the following:

A. The parties agree to support the long-term management of the lands and waters that comprise the JC NERR, in compliance with regulations of the National Estuarine Research Reserve Program contained in 15 CFR Part 921. Through cooperative efforts,

the landholders will support and complement ongoing reserve educational, stewardship and research programs, as stated in the JC NERR management Plan.

B. The NJCF agrees to manage their land holdings in the JC NERR according to the provisions of the JC NERR Management plan. Primary goals are:

Key management information needs, especially with respect to eutrophication, habitat loss and alteration, effects of climate change and sea level rise on coastal communities and resources, and resource conservation are supported with advanced coastal and estuarine research and observing capabilities at relevant time and space scales.

Coastal decision-makers use science-based information to manage New Jersey's natural resources.

The K-12 community and the general public possess increased awareness and understanding of estuaries and coastal watersheds and how they are affected by human behavior and natural change.

Resource managers use reserve science to protect, conserve and restore estuarine habitat, resources and water quality.

C. Where and when it is mutually beneficial, the JC NERR and NJCF will identify opportunities to partner on land acquisition projects. Any additional lands acquired through this partnership will be consistent with the terms and conditions of this document, the JC NERR Management Plan, and codified as an addendum to this document.

#### IV. References and Authority

##### A. New Jersey Conservation Foundation

The mission of New Jersey Conservation Foundation (NJCF) is to preserve New Jersey's land and natural resources for the benefit of all. NJCF is a private, not-for-profit organization that relies on philanthropic support and grants from a variety of public and private organizations and individual donors.

Through acquisition and stewardship NJCF protects strategic lands, promotes strong land use policies, and forges partnerships to achieve conservation goals. Since 1960, NJCF has protected over 100,000 acres of natural areas and farmland in New Jersey – from the Highlands to the Pine Barrens to the Delaware Bay, from farms to forests to urban and suburban parks.

NJCF has been active in land preservation in the New Jersey Pine Barrens region for over three decades and owns and manages more than 12,000 acres in the Heart of the Pine Barrens.

The largest natural area on the Mid-Atlantic seaboard, the New Jersey Pine Barrens is a heavily forested area covering 1.1 million acres and its underground aquifers contain 17 trillion gallons of the purest drinking water in the country. The Pinelands National Reserve was created by Congress under the National Parks and Recreation Act of 1978. America's first National Reserve, the Pine Barrens account for 22 percent of New Jersey's land area covering portions of seven counties and 56 municipalities.

#### B. Jacques Cousteau National Estuarine Research Reserve

The JC NERR is a center of expertise for the protection and preservation of estuaries and coastal watersheds through science-based management and informed public stewardship. The lands that comprise the JC NERR are managed as a partnership of state and federal landholders. Rutgers-Institute of Marine and Coastal Sciences (hereinafter referred to as IMCS) manages and operates the JC NERR. Rutgers-IMCS has a field station and other facilities within the Reserve's boundaries and has been conducting continuous research throughout the Reserve Region since 1957. Rutgers-IMCS receives the federal financial assistance and has overall responsibility for Reserve management. The JC NERR serves as the umbrella for an integrated management approach among Reserve landholders.

#### V. Lands managed by NJCF to be Included in the JC NERR Boundary

NJCF properties included in the boundaries of the JC NERR are:

##### Bear Creek Preserve (100 acres)

Bear Creek Preserve offers a rare chance to view water and wading birds up close in various wetland habitats. This 100-acre preserve is located where the Bear Creek flows into the lower Mullica River. The Mullica River in this area is close enough to the ocean that its waters rise and fall with the tides. The water is also brackish, meaning it is a mix of fresh and seawater.

A sandy dike road starts at the access point on Lower Bank Road, just north of the Mullica River Bridge. After traversing Atlantic white cedar swamp, the road runs along a dike that dams the water of the Bear Creek, creating a fresh water pond and wetland habitat on one side, and a brackish water wetland on the other. This mix of habitat types attracts a wide diversity of wildlife species. Coupled with views of the Mullica River and mudflats that are exposed at low tide, the property is a great location for watching birds and other wildlife. The dike offers great views of the lower Mullica River Bald Eagle nest, located just across the river.

The property was donated to NJCF in 1986 by the Bear Creek Conservancy, a group of duck hunters and conservationists who wanted to ensure that the property was always protected.

### Hanselman Preserve (57 Acres)

The Hanselman Preserve is comprised of two units along North Manheim Avenue in Galloway Township, Atlantic County. The property captures the gradient of coastal forest habitats from pitch pine lowland and Atlantic white cedar forest to deciduous shrub-scrub wetlands to salt marsh flats. It is adjacent to land conserved by the New Jersey Natural Lands Trust as part of their Clark's Landing Preserve project area.

### Rudolph Property (31 acres)

The Rudolph property is dominated by a mixed pitch pine – scrub oak upland. It is adjacent to several out-parcels of the Bass River State Forest. One portion of the property extends to the east and has frontage on the Wading River.

### Lee Property (20 acres)

Pending acquisition, 20 acres in Galloway Township, Atlantic County, NJ will be acquired by NJCF and the JC NERR. This parcel is predominantly an Atlantic white cedar forest and is mapped as a pine/cedar forest. The property is dominated by pitch pine lowlands with a few scattered Atlantic white-cedars. The under story is a typical mix of low bush blueberry and huckleberry. The habitat is suitable for Pine Barren tree frogs and other threatened and endangered species. Once acquired, this land would be added to the Core Reserve boundary area. Nearby properties are being used as logging sites, making this site susceptible to similar activities.

### Other Provisions

Nothing in this agreement diminishes the independent authority or coordination responsibility of each party in administering its statutory obligations.

### VI. Liability

Each Party shall have complete responsibility for injury to its own personnel and damage to its own property occurring incidental to the conduct of Program activities. Each Party will be responsible for any injury or property damage to the other party or to third parties caused by the negligence of its own employees, students, or agents acting legitimately within the scope of their employment, studies, or activities.

### VII. Financial Commitment

This agreement does not constitute a financial commitment on the part of any of the parties. Financial support will be covered in separate agreements or proposals and will be subject to the ordinary and administrative procedures of the parties.

VIII. Effective Date and Termination

This agreement shall become effective on the date of last signature and shall continue in force until terminated through mutual agreement following a written notice to the other Parties 90 days in advance of such termination. The terms and conditions of this agreement may be amended by mutual consent of the Parties, approved and expressed in writing by the Coordinating Committee. It is the intention of the Parties to review and update this agreement in two years.



Michele S. Byers  
Executive Director  
New Jersey Conservation Foundation

Date FEB 18, 2009



Michael De Luca  
Manager  
Jacques Cousteau National Estuarine Research Reserve

Date February 23, 2009

**Appendix F**  
**Memorandum of Agreement**

**City of Bridgeton**

## **I. Background**

Recently, much attention has focused on the concept of creating sustainable communities in coastal areas, and the need for adequate databases and continuing information transfer to support this effort. More importantly, application of the sustainable community concept is proposed in a holistic framework that encompasses the interrelated nature of coastal processes and the use of scientific information in the planning process. More emphasis is beginning to be placed on local and regional responsibility for community sustainability and thus an increased need for information and technology transfer. It is within this context that opportunities exist to enhance coastal management in the Bridgeton region through education and outreach services.

Key coastal management issues include port management, habitat loss, sea-level rise, environmental quality, and loss of diversity, among others. In response to these needs, the Institute of Marine and Coastal Sciences at Rutgers University has made strong commitments to bring their research capabilities in marine and coastal science to bear on coastal resource issues. The City can capitalize on this expertise to sustain the economic and environmental interests associated with its coastal resources.

In addition to joint efforts aimed at enhancing coastal management, opportunities exist to enrich science education via the advanced research and technological capabilities available through the Institute of Marine and Coastal Sciences. Active learning and hands-on, minds-on approaches to education are invaluable teaching tools at all levels of education, especially in the sciences. Through its *Project Tomorrow* program, the Institute has developed a number of well-established partnerships with the precollegiate community. *Project Tomorrow* capitalizes on natural student fascination with the ocean to help develop basic skills in reading, writing, math, problem-solving, and critical thinking. Opportunities exist where scientists and educators can work together to stimulate interesting and meaningful science learning in the classroom, and to help prepare the next generation of decision-makers to be informed environmental stewards.

The Institute of Marine and Coastal Sciences (hereinafter referred to as IMCS), the School of Business at Rutgers-Camden, and the City of Bridgeton (hereinafter referred to as City), and collectively hereinafter referred to as the Parties, agree to collaborate on establishment of educational and outreach programs that meet the local and regional needs of the Bridgeton region.

## **II. Objectives**

The primary goals are to:

- Enhance educator capability in the nature of scientific inquiry.
- Immerse school systems in an active learning process.
- Develop links between the higher education and precollege communities to enrich interdisciplinary learning across all grade levels.
- Seek funding to support programs of mutual interest.
- Support informed coastal decision-making through education, outreach, and technology transfer.
- Catalyze economic development that is compatible with the environmental goals and objectives of the Bridgeton region.

Several key challenges and concerns are associated with the realization of these objectives. The Parties agree to address these challenges in a collaborative manner, which are to:

Encourage the development of sustainable coastal communities in a manner that promotes economic development and protects coastal resources.

Stimulate private investment and enhance business opportunities in a manner that is compatible with preservation of coastal resources.

Ensure coordination among the Parties.

Improve coastal decision-making by transferring results of coastal research to user groups through a coordinated program of education and outreach.

## **III. Role of the Parties**

The Parties enter into this agreement to facilitate a regional science enrichment and economic development program that capitalizes on the natural resources of the Bridgeton area and the research and technology capabilities of IMCS. Outreach is a key element critical to the success of the Program, especially for rapid dissemination of demonstration and research findings to the coastal user community in the Bridgeton region.

The Parties agree to provide for active cooperation in the advancement, organization, and conduct of coastal research, demonstration, education, training and business development. Of particular importance is the need to conduct and deliver programs related to coastal ecosystem health and coastal processes as part of an integrated program to meet the changing needs of coastal users in a manner that is compatible with environmental concerns. This agreement sets forth the respective roles of the Parties in meeting these objectives.

**Specifically, the Parties agree to:**

1. Organize forums such as Coastal Decision-Maker Workshops to enhance coastal decision-making and provide periodic scientific updates.
2. Provide field demonstrations of innovative techniques, methods, and practices to improve the capabilities of coastal planning efforts at the local level.
3. Develop educational programs that capitalize on the natural resources of the Bridgeton region to enrich basic and problem-solving skills of precollege students.
4. Provide opportunities for Bridgeton-area educators to participate in science enrichment programs such as MARE and Summer Research Experiences for educators.
5. Develop business opportunities that are compatible with local environmental concerns.

**IV. Coordination and Management of Activities**

It is mutually agreed that a Coordinating Committee shall administer the Program with advice and guidance from an Advisory Committee. The Coordinating Committee shall consist of the Director of the Institute of Marine and Coastal Sciences at Rutgers or their designee, Mayor of the City or their designee, Superintendent of Schools of the City or their designee, the Economic Projects Coordinator for the City or their designee, the Director of the Management and Entrepreneurship Training Unit at the Rutgers-Camden Business School, and the Director and Associate Director of Project Tomorrow or their designees.

The Coordinating Committee shall:

1. Identify priorities in consultation with local user groups
2. Prepare collaborative proposals to external funding agencies such as CREDA, Dodge, and Pew to seek funds that support activities identified by this agreement
3. Foster linkages between the science, precollege, coastal management, and local government communities

The Coordinating Committee shall meet annually or more frequently as mutually agreed. At its meeting the Committee will:

1. Develop and modify as necessary, an annual statement of work for the activities covered under this agreement.
2. Develop, coordinate, and foster communications between IMCS and the City.
3. Integrate insofar as is practicable the education and outreach programs of the parties with the existing activities and programs of the Parties.
4. Exchange information so that the Parties will be informed of the plans, programs, needs, and probable future trends and patterns of the coastal environment and economy.

The Advisory Committee shall meet annually to provide advice to the Coordinating Committee on funding opportunities, partnerships, programs, and activities of interest to the parties. Committee members shall include:

Director, Bridgeton Department of Development and Planning  
President, Bridgeton Development Corporation  
Director, Tri-County Community Development Corporation  
Chair, Bridgeton Municipal Port Authority  
President, Bridgeton Downtown Association  
Chair, Bridgeton Church Council  
President, Cumberland County College  
Superintendent of Schools, Cumberland County  
Director, Cumberland County Planning and Economic Development  
Chair, Aquaculture Development Corporation  
Executive Director, Cumberland County Utilities Authority  
Executive Director, Cumberland County Development Corporation  
Executive Director, Cumberland County Empowerment Zone  
Director, Haskin Shellfish Research Laboratory  
Director, Garden State Principals Center  
Director, Environmental Affairs, Public Service Electric & Gas Co.  
Director, Research for Better Schools/Eisenhower Consortium  
Director, Walter Rand Institute for Public Policy at Rutgers-Camden

## **V. Facilities**

The parties agree to seek external funding to develop facilities such as the Sheppard House that can be used to support programs and activities that meet the scope of work outlined in this agreement.

## **VI. Patent Rights**

Rights to inventions, improvements, and/or discoveries, whether patentable or copyrightable or not, created or developed in the course of Program activities made solely by employees of a Party shall belong to the Party and be administered in accordance with its patent and copyright policies. Rights to inventions, improvements, and/or discoveries created or developed in the course of Program activities, whether or not patentable or copyrightable, which were made jointly during the performance of this Agreement shall be jointly owned by the Parties who created or developed such inventions, improvements, and/or discoveries, and used to support demonstration and research activities of the Program. Such inventions, improvements, and/or discoveries shall be subject to the terms as agreed upon by the Parties in accordance with their respective patent and copyright policies. When third party funding is involved, each Party shall take appropriate action to ensure that such third Party's rights are protected.

Nothing herein shall be deemed to establish a relationship of principal and agent, a partnership or joint venture between the Parties, nor any of their agents or employees for any purpose whatsoever. This Agreement shall not be construed as constituting or as creating any form of legal association or arrangement, which would impose liability upon one Party for the act or failure to act of the other Party.

Notices, payments, statements, reports, and other communications under this Agreement shall be in writing and shall be deemed to have been received as of the date dispatched if sent by public courier (e.g., Federal Express) or by express mail, return receipt requested and addressed as follows:

Coordinating Committee  
c/o Institute of Marine and Coastal Sciences  
Rutgers – The State University of New Jersey  
71 Dudley Road  
New Brunswick, New Jersey 08901-8521

## **VII. Liability**

Each Party shall have complete responsibility for injury to its own personnel and damage to its own property occurring incidental to the conduct of Program activities. Each Party will be responsible for any injury or property damage to the other party or to third parties caused by the negligence of its own employees, students, or agents acting legitimately within the scope of their employment, studies, or activities.

## **VIII. Equipment**

All equipment purchased by or for the Program shall be the property of the contributing Party in the event of dissolution or termination of the Program, unless otherwise agreed. An equipment inventory indicating ownership, costs, and condition of each item under the auspices of the Program shall be maintained by the Coordinating Committee and made available annually to the Parties.

## **IX. Financial Commitment**

This agreement does not constitute a financial commitment on the part of any of the parties. Financial support will be covered in separate agreements or proposals and will be subject to the ordinary and administrative procedures of the parties.

## **X. Publications**

The principal investigator designated for the conduct of a specific project supported by the Program shall have primary responsibility for the quality of work being submitted for publication, as well as for adherence to the publication guidelines of the Party supporting the project. The Coordinating Committee shall be given an opportunity to review, prior to publication, all publications arising from work sponsored or coordinated by the Program, with the time for such limited to 30 days. Publication restrictions that may be incorporated into grant or contract research will be observed recognizing that the Parties do not accept grants that prohibit publication of results. The Coordinating Committee will, upon request, provide to any cooperating party, prior to publication, a copy of any manuscript resulting from Program activities.

Publication may be independent or joint as agreed upon, always giving credit to the parties and to contributing parties, yet recognizing within proper limits the rights of the individual doing the work.

In case of failure to agree as to the manner of publication or interpretation of results, each party may publish data after due notice and submission of the proposed manuscripts to the other parties. In such instances, the party publishing the data will give credit to the Parties, but will assume full responsibility for any statements on which there is a difference of opinion.

## **XI. Nondiscrimination in Employment and Programs**

In connection with the performance of work under this agreement, the Parties agree not to discriminate against any employee or applicant for employment because of ancestry, age, sexual orientation, physical or mental disability, marital, military or veteran status, sex, race, religion, color, or national origin. This provision shall include, but not be limited to, the following: employment, promotion, demotion or transfer, recruitment or

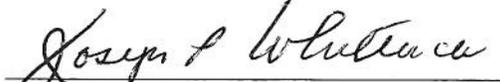
recruitment advertising, layoff or termination, rates of pay or other forms of compensation, and selection for training including apprenticeship. Participants in programs sponsored by the Program and/or cooperating parties shall not be discriminated against because of any status delineated above.

## **XII. Effective Date and Termination**

This agreement shall become effective on the date of last signature and shall continue in force until terminated through mutual agreement following a written notice to the other Parties 90 days in advance of such termination. The terms and conditions of this agreement may be amended by mutual consent of the Parties, approved and expressed in writing by the Coordinating Committee. It is the intention of the Parties to review and update this agreement in two years.

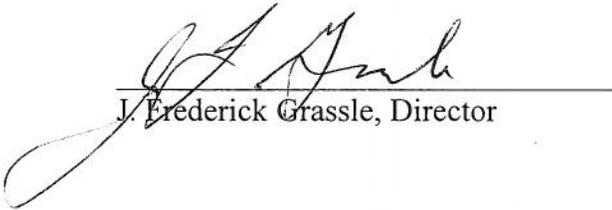
**APPROVED:**

**For Rutgers – The State University of New Jersey:**

  
\_\_\_\_\_  
Joseph P. Whiteside  
Senior Vice President and Treasurer

1/7/2000  
Date

**For the Institute of Marine and Coastal Sciences  
Rutgers - The State University of New Jersey:**

  
\_\_\_\_\_  
J. Frederick Grassle, Director

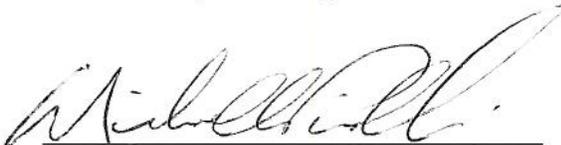
1/6/00  
Date

**For the Rutgers-Camden Campus**

  
\_\_\_\_\_  
Roger Dennis, Provost

1/27/2000  
Date

**For the City of Bridgeton:**

  
\_\_\_\_\_  
Michael A. Pirolli, Mayor

February 2, 2000  
Date

**Attest:**

  
\_\_\_\_\_  
Darlene J. Richmond, City Clerk

2-2-00  
Date

# **Appendix G**

## **NY/NJ Bight Seamless Network Proceedings Document**

Proceedings from

# **New York/New Jersey Bight Oceans Initiative: A Workshop to Create a Seamless Network of Protected Shores**

*A Cooperative Project Between*  
**the Institute of Marine and Coastal Sciences at Rutgers University  
the National Park Service and  
the National Oceanic and Atmospheric Administration**



**Proceedings from**

**New York/ New Jersey Bight Oceans Initiative:  
A Workshop to Create a Seamless Network of Protected Shores**

A Cooperative Project Between the Institute of Marine and Coastal Sciences at Rutgers University, the National Park Service and the National Oceanic and Atmospheric Administration

Michael P. De Luca  
Lisa Auermuller  
Melanie Reding  
Scott Haag

*The Jacques Cousteau National Estuarine Research Reserve, managed by the Institute of Marine and Coastal Sciences at Rutgers University is dedicated to improving the management of coastal environments through science, education and stewardship.*

*The National Park Service (NPS) is a bureau within the United States Department of the Interior. The NPS preserves unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education and inspiration of this and future generations. The NPS also cooperates with partners to extend the benefits of natural and cultural resource conservation and outdoor recreation throughout this country and the world.*

*The National Oceanic and Atmospheric Administration's mission is to understand and predict changes in Earth's environment and conserve and manage coastal and marine resources to meet our Nation's economic, social, and environmental needs.*

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Gateway National Recreation Area  
National Park Service  
210 New York Avenue  
Staten Island, NY 10305  
[www.nps.gov/gate/](http://www.nps.gov/gate/)

National Oceanic and Atmospheric Administration  
1401 Constitution Avenue, NW  
Room 6217  
Washington, DC 20230  
[www.noaa.gov](http://www.noaa.gov)



Proceedings from

# **New York/New Jersey Bight Oceans Initiative: A Workshop to Create a Seamless Network of Protected Shores**

*A Cooperative Project Between*

**the Institute of Marine and Coastal Sciences at Rutgers University  
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Kim Tripp - National Park Service

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Mike Bilecki - National Park Service

Norb Psuty – Rutgers, Institute of Marine and Coastal Sciences

Michael De Luca – Rutgers, Institute of Marine and Coastal Sciences

Madeline Gazzale – Rutgers, Institute of Marine and Coastal Sciences

Melanie Reding - Rutgers, Institute of Marine and Coastal Sciences, Jacques Cousteau National Estuarine Research Reserve

Lisa Auermuller - Rutgers, Institute of Marine and Coastal Sciences, Jacques Cousteau National Estuarine Research Reserve

Deborah Long - Long Island National Wildlife Refuge

Margaret Davidson - Coastal Service Center, NOAA

Kate Barba - Office of Ocean and Coastal Resource Management, NOAA

Betsy Blair - Hudson River National Estuarine Research Reserve

Reed Bohne - National Marine Sanctuary Program

Many others contributed to the successful organization and conduct of the workshop. Thanks to Kim Tripp, Betsy Blair and Melanie Reding for their assistance with facilitation of the breakout groups, Mary Judge (Barnegat Bay National Estuary Program), Lauren Wenzel (NOAA, Marine Protected Areas Center) and Michael Migliori (NOAA, Estuarine Reserve Division) for serving as rapporteurs, volunteers of the Jacques Cousteau National Estuarine Research Reserve for assistance with assembly of program materials, and to Madeline Gazzale for her sterling efforts to prepare, edit and produce the Proceedings document.

Funding for the workshop was provided by National Park Service Natural Resource Preservation Program through the National Park Service's North Atlantic Coast Cooperative Ecosystem Studies Unit. Funding was also provided from NOAA through the Jacques Cousteau National Estuarine Research Reserve.



## EXECUTIVE SUMMARY

Numerous federal, state and local agencies and conservation organizations share common mandates to protect and conserve sensitive marine, coastal and estuarine ecosystems and the resources that rely on these critical habitats. In 2006, a Memorandum of Agreement was developed between NOAA and the Department of the Interior to enhance partnerships across protected area management programs (seamless networks) to share knowledge and leverage resources on behalf of common resource interests and management responsibilities. Seamless networks have enormous potential value for the nation. Benefits include increased efficiencies of service and availability of information, an expanded array of recreation opportunities, transportation alternatives, and spatially relevant protection of our natural and cultural heritage.

On May 13 - 14, 2008, representatives of key federal and state agencies, nongovernmental organizations, and experts from relevant disciplinary partners met to identify collaborative approaches and programs to advance a New York/New Jersey Bight Seamless Network of Protected Shores. Key objectives were to identify common interests in stewardship, research and monitoring responsibilities, and to explore strategies to develop a collaborative network on behalf of these common interests. Real world examples of seamless network collaboration were presented, along with specific challenges to sustaining networks at various scales.

Workshop participants were divided into three thematic breakout groups - Research and Monitoring, Stewardship and Natural Resource Management, and Outreach and Education. Each breakout group used a common matrix to identify areas for collaboration, sources of information, available resources, steps for implementation, a timeline, and performance metrics to evaluate success. Matrices are provided in Appendix V.

These groups were asked to identify mutual interests, propose ideas to enhance cooperative conservation, and to identify several project priorities that could be met through seamless network collaboration. Action items, a timeline, and performance metrics were developed for each project priority. Proposed areas for collaboration included sharing platforms and data, ecosystem-based management, human use of coastal and marine resources, education and outreach, and evaluation of methods and products.

The themes of global climate change and sea level rise were pervasive throughout all breakout group discussions. The research and monitoring group listed climate change as one of their monitoring priorities, along with related monitoring efforts such as shoreline geomorphology, sea level elevations and sediment elevation tables. The stewardship and natural resource management group recognized climate change in a number of their priority issues. Examples include characterizing intertidal and subtidal habitat loss and functional degradation, developing a regional sand and sediment management plan, alternative energy development, and coastal resilience including disaster response. The outreach and education group outlined pilot projects, focusing on sea level rise messaging for various audiences.

One workshop participant noted, seamless networking is “easier said than done”. The stewardship and natural resource management group spent time discussing the functionality and organizational structure of a seamless network. In addition to engaging the seamless network partners on specific issues, the stewardship and natural resources group recommended the following steps:

- An organizational tool is needed to convene and coordinate partners.
- Existing data plans should be synthesized.
- Gap analyzes should be performed.
- Successful models should be identified.
- Seamless network vision and goal(s) should be established.
- Pilot projects should be initiated for smaller geographic areas.

Workshop participants agreed that developing pilot projects is one way to test the functionality of the seamless network. A variety of projects were identified, with two possessing near-term opportunities for implementation. One of these is to prepare a baseline map of submerged natural and cultural resources for use by multiple resource partners. Bathymetry, sediment type, and habitat maps accompanied by detailed inventories comprise critical information needed by park managers to design effective resource protection strategies, identify restoration needs, and to implement long-term monitoring programs. This pilot will aim to test and evaluate state-of-the-art and cost-effective methods for mapping submerged habitats and cultural resources within nearshore ocean and bay environments. Such information can also provide a mechanism for scientists, managers and educators to communicate and collaborate on education and outreach programs and services.

The second project aims to engage the seamless network partners to develop a NY/NJ Bight online, GIS data repository. Creation of the repository will provide a listing of partner GIS and Remote Sensing Datasets, thus enabling partner agencies to assess data availability / gaps, solicit partners for technical assistance, and provide contact information for data distribution.

One final recommendation concerned the need to ensure that network activities advance. For this to occur, and for the NY/NJ Bight to function as a true seamless network, one partner must serve as the coordinating body for all seamless network partner activities. This idea fueled the proposed “Multi-Agency National Ocean Center” for the Gateway National Recreation Area at Sandy Hook, NJ. Recognizing that much time may be needed to establish this entity, it is extremely important for the network partners to communicate regularly, and support collaborative activities such as the pilot projects. A steering committee will be formed for these purposes.





# INTRODUCTION TO THE SEAMLESS NETWORK CONCEPT

## Definition of a Seamless Network of Protected Areas

For the purpose of this workshop, a Seamless Network of Protected Areas was defined as *“a collection of protected conservation and public natural areas, which share similar resources and perform cooperative and joint activities in order to meet common goals and objectives.”*

Numerous federal, state and local agencies and conservation organizations share common mandates to protect and conserve sensitive marine, coastal and estuarine ecosystems and the resources that rely on these critical habitats. These include the National Park Service (NPS), U. S. Fish and Wildlife Service (FWS), the National Marine Sanctuary Program (NMS), and the National Estuarine Research Reserve System (NERRS). The creation of a seamless network of protected shores seeks to establish a working relationship at the national, regional and local levels to foster networking, inter-agency communications and coordination of programs, and to provide a means to share knowledge and leverage resources on behalf of shared interests and management responsibilities. Benefits of a seamless network include: 1) improved management and operational efficiency; 2) increased understanding of important natural and cultural resources within the areas managed; 3) increased effectiveness of joint planning efforts; 4) enhanced public awareness and education; 5) improved law enforcement and rescue capabilities; and 6) identification of shared research and/or monitoring priorities.

## Seamless Network Goal

*To facilitate partnership opportunities among federal, state and local agencies and non-government organizations toward enhanced marine resource conservation and education.*

## National Scope

In 2006, a Memorandum of Agreement was developed between the protected area management programs of NOAA and the Department of Interior to enhance working partnerships across government “to achieve a higher level of coastal and marine resource protection and conservation through effective interagency coordination.” (NOS Agreement Code: MOA-2006-036/7196, see Appendix I).

The NPS Advisory Board has promoted the concept of a network of protected areas and has challenged the NPS to take an active role to make this vision a reality. The board has recommended the NPS “...serve as a catalyst to encourage collaboration among public and private park and recreation systems at all levels – to build a network of parks and open space across America.” In 2006, the NPS director reiterated the goal “to promote a seamless network of parks through linked outdoor recreational opportunities in parks and communities to tourism, health and conservation.”

## Northeast Region

For the northeast region, the NPS identified several steps to advance implementation of a seamless network:

1. Convene workshops throughout the region, with multi-agency participation, to identify (see “Conserving Ocean and Marine Resources: Northeast Region Ocean Park Strategic Plan”, Appendix II):

- Common stewardship responsibilities.
- Priority marine resource threats that confront each agency.
- Common priority research, inventory and monitoring needs.
- Environmentally sensitive resources under stewardship of each agency, with a focus on common priority resources.
- The capacity for sharing resources (e.g., personnel, facilities, personnel).
- Opportunities among specific parks, refuges, sanctuaries, reserves and/or state/local conservation areas that embrace the seamless network concept.

A “Seamless Network Core Team” (NPS, NOAA Sanctuaries, US FWS, and NOAA Estuarine Reserve Program) held two workshops in calendar year 2008, one for the Gulf of Maine region and the geographic area of interest for this document--the NY/NJ Bight region.

2. Propose and prepare a feasibility study to establish a National Ocean Center of Excellence at Gateway’s Sandy Hook Unit. A multi-agency Center (i.e., NPS, NOAA, USGS, US Coast Guard, others), with strong academic involvement, would advance the seamless network initiative throughout the region, and promote the exploration, protection, policy, and education goals of the Northeast Region Strategic Plan.

3. Create opportunities to co-locate agency personnel on a long-term basis or short-term detail to foster collaboration and implement the seamless network concept.

## Why is a Seamless Network of Protected Areas Needed?

A diverse array of public and private open spaces are managed by tens of thousands of citizens, non-profit groups, city, state and regional entities, federal agencies, land trusts and park and forest districts. These players share a common interest in preserving natural resources, special places and recreational opportunities for the public. These organizations can benefit from working together to manage resources at the appropriate spatial scales required for resource sustainability, rather than at the juridical boundaries governing individual management units. Further, land managers face user conflicts on a regular basis and frequently miss opportunities for increased efficiency and effectiveness of service that can be achieved through cooperation with adjoining land managers and interest groups.

Agencies are repeatedly told the public has no interest in who manages or owns parks and forestlands, as long as they are reasonably accessible and well managed. Recreational visitors are not inclined to pay attention to specific park boundaries or management responsibilities, but prefer to focus on their experiences. Natural resources such as forests, geologic features and species are influenced by the geographic extent of the resource and also by the environmental processes that place non-natural limits on these resources. Human activities that affect distribution, abundance and health of natural resources, such as climate change, demand a broader vision of resource conservation--a vision beyond jurisdictional boundaries.

## What are the Benefits of a Seamless Network?

Seamless networks have enormous potential value for the nation. Benefits include increased efficiencies of service and availability of information, an expanded array of recreation opportunities, transportation alternatives, and spatially relevant protection of our natural and cultural heritage. As outlined in the Seamless MOA (Appendix I), priorities that can produce near-term benefits are:

- Joint review of financial and administrative processes, to facilitate the exchange of funds between the agencies or sharing use of personnel, equipment and facilities as needed.
- Joint emergency response to groundings, oil spills and disasters.
- Marine mammal stranding response, research and monitoring.
- Law enforcement.
- Coordinated management plan reviews, where partners sites are undergoing management plan reviews, to the extent that there is simultaneous, parallel or complementary added value.
- Boundary mapping, marine habitat mapping and resource characterization.
- Monitoring, observation and research.
- Marine and coastal habitat restoration.
- Marine invasive species monitoring and control.
- Education, agency “in-reach”, outreach, ocean literacy, particularly focused on identifying and articulating consistent messages related to the agencies’ ocean and coastal stewardship responsibilities.
- Coordinated land acquisition.

The following guiding principles define the conditions for successful development of a seamless partnership:

- Partners have compatible or complementary goals.
- Partners commit to removing institutional barriers.
- Cooperation is critical to the success of each individual participant’s goal.
- Partners commit to sharing resources and information.
- Partners have to be willing to communicate frequently.



# THE NEW YORK/NEW JERSEY BIGHT SEAMLESS NETWORK WORKSHOP

The New York/ New Jersey Bight Oceans Initiative: A Workshop to Create a Seamless Network of Protected Shores was held at Rutgers University on May 13-14, 2008. Invited participants included representatives of key federal and state agencies, nongovernmental organizations, and experts from relevant disciplinary partners.

## Workshop Goals and Objectives

### Goal:

To identify collaborative approaches and programs to advance the New York/New Jersey Bight Seamless Network of Protected Shores.

### Objectives:

- Engage stakeholders from protected area management programs in discussions to establish a Seamless Network of Protected Areas for the NY/NJ Bight region.
- Identify common interests in stewardship responsibilities, marine resource issues, research priorities and monitoring needs, environmentally sensitive resources, and operational resources.
- Explore strategies to effectively and efficiently achieve common goals through the vision of a seamless network of parks and protected areas.
- Identify next steps and actions for participants to collaborate as a network of protected areas.

Expected outcomes for the meeting were to establish a working relationship at national, regional and local levels; facilitate inter-agency communications and coordination of programs; and provide a means to share knowledge, and resources.

### Opening Plenary: “A Vision for a Seamless Network of Protected Areas”

Cliff McCreedy, Marine Resource Program Leader for the NPS, delivered the opening plenary talk. He addressed the “protected area” paradox, where despite the public’s perception of parks, natural resource degradation is a reality. Sixty percent of the United States population resides in coastal counties placing tremendous pressure on natural resources and thus resource managers to protect watersheds, wetlands, estuaries, and near shore and open ocean resources. Partnerships and interagency coordination are essential elements of protection strategies, and provide a strong impetus to develop regional seamless networks.

One of the challenges facing natural resource managers is to maintain the value of the resource in the face of declining budgets and the need to raise revenue through user or access fees. Resource managers also must make critical choices in the face of climate change. Programs like the NPS' "Climate Ready Parks" stress the need for resiliency in light of rising sea levels and increased storm intensities. In order to overcome these and other challenges, seamless network partners must adopt an ecosystem-based management protocol. A model demonstrating human factors, the need for resiliency and ecological integrity was presented. The first rule to any ecosystem-based management strategy is the need to preserve all the pieces.

## Key Aspects of a NY/NJ Bight Seamless Network:

### A Panel Discussion Moderated by Dr. Norb Psuty

Representatives of key agencies in the NY/NJ Bight Seamless Network highlighted their respective role and interests.

- **Gateway National Recreation Area - National Park Service**

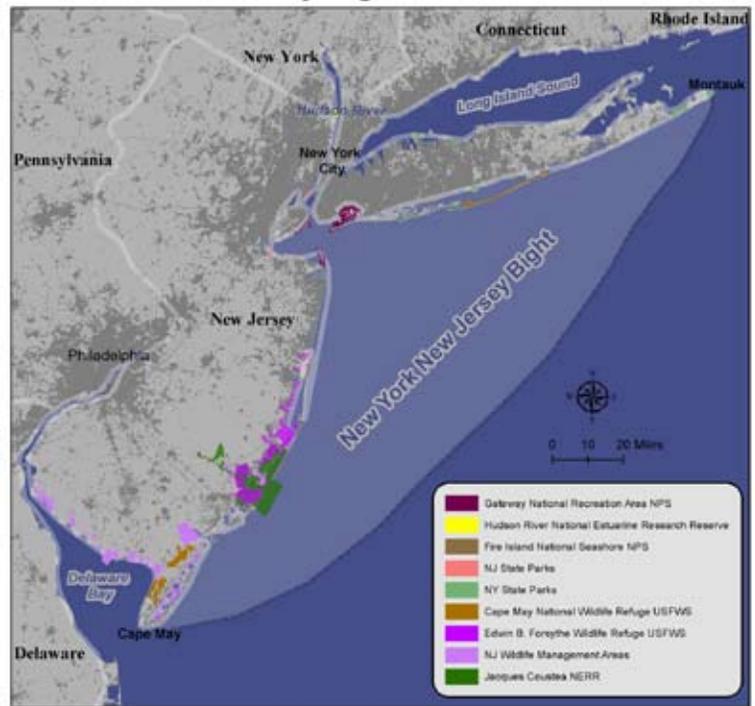
Barry Sullivan, General Superintendent – Gateway National Recreation Area, NPS, focused on the Northeast Region Ocean Park Strategic Plan. Ocean stewardship includes natural and cultural resources, education and protection. The main focus areas of the plan include: 1) establishing a seamless network of ocean parks, sanctuaries, refuges, and reserves; 2) discovering, mapping, and protecting ocean parks; 3) engaging visitors and the public in ocean park stewardship and 4) increasing technical capacity for ocean exploration and stewardship.

Goals specific to discovering, mapping and protecting ocean parks include: 1) inventorying and mapping natural and cultural resources within the submerged boundaries of ocean parks; 2) understanding and quantifying threats to submerged resources, including those associated with climate change; 3) identifying impaired resources and developing restoration strategies; 4) expanding the natural resource vital signs monitoring program to more fully address ocean and estuarine resources; 5) expanding understanding of ocean park boundaries, jurisdictions and authorities; and 6) increasing the NPS ocean and marine presence.

- **National Wildlife Refuge System**

Deborah Long, Refuge Manager, National Wildlife Refuge System (NWR) focused on the NY/NJ Bight refuges. Core program areas include threatened and endangered species, grasslands, forests, invasive species and visitor services. Ways in which the NWR could contribute to the NY/NJ Bight Seamless Network, specifically in the fields of research and monitoring, and stewardship and natural resource management were highlighted. Suggested seamless network project areas included salt marsh restoration, sediment elevation tables (SETs), beach nesting bird monitoring, invasive species management (i.e. *Phragmites* sp. removal), resource protection (i.e. coastal clean-ups) and law enforcement.

**New York New Jersey Bight known Protected Areas**



- **Estuarine Reserves Division, NOAA**

Erica Seiden, Project Manager, Estuarine Reserve Division (ERD) of NOAA, provided background information on the twenty-seven reserves around the country. The reserve system was created for long-term research and monitoring, education and resource stewardship. There are a number of locally relevant, but nationally significant reserve-wide programs. These programs include the National Estuarine Research Reserve's (NERRS) system-wide monitoring program (SWMP), the graduate research fellowship program (GRF), the coastal training program (CTP), the K-12 estuary education program (KEEP) and resource stewardship programs.

Through the use of examples from stewardship, monitoring, education and outreach, ways in which reserve sites have successfully partnered for resource protection were referenced. Seamless network opportunities, including expanding the IOOS network, habitat restoration, coordinating land acquisition and conservation planning, monitoring and controlling invasive species, and sharing resources for enforcement and protection of natural and cultural resources were addressed.

- **Hudson River NERR**

Betsy Blair, Manager of the Hudson River NERR spoke regarding the role the Hudson River Reserve could play in advancing the seamless network in the NY/NJ Bight. For example, the System-wide Monitoring Program administered by the NERRs could provide seamless network partners access to data, technical experience with monitoring systems, as well as approaches and experience in building networks through collaboration. Likewise, the Hudson River Habitat Initiative, a project to inventory, map and monitor change in all Hudson River habitats, could provide access to a database and technical experience, and could also serve as a model for an emerging approach to ensure future habitats.

In the area of stewardship and natural resource management, the Hudson River NERR's habitat restoration for marsh nesting birds, shoreline management and climate change programs could be used as resources for other seamless network partners. Public education and training for decision makers as outreach and education resources are also available through the Hudson River NERR.

Benefits of a seamless network to the Hudson River NERR could include collective wisdom, access to a wide range of expertise, the opportunity to develop wider consensus on issues of importance and the potential for additional partnerships.

- **Division of Parks and Forestry, NJ DEP**

Robert Cartica, Administrator of the Office of Natural Lands Management, who represented NJ DEP's Division of Parks and Forestry, stated the mission of the Division: "Dedicated to the excellent stewardship of the State's rich and diverse historic, cultural, recreational and natural resources for the benefit of present and future generations." The Division of Park and Forestry, is comprised of 428,707 acres of public lands including, among other sites, 51 state parks and forests, 37 state natural areas and four state marinas.

Liberty State Park, Island Beach State Park and Cape May Point State Park, three New Jersey's coastal parks were highlighted. Extensive restoration efforts have been planned for Liberty State Park. Island Beach State Park's tremendous natural resources including sea-beach amaranth and the Sedge Islands Marine Conservation Zone were noted. Closing with Cape May Point State Park, Robert spoke about resource challenges such as dynamic shorelines and restoration of areas once dominated by *Phragmites* sp., an invasive marsh reed.

## **Real World Models of Protected Area Networks**

Representatives from other protected area networks were invited to speak about the benefits and challenges they have faced working collectively with partners. Speakers included Paul Siri from the California State Coastal Conservancy,

Jeff Fullmer from the Long Island Sound South Shore Estuary Reserve, and Lauren Wenzel from NOAA's National Marine Protected Areas Center.

- **California State Coastal Conservancy**

Paul Siri, Executive Director, Ocean Science Applications for the California State Coastal Conservancy, focused on the Conservancy's governance, policy, and information development. Examples of state and regional marine management issues, ecosystem management and the use of emerging technology to address regional issues were presented.

Using the example of Integrated Ocean Observing System (IOOS), Paul referred to the California Ocean Science Applications (OSA) Program's role as a link to those who benefit from information provided by observing systems to those who can use and benefit from the information. Paul described the levels of partnering by associations within IOOS, ranging from federal partners, regional associations and state-based partnerships.

Ecosystem management as outlined in the West Coast Governor's Action Plan was discussed. This plan calls for West Coast states to examine ongoing community-based efforts using ecosystem management principles through an interdisciplinary partnership of social and natural scientists, numerous academic, government and nongovernmental organizations, and some key management and policy experts. As part of this initiative, these partners were tasked with assessing the science needed for large-scale ecosystem based management, developing research agendas for the primary knowledge gaps, and testing a framework for using scientific understanding about trade-offs among key ecosystem services. Appropriately scaled topics for ecosystem assessment and management applications included hypoxia, productivity, marine protected areas, anadromous species recovery, water resources, sustainable energy, and climate change.

Also addressed were the complexities of California's management responsibility for marine and coastal resources, uses, and activities within three miles of its shore. Cooperative management programs must be created which involve government agencies, academic institutions, and private interests. One such program is the Coastal Ocean Currents Monitoring Program (COCMP), which is designed to close the gap between scientists and coastal managers.

In conclusion, Paul stated from personal experience with partnerships, "change requires incentives."

- **Long Island Sound South Shore Estuary Reserve**

Jeff Fullmer, Director, spoke on behalf of the Long Island Sound South Shore Estuary Reserve (LISSSER). The LISSSER council of stakeholders is comprised of representatives from New York State, Reserve towns, villages and cities, Nassau and Suffolk County, the recreation, business, academic, and environmental fields and citizens. Through a comprehensive management plan, Reserve goals are to improve and maintain water quality, protect and restore living resources, expand public use and enjoyment of the estuary, sustain and expand estuary related economy, to increase education, outreach and stewardship, and improve knowledge for ecosystem management.

Implementation strategies emphasize cooperation with Council partners to advance actions outlined in a Comprehensive Management Plan, provide administrative and technical support to the Council and monitor plan implementation.

LISSSER has fostered a variety of successful partnership projects such as: 1) a series of stakeholder meetings and workshops, with the NY Oceans and Great Lakes Ecosystem Conservation Council to develop place-based ecosystem-based management demonstration projects; 2) school-based programs, including the South Shore Estuary Learning Facilitators Program; 3) a certification program that recognizes Stewardship Partners; and 4) cooperative interpretative exhibits.

The importance of documenting partner accomplishments was underscored, such as the "Partners for Progress" publication of LISSSER.

- **National Marine Protected Areas Center**

Lauren Wenzel, Development Coordinator, spoke on behalf of the National Marine Protected Areas (MPA) Center. The Center was created to develop and implement a scientific-based, comprehensive national system of MPAs. These areas represent diverse U.S. marine ecosystems, and nation's natural and cultural resources. The Center improves MPA coordination, stewardship and effectiveness.

There are approximately 1,800 MPAs in U.S. waters which are managed by federal, state and local MPA authorities. A majority of the MPAs permit multiple uses with only a few prohibiting extractive activities. Federal programs are responsible for managing the greatest MPA area, while states manage the greatest number of MPAs. Seventy-five percent of the MPAs were established for natural heritage such as biodiversity.

The Center has been a valuable tool in establishing a national vision for developing and using MPAs to conserve and sustain important natural and cultural resources. The center also provides a neutral forum for collaboration across states, tribes and federal agencies. Other benefits include building the scientific foundation and technical capacity for effective use of MPAs and networks of MPAs. The public is provided with opportunities for participation and valuable information regarding national MPAs. Resource conservation issues that could not otherwise be addressed by individual sites or programs can now be addressed. Regional MPA planning includes gap analyzes, resource characterization, and human use analyzes.

The Seamless Networks Initiative relates to conservation objectives of the MPA Center, one of which includes hosting regional workshops to identify resource protection gaps. Workshops will strengthen existing MPA sites and/or establish new sites. Sites with management plans would be nominated for inclusion in the national system of MPAs. These regional gap analysis workshops are scheduled to take place in 2009.

## **Integrating Themes for a NY/NJ Bight Seamless Network**

Workshop participants were divided into three breakout groups - Research and Monitoring, Stewardship and Natural Resource Management, and Outreach and Education. Each breakout group used a common matrix to identify areas for collaboration, sources of information, available resources, steps for implementation, a timeline, and performance metrics to evaluate success. Matrices are provided in Appendix V.

Objectives for the breakout sessions on day one were to:

1. Identify mutual interests and propose ideas for enhancing cooperative conservation.
2. Prioritize three - five ideas into specific projects to accomplish mutual interests and goals.

Objectives for the breakout session on day two were to:

1. Identify and evaluate **internal** resources to advance ideas.
2. Identify resources, **external** to the partners, needed to advance ideas.
3. Clarify roles for implementation.
4. Establish timelines and measurable actions for moving ideas forward.

## **Research and Monitoring**

### **Summary of Discussion**

The research and monitoring group reviewed research topics of interest to all participating partners. The priorities were consolidated into the following topics:

1. Cooperative Research Platforms\*
  - a. Functions, skills, equipments, etc. and sharing the information  
Data repository and sharing\*

2. Data Management/Sharing
  - a. Research driven technology/techniques, collecting, organization, and quality control
3. Monitoring
  - a. Shoreline (Geomorphology)
  - b. Climate change
  - c. Land use change
  - d. Water quality
  - e. Marine mammal abundance
  - f. Living resources (species, ecosystems and habitats)\*
  - g. Marsh surface elevation or SET
  - h. Efficacy of education/outreach
  - i. Endocrine disrupters
4. Mapping
  - a. Benthic habitat\*
  - b. Jurisdictional mapping with emphasis of habitat and species management
  - c. Archaeological, submerged archaeological resources
  - d. Real time/policy application (i.e. Ship Strikes and Whales, Restoration)
5. User Inventory/Social Science
  - a. Recreation
  - b. Visitor
  - c. Demographics
  - d. Human Use\*
  - e. Outreach
  - f. Archaeology

(\* Indicates topics with the highest mutual interest)

The research and monitoring group made the following monitoring recommendations:

- A current baseline data inventory needs to be initiated for the following topics: benthic habitat mapping, archaeological resources, boundary mapping, endocrine disrupters/toxicology monitoring, marine mammal abundance and living resources monitoring.
- Long-term monitoring efforts should be considered for geomorphology, land use, sea level rise, air quality, and sediment elevation tables (SETs).
- All monitoring and/or research projects should utilize an adaptive management protocol.

## **Main Themes**

### **Benthic Mapping**

The research and monitoring group identified benthic mapping as an ideal candidate for a pilot “seamless network” project due to the tremendous need for mapping and the existing capacity for mapping using undersea technology. The pilot project would engage several partners and demonstrate the utility of a common baseline map to inform management efforts in a multijurisdictional area. Partners also expressed interest in assembling a benthic mapping data repository to share information on resources, habitats, and ecosystem dynamics. Once a site-specific pilot project has been completed, efforts can be devoted to scaling up the mapping for use at a regional scale.

### **Data Repository**

The research and monitoring group identified many existing data sets to populate a benthic mapping repository. Data should include estuary and ocean mapping information. The project matrix lists existing data of interest to the participants and includes, where possible, data sources, spatial and temporal range of the data, and other relevant descriptive information.

## Research Platforms

The research and monitoring group also identified research platforms including research supplies, staff, technology and expertise required to support a benthic mapping project. A list of these resources is provided in the Research and Monitoring matrix.

## Action Items and Next Steps

The breakout group identified suitable protected areas for a benthic mapping project. Recommendations included:

- All or portion of Great South Bay – NPS, USFWS, The Nature Conservancy, and South Shore Estuary.
- The JC NERR including its offshore boundary and the Forsythe National Wildlife Refuge.
- Gateway National Recreation Area – Sandy Hook, NJ.

The Institute of Marine and Coastal Sciences at Rutgers University will serve as coordinator for the pilot project. Next steps are to:

- Create a benthic mapping steering committee by August 1, 2008.
- Create a website for data dissemination.
- Establish a process to add data to the website.
- Complete a gap analysis.
- Coordinate and select technological services.
- Develop a communication/outreach plan to translate results of the pilot project to the broader seamless network community.

## Stewardship and Natural Resource Management

### Summary of Discussion

Participants reviewed the priority stewardship and natural resource management issues of the regional stakeholders. An extensive list was generated, and consolidated into the following priorities:

1. Clarify the Organizational Structure of Seamless Network.
2. Characterize Intertidal and Subtidal Habitat Loss and Functional Degradation.
  - a. Loss of Ecosystem Services.
  - b. Marine Climate Change Impacts.
3. Identify Land Acquisition Priorities.
4. Develop a Regional Sand and Sediment Management Plan.
5. Monitor Invasive Species.
6. Alternative Energy Development.
7. Coastal Resilience Including Disaster Response.

### Main Themes

#### Seamless Network Inventories

Group discussion focused on identifying specific resource inventories of interest to seamless network partners, and the point of contact for this information. Data for these inventories would be drawn from existing resources, specifically targeting the following sources:

#### Resource Protection Strategic Plans

By reviewing and comparing the objectives, and initiatives of the partner's resource protection strategic plans commonalities and thematic overlaps can be identified. Actions identified in the plans can be strategically developed into a set of priority actions for the seamless network.

## **Protected Areas**

NOAA's Marine Protected Area Center has worked with partners to develop a Marine Protected Areas Inventory containing information on state, territorial and federal MPAs, including GIS data. The Center has the capacity to provide national and regional analyses of MPAs, including areas protected, level of protection, conservation goal, and other information. Seamless network partners can add local additions and terrestrial components to the NOAA effort. Areas protected with special designations (i.e., Pinelands) can be added as protection overlays. These overlays will enable a gap analysis to inform protection and conservation efforts at a variety of scales.

## **Shoreline Mitigation/Sediment Management Protocols**

Shoreline mitigation and sediment management is part of a broader issue of shoreline change. As sea levels continue to rise, our shorelines will require increasing mitigation. Hardened shorelines found along the coasts of NY and NJ will only exacerbate the problem. Many shoreline mitigation projects are underway. Management protocol resources already exist which could be culled for inclusion into the inventory. Past and current projects, which could be included in the first inventory draft are:

- The Bayside Shoreline Restoration Project.
- USFWS' Beach Management Plan.
- USGS' Models for Focus Areas Affected by Climate Change.
- NOAA' Fisheries List of Potential Restoration of Tidal Flow.
- NY Department of Environmental Conservation's Shoreline Restoration Project.
- Fire Island/Great South Bay's Marine Protected Areas Planning.
- Existing Aerial Photography Used to Assess Habitat Loss.

## **Organizational Discussions**

The stewardship and natural resources management group also discussed organizational questions and the dynamics of working as a "seamless network".

### ***Questions About Seamless Networking***

Questions posed included:

- What are the barriers to a Seamless Network, in light of the different missions and goals of the partner entities?
- How do workshop priorities weigh against existing agency priorities, in light of current time and staff constraints?
- What is important enough to generate a "buy-in" to Seamless Network?
- What is the right geographic scale?

### ***Recommendations for Functionality as the NY/NJ Bight Seamless Network***

The stewardship and natural resource management group prefer to engage seamless network partners on specific issues and noted the value of professional exchange and problem solving. Areas of common interests need to be identified and should be based on partner's management responsibilities.

The following steps were recommended to facilitate the seamless network concept for the NY/NJ Bight:

- An organizational tool is needed to convene and coordinate partners.
- Existing data and plans should be synthesized.
- Gap analysis should be done.
- Successful models should be identified.
- A seamless network vision and goal(s) should be established.
- Pilot projects should be initiated for smaller geographic areas.

## Action Items and Next Steps

Each stewardship and natural resource management proposed project idea has a series of next steps and assigned responsible parties. These are all detailed in the project matrices. A few larger projects are called out below.

A Fire Island Bay Shoreline Restoration Project will be lead by Mike Bilecki. They will develop the project design with partners and will determine the appropriate permits needed to complete the project.

An Inventory of Protected Areas will be lead by JC NERR, NOAA's Marine Protected Areas Center and the Regional Planning Association (RPA). The JC NERR will take the lead on the inventory of all GIS resources in the region. The RPA and NOAA's MPA will work with the JC NERR to combine all data into an online mapping resource.

## Education and Outreach

### Summary of Discussion

Participants listed existing education and outreach programs available through seamless network partners and noted target audiences. Priority topics are:

- Water quality
- Restoration
- Invasive species
- Sea level rise
- Basic estuarine and ocean literacy
- Recognition and value of natural network
- Education and stewardship
- Homeowners and their relationship to their watershed

Also discussed was delivery of outreach and education programs through the seamless network. All agreed there is no need to educate the public about the concept of a seamless network. Rather, agency messages need to be universal and accessible to the public. The public is not concerned with whether or not they are in a state or federal park, or national wildlife refuge; it is the quality of the experience that concerns them.

Outreach and education programs should be developed with a strong stewardship message to motivate people to take action or change behavior. Benefits of a seamless network of education and outreach include collaboration, leveraging of resources, and avoidance of duplication.

### Main Themes

#### Climate Change and Sea Level Rise

The importance of education and outreach regarding climate change was a common theme among group members. "Seamless" messages developed around climate change and sea level rise would benefit all partners. The messages would be most effective if climate change awareness was promoted in a way that prompted action. The messages could be crafted from a number of perspectives including "the importance of protecting natural and human communities, the value of conservation as protection and mitigation", and "conservation of coastal/marine resources at risk due to climate change." The group also discussed the importance of crafting an appropriate message based on the audience and delivery mechanism.

The outreach and education group listed the following current climate change projects and target audiences:

- Sustainability, green building techniques and benefits and, alternative energy strategies targeted at builders.
- Benefits of purchasing property for carbon sequestration.
- Flood plain management education.
- Sea level rise and its effect on habitats and communities.
- Impact on recreation.
- Land loss in NJ due to sea level rise.
- Public outreach on climate change.
- Train the trainers models.

Focusing on the message of “the value of conservation as protection and mitigation”, the group recommended two pilot projects--one targeting the public and one targeting decision makers.

### **Reaching the Public through Interpretative Materials**

Using a variety of interpretive techniques, the outreach and education group decided the following message should be used by all seamless network partners when targeting the public about the effects of sea level rise: “Wetlands are important to protect natural and human communities”. Public interpretative avenues and resources, presently being used by the seamless network partners, include the NPS’ Coastal Heritage Trail, a variety of interpretive centers, podcasts, websites, and inundation model maps done by Rutgers Center for Remote Sensing and Spatial Analysis (CRSSA) and USFWS Graphics Specialists.

### **Reaching Local Elected Officials**

Capitalizing on the strengths of the seamless network partners in the area of decision maker outreach, an additional seamless network pilot project would target local elected officials. The message to the decision makers would be “Promote risk-wise decision making and raise awareness of economic benefits/incentives to conservation”. Valuable resources already within the seamless network are the JC NERR Coastal Training Program, Resilient Communities Program at the Urban Coast Institute, Rutgers’ CRSSA inundation mapping project, the Trust for Public Land (TPL) and USFWS and NJ DEP documents on the economic benefits of preserved lands, the TPL 2020 document, and the habitat Priority Planner tool available from NOAA’s Coastal Service Center.

### **Action Items and Next Steps**

Both outreach and education pilot projects have a series of next steps and a similar need for research on the economic and recreational value of wetlands.

Other action items are:

#### ***Reaching the Public through Interpretive Materials***

A consistent and concise message needs to be developed around the theme: “Wetlands are important to protect natural and human communities”. This effort will include message branding to help ensure a cohesive look in interpretive materials developed by all partners. Additionally, the group decided visualization tools and/or flash pieces to go with inundation maps would be valuable. Other next steps include a focus group to test attitudes towards sea level rise, piloting of messages, development of an evaluation tool and involvement of tourism in the promotion and education of the final interpretive materials.

The JC NERR was listed as the lead on this effort, along with the NPS, the Urban Coast Institute and the NJ DEP. The group decided this effort should begin with monthly communication, commencing in the summer of 2008.

### ***Reaching Local Elected Officials***

A number of next steps were identified for the decision maker outreach pilot project. A needs assessment should be conducted to identify the best opportunities and timing to communicate with this audience. The needs assessment will also identify:

- Coastal fellowship options.
- Local conservation champions who could provide conservation training opportunities.
- Funding opportunities, especially through the foundation community.
- Project opportunities to engage the local community and give them “hands on” experience with conservation.

Parties involved in moving this pilot project forward include the JC NERR, the Urban Coast Institute, TPL and State Naturalists from NY, Delaware, and NJ Department of Environmental Protection of Conservation offices.



## CLIMATE CHANGE – AN OVERARCHING THEME

Global climate change is one of the most pressing challenges facing natural resource managers today. The science community no longer debates whether climate change is happening; they debate the rate at which change is occurring. The Intergovernmental Panel on Climate Change concluded in February 2007 that it is “unequivocal” that Earth’s climate is warming, and that it is “very likely” (a greater than 90 percent certainty) that the heat-trapping emissions from the burning of fossil fuels and other human activities have caused “most of the observed increase in globally averaged temperatures since the mid-twentieth century”.

According to the Union for Concerned Scientists, “the Northeast and the rest of the world face continued warming and more extensive climate-related changes to come—changes that could dramatically alter the region’s economy, landscape, character, and quality of life.” They go on to state, “By the end of this century, global sea level is projected to rise 7 to 14 inches under a lower emissions scenario and 10 to 23 inches under a higher-emissions scenario. Several lines of evidence indicate that these projections may be quite conservative. Even under these projections, many areas of the densely populated Northeast coast face substantial increases in the extent and frequency of coastal flooding and are at increased risk of severe storm-related damage.

- Boston and Atlantic City, for example, can expect a coastal flood equivalent to today’s 100-year flood every two to four years on average by mid-century and almost annually by the end of the century.
- New York City is projected to face flooding equivalent to today’s 100-year flood once every decade on average under the higher-emissions scenario and once every two decades under the lower-emissions scenario by century’s end.
- Sea-level rise is also projected to permanently inundate low-lying coastal areas and increase shoreline erosion and wetland loss. The areas most vulnerable to shoreline erosion include portions of Cape Cod, Long Island, and most of coastal New Jersey.
- Because of the erosive impact of waves (especially storm waves), the extent of shoreline retreat and wetland loss is projected to be many times greater than the loss of land caused by the rise in sea level itself.
- The high concentration of population, property, infrastructure, and economic activity in coastal areas of the Northeast create considerable challenges for emergency response, hazard mitigation, and land-use planning.

Combined with the conservative nature of these sea-level rise projections, these factors leave little room for delay or complacency in reducing heat-trapping emissions and adapting to rising sea levels.”

Natural resource managers and scientists observe the effects of sea level rise and warming trends through flora, fauna and water monitoring efforts. Increased storm frequency and intensity, coastal inundation, species range extensions and shoreline erosion are issues which all seamless network partners are facing. These threats are only going to continue to increase overtime.

The themes of global climate change and sea level rise were pervasive throughout all breakout group discussions. The research and monitoring group listed “climate change” as one of their monitoring priorities, along with related monitoring efforts such as shoreline geomorphology, sea level elevations and sediment elevation tables. The stewardship and natural resource management group recognized climate change in a number of their priority issues. Examples include characterizing intertidal and subtidal habitat loss and functional degradation, developing a regional sand and sediment management plan, alternative energy development, and coastal resilience including disaster response. The outreach and education group outlined two pilot projects, focusing on sea level rise messaging for various audiences.

As the NY/ NJ Bight Seamless Network develops pilot projects and cooperative mechanisms to coordinate programs and activities, issues associated with sea level rise and climate change present key, near-term opportunities for seamless collaboration.





# SEAMLESS NETWORK CONCLUSIONS

## A Network of Common Interests and Goals

A number of common interests and goals were derived from discussions within the breakout groups and between workshop participants. Proposed areas for collaboration, which can be capitalized on and improved include:

- Sharing platforms and data.
- Global climate change and sea level rise.
- Ecosystem-based management.
- Human use of coastal and marine resources.
- Education and outreach.
- Evaluation of methods and products.

## Addressing the Functionality of a Seamless Network

The stewardship and natural resource management group spent time discussing the functionality and organizational structure of a seamless network. In addition to engaging the seamless network partners on specific issues, they recommended the following steps be taken in order to facilitate the seamless network concept for the NY/NJ Bight:

- An organizational tool is needed to convene and coordinate partners.
- Existing data plans should be synthesized.
- Gap analyzes should be performed.
- Successful models should be identified.
- Seamless network vision and goal(s) should be established.
- Pilot projects should be initiated for smaller geographic areas.

## Advancing Pilot Seamless Network Projects

Working through smaller pilot projects is one way to test the functionality of the seamless network. The following NY/NJ Bight Seamless Network pilot projects are proposed and will highlight the opportunities and challenges of working as a network of partners.

### Benthic Mapping Project - Sandy Hook, NJ

Although the NPS maintains stewardship responsibility for a significant amount of submerged marine areas, limited information exists on natural resources. Bathymetry, sediment type, and habitat maps accompanied by detailed inventories comprise critical information needed by park managers to design effective resource protection strategies, identify restoration needs, and to implement long-term monitoring programs. As a result of the National Ocean Park Stewardship Action Plan, the NPS has placed high priority on assembling an inventory and map of natural and cultural resources within submerged park lands. The NPS seeks opportunities to test and evaluate state-of-the-art and cost-

effective methods for mapping submerged habitats within nearshore ocean and bay environments. The Sandy Hook Unit of gateway provides an excellent site for such a pilot, and can serve as a testbed for other coastal national parks throughout the Atlantic coast (e.g., Cape Cod, Fire Island, Assateague Island).

A pilot project will be developed to create a benthic habitat map for the Sandy Hook component of the Gateway National Recreation Area. This project will employ an autonomous undersea vehicle to explore and map distribution of habitat and resources in the nearshore environment near Sandy Hook. Next steps for this project include establishing a benthic mapping steering committee - fall 2008: lead Rutgers University-IMCS, and demonstration mapping project at Sandy Hook; fall 2008: lead Rutgers and NPS.

Benthic mapping data sets can provide a platform for researchers and educators to collaborate in the creation of a variety of educational resources to compliment the benthic mapping project. Providing data from the benthic mapping project in a format appropriate for classroom use (such as the Chesapeake Bay Program Data Hub (<http://cheseapeakebay.net/data/index.htm>)) should include and compliment a variety of current and future lesson plans.

Lesson plans focused on current research and state of the art mapping technologies are well suited for addressing national and local science education standards such as Science as Inquiry and Science as a Human Endeavor. The multidisciplinary nature of benthic mapping makes it a useful tool to teach real world issues such as climate change, eutrophication and invasive species through comparative studies. Benthic habitat mapping can provide a platform for comparing biological communities and their physical and chemical environments.

### **NJ/NJ Bight GIS Data Repository**

Using the NOAA MPA Center map as a baseline, the JC NERR will work with the seamless network partners to develop a NY/NJ Bight online, GIS data repository.

Geographic Information Systems are storage medium for spatial and temporal environmental datasets. These datasets can include, but are not limited to information on:

- Administrative boundaries
- Cadastral datasets
- Hydrographic, Physical and Chemical values
- Species location
- Digital Elevation and Bathymetric Models.

The creation of a GIS data directory will provide a one stop listing of partner GIS and Remote Sensing Datasets. This directory will allow partner agencies to assess data availability / gaps, solicit partners for technical help and provide contact information for data distribution. Datasets will be maintained by the original creator, allowing for a seamless update or revision without the need for constant repository data maintenance.

The creation of a data repository that includes a detailed inventory of benthic species within a specific region will provide a wealth of resources for educators and additional user groups. An online inventory will include links to pictures, general information and statistical data for use in research and education as well as additional information links to partners within the seamless network.

GIS, GPS and RS have become increasingly useful tools for educators to teach students about local communities. Local data sets gleaned from a data repository will encourage the combination of interactive mapping and spatial analysis within the classroom, and on educational field trips. Stewardship activities would also benefit from this information.

## **The Other Benefits of Networking**

The NY/NJ Bight partners in attendance were given the opportunity to discuss potential projects and share new ideas. Networking at the workshop led to the formation of several new projects. An example includes:

### **NPS/FWS Marine Jurisdiction Meeting**

NPS and FWS staff discussed the need for an additional meeting to focus on marine jurisdiction topics. This meeting will focus on NPS areas, with particular attention being given to Gateway NRA and Fire Island National Seashore. Gateway National Recreation Area may host this meeting in late November 2008. Topics will include legal issues regarding jurisdiction on or within federally created enclaves. This includes waters below mean high water, commercial and recreational fishing, boating, shipping, archeological resources, permits, cleaning up polluted/contaminated marine and coastal areas and restoring injured resources and lost services.

## **A “Clearinghouse” for the NY/NJ Bight Seamless Network**

In order for the NY/NJ Bight to function as a true seamless network it may be necessary to have one partner serve as the coordinating body for all seamless network partner activities. This idea fueled the proposed “Multi-Agency National Ocean Center” for the Gateway National Recreation Area at Sandy Hook, NJ.

Sandy Hook, New Jersey, located at the center of the NY/NJ Bight area, currently supports operations of the National Park Service, NOAA-National Marine Fisheries Service, US Coast Guard, Rutgers University Institute of Marine and Coastal Sciences, NJ Marine Science Consortium, Brookdale Community College, the Marine Academy of Technology and Environmental Sciences, and the American Littoral Society. It represents an ideal location to initiate a multi-agency, multi-institution center to focus on research, monitoring and education related to the conservation and management of marine/coastal natural resources and the region’s maritime heritage. This effort will be lead by the NPS. It is expected that a steering committee and feasibility proposal will be prepared by June 2009.



# APPENDIX

## I. NOS Agreement Code: MOA-2006-036/7196

See: [www.sanctuaries.noaa.gov/management/ocean\\_action/pdfs/general\\_agreement.pdf](http://www.sanctuaries.noaa.gov/management/ocean_action/pdfs/general_agreement.pdf)

## II. Conserving Ocean and Marine Resources: Northeast Region Ocean Park Strategic Plan

See: [www.nps.gov/nero/oceans/NER\\_ocean\\_strategy\\_June2007.pdf](http://www.nps.gov/nero/oceans/NER_ocean_strategy_June2007.pdf)

## III. Agenda

**Tuesday – May 13th, 2008**

### 9:00 a.m. Welcome and Conference Overview and Objectives

- Michael De Luca, Sr. Associate Director – Institute of Marine and Coastal Sciences at Rutgers University
- Barry Sullivan, Superintendent – Gateway National Recreation Area
- Kim Tripp, Director/Research Coordinator – Jamaica Bay Institute, Gateway National Recreation Area

### 9:30 a.m. Opening Plenary: A Vision for a Seamless Network of Protected Areas

- Cliff McCreedy, Marine Resource Program Leader, National Park Service (WASO), Ocean and Coastal Resources Branch, Water Resources Division

### 10:00 a.m. Key Aspects of a NY/ NJ Bight Seamless Network: A Panel Discussion

- *Norb Psuty, Rutgers Institute of Marine and Coastal Sciences – Moderator*

#### **Seamless Network Panel:**

- Barry Sullivan – National Park Service
- Deborah Long – Refuge Manager, Long Island NWR
- Erica Seiden – NOAA
- Betsy Blair – Hudson River NERR/NYDEC
- Robert Cartica – NJDEP Division of Parks and Forestry

### 11:00 a.m. Break

**11:15 a.m. Real World Models of Protected Area Networks**

- Paul Siri – California State Coastal Conservancy
- Jeff Fullmer – The Long Island South Shore Estuary Reserve
- Lauren Wenzel – National Marine Protected Areas Center, NOAA

**12:30 p.m. Lunch**

**1:30 p.m. Results of Pre-workshop Survey**

- Scott Haag, JC NERR

**Charge to the Breakout Committees**

- Lisa Auermuller, JC NERR

**2:00 p.m. Commence Breakout Sessions**

**3:15 p.m. Break**

**3:30 p.m. Resume Breakouts**

**5:00 p.m. Reconvene as a Full Group**

- Report – out on progress made during discussions

**5:30 p.m. Conclude Day 1**

**6:00 p.m. Conference Reception**

**Wednesday – May 14th, 2008**

**9:00 a.m. Synthesis of Day 1 – Norb Psuty, Rutgers Institute of Marine and Coastal Sciences**

- Report – out on progress made including highlights from breakout groups

**9:30 a.m. Reconvene Breakout Groups**

**12:00 p.m. Lunch/Gallery Walk**

**1:30 p.m. Breakout Groups Report Out**

- Future Actions
- Timelines for Progress
- Responsible Parties
- Measures of Successful Implementation

**2:30 p.m. Closing Plenary – Seamless Network Panel**

- *Michael De Luca, Institute of Marine and Coastal Sciences at Rutgers University – Moderator*

**3:00 p.m. Adjourn**

## Appendix IV: NY/NJ Bight Seamless Network Participant List

The following is a list of workshop participants, their titles and their associated affiliations:

| Last Name   | First Name   | Title  | Organization   |
|-------------|--------------|--|--|
| Adamo       | Doug         | Chief of Natural Resources   | Gateway National Recreation Area                             |
| Aermuller   | Lisa         | Watershed Coordinator  | Jacques Cousteau National Estuarine Research Reserve         |
| Bilecki     | Mike         | Chief, of Natural Resource Management                                | National Park Service - Fire Island National Seashore        |
| Blair       | Betsy        | Manager  | Hudson River National Estuarine Research Reserve             |
| Braudis     | Brian        | Refuge manager   | Edwin B. Forsythe National Wildlife Refuge                   |
| Cartica     | Robert       | Administrator, Natural Lands Management                              | NJ Division of Parks and Forestry                            |
| Chase       | Alison       | Natural Resources Defense Council                                    | Harbor Bight Policy Fellow                                   |
| Correll     | Philip       | Trail Manager  | National Park Service  |
| De Luca     | Michael      | Associate Director   | Rutgers, Institute of Marine and Coastal Sciences            |
| DiGiovanni  | Rob          | Director   | The Riverhead Foundation of Marine and Research Preservation |
| Dillingham  | Tim          | Director   | American Littoral Society                                    |
| Feurt       | Ward         | Refuge manager   | USFWS  |
| Fullmer     | Jeff         | Director   | South Shore Estuary Reserve                                  |
| Freudenberg | Robert       | Associate Planner  | Regional Plan Association                                    |
| Gazzale     | Madeline     | Communications Coordinator   | Rutgers, Institute of Marine and Coastal Sciences            |
| Gouveia     | David        | Marine Mammal Coordinator  | NOAA NE Region   |
| Haag        | Scott        | Field Researcher/GIS Coordinator                                     | Jacques Cousteau National Estuarine Research Reserve         |
| Haake       | Kathy        | Project Manager  | Trust for Public Land  |
| Halavik     | Tom          | Senior Fish and Wildlife Biologist - Southern New England - NY Bight | Southern New England Coastal Program                         |
| Hales       | Stan         | Director   | Barnegat Bay National Estuary Program                        |
| Hamilton    | Layne L.     | Refuge manager   | Florida Panther and Ten Thousand Islands NWR                 |
| Harrison    | Adrienne     |  | NOAA - Coastal Services Center                               |
| Jage        | Chris        | Assistant Director, South Jersey                                     | NJ Conservation Foundation                                   |
| Judge       | Mary         | Program Assistant  | Barnegat Bay National Estuary Program                        |
| Kirk-Pflugh | Kerry        | Chief  | New Jersey State DEP   |
| Kreisberg   | Robin        | Executive Director   | Friends of the Bay   |
| Lepore      | Robin        | Boston Support Office  | N.E. Region - National Park Service                          |
| Long        | Deborah      | Refuge manager   | Long Island NWR  |
| Lytton      | Gary         | Manager  | Rookery Bay  |
| MacDonald   | Tony         | Director   | Monmouth University/Urban Coast Institute.                   |
| McCreedy    | Cliff        | Marine Resource Program Leader                                       | National Park Service  |
| Migliori    | Michael      | Program Specialist   | NOAA-NERRS   |
| Pendery     | Steven       | Archeologist   | NPS Northeast Regional Office                                |
| Popolizio   | Carlo        | USFWS biologist  | USFWS  |
| Psuty       | Norb         | Professor  | Rutgers, Institute of Marine and Coastal Sciences            |
| Rafferty    | Patti        | Coastal Ecologist  | NY- NPS  |
| Reding      | Melanie      | Education Coordinator  | Jacques Cousteau National Estuarine Research Reserve         |
| Reilly      | Patti        | Education and Outreach   | NPS Northeast Regional Office                                |
| Roman       | Charles      |  | National Park Service  |
| Seiden      | Erica        | Program Manager  | NOAA, Estuarine Reserves Division                            |
| Shenot      | Jeff         | Strategic Planning and Policy Coordinator                            | NOAA - Fisheries Office of Habitat Conservation              |
| Silveria    | Tanya Mendes | Visiting Scholar   | Rutgers, Institute of Marine and Coastal Sciences            |
| Siri        | Paul         | Guest Speaker  | CA Coastal Conservancy                                       |
| Stilwell    | David        | Project Leader, NY Field Office                                      | US Fish and Wildlife Service                                 |
| Sullivan    | Barry        | General Superintendent   | National Park Service  |
| Tanacredi   | John         | Department of Earth and Marine Sciences                              | Dowling College  |
| Ticco       | Paul         | Northeast Regional Coordinator                                       | Sanctuary Program  |
| Tripp       | Kim          | Jamaica Bay Institute Director                                       | National Park Service  |
| Wells       | Richard      | Acting Superintendent  | National Parks Service                                       |
| Wenzel      | Lauren       | Designated Federal Official  | NOAA-National Marine Protected Areas Center                  |
| Woiwode     | Nathan       | Policy Advisor   | The Nature Conservancy                                       |
| Zeppie      | Christopher  | Director   | Environmental Policy and Compliance                          |

## Appendix V - Breakout Matrices

### Breakout Session: Research and Monitoring

| Project Idea<br><i>Demonstrate the ability to work innovatively &amp; collaboratively to develop benthic habitat maps for a broad user community</i>   | Existing data/Who has it   | Internal Resources  | External Resources Needed  | Next Steps Towards Implementing   | Responsible Parties (including "Champion")  | Timeline for Each Step  | Measurement of Success |
|--|--|---|--|---|---|---|------------------------|
| <ul style="list-style-type: none"> <li>Core samples/NOAA/ when – unknown, depth – unknown</li> <li>Habitat Map (Great South Bay pilot study/NPS GIS NER Coordination)/&lt;1m depth</li> <li>Cultural Resource Inventory from Cape Hatteras to Bay of Fundy/BLM NOAA MPA Inventory/1979 out to 3 miles</li> <li>Side Scan Sonar estuarine Environment – GSB Peconic Bay, Hudson River/Stony Brook SOMAS Rutgers</li> <li>Deep water &gt;2m</li> <li>Topography east coast shorelines/USGS CMGMP</li> <li>OPA shore sediment data – core &amp; grab samples/NJ Bureau of Geology/1m 1990 out to 3 m</li> <li>SAV-NY &amp; NJ/NYS DEC DOS Coastal, Cornell, NJDEP, NOAA, Seacap, Suffolk Co./1999/2000</li> <li>GIS plotted NAV history of Jamaica Bay &amp; Rockaway 1899 &amp; 1999/NERR,NPS GATE BNL/1999/2000</li> <li>Submerged Soils map of Jamaica Bay &amp; GATEWAY/USDA NPS/GATE/2005</li> <li>CODAR surface currents LI, NJ, NY, BIGHT</li> <li>Rutgers for 3-4 years</li> <li>LIDAR throughout coastal NY/NJ/State DEP, NPS, USACE, Columbia University/1998 to present</li> <li>Shellfish surveys throughout SSER/SSER TNC LI Towns/10 yrs</li> <li>Currents tidal temp. Climatic/NOAA, Fisheries/NMFP/time? Extent?</li> <li>Bathymetric mapping, soil type biolog diversity inventory/NERR each reserve/from inception update every 5 yrs</li> <li>Archeological Survey/FIS Beach nourishment/FIS NPS/1990's out to around 1 mile</li> <li>USFWS Coastal Programs habitat mapping for Peconic NEP LI Sound NEP SSER/USFWS/COOS/NY Bight watershed study &amp; NWI wetland maps</li> <li>NOAA Integrated Ocean &amp; Coastal Mapping Initiative (Roger Parsons)</li> </ul> | <ul style="list-style-type: none"> <li>NOAA – staff, boats, side scan sonar technology</li> <li>NPS boats, GIS, Scientist, University partners, NY BIGHT (Rutgers, Stony Brook, CUNY) -</li> <li>Rutgers undersea research capability</li> <li>NY/NJ Sea Grant People \$\$\$</li> <li>National and NY State Estuary Programs – People/staff/equipment</li> <li>Suffolk County Marine Program People/staff/equipment</li> <li>Suffolk Co. Health Dept. water quality &amp; benthic data – people/staff/equipment</li> <li>Dowling-boats, staff, students, airplanes, data analysis (trends-biostatistics)</li> <li>Riverhead Foundation Marine Mammal expertise</li> <li>Use CESU Network also</li> <li>NERRS habitat maps</li> <li>Monmouth University Side Scan Sonar project in Manasquan, Navesink \$\$\$ etc.</li> <li>NJDEP Bureau of shellfisheries</li> <li>USFWS 1963 Shellfish maps (NJ)</li> <li>CMECS Coastal &amp; marine ecological classification system for creating standard maps (Adrienne Harrison)</li> <li>Digital coast portal/inventory of existing data NOAA Coastal Services Center</li> </ul> | <ul style="list-style-type: none"> <li>Need to engage NYDEC, Local government (counties /towns)</li> <li>State historic preservation offices</li> <li>NYC Parks &amp; Recreation, NGOs (ie Audubon, Littoral Society) USACE, NY/ NJ Port Authority</li> <li>Other customers (ie Homeland Security, alternative energy groups) State coastal zone management programs, EPA</li> <li>Focus on habitat conservation priorities &amp; restoration</li> <li>MARCOOS collaboration (Josh Kohut)</li> <li>Relate to TNC Eco - regional planning</li> </ul> | <ul style="list-style-type: none"> <li>Establish a Project Steering Committee</li> <li>Define elements/parameters/scope of work for benthic maps</li> <li>Conduct GAP Analysis</li> <li>GAP analysis to identify where habitat protection is needed but is not getting accomplished</li> <li>Coordinate &amp; select technical services</li> <li>Field reconnaissance/site selection</li> <li>Create website for information transfer/networking</li> <li>Communicate Outreach Plan</li> <li>Common monitoring variables</li> <li>SET's to obtain trends for shallow water/sediment change?</li> <li>Need Seamless Network Mid Atlantic (Resource) Map</li> <li>Correlate land use</li> <li>Change with habitat</li> <li>Community Change</li> </ul> | <ul style="list-style-type: none"> <li>Jacques Cousteau NERR will organize initial steering committee meeting</li> <li>Monmouth University (Jim Nickels)</li> </ul> | <ul style="list-style-type: none"> <li>Establish a steering committee by August 2008</li> </ul> | <ul style="list-style-type: none"> <li>Create map products that benefit a number of agencies &amp; user groups</li> <li>Develop well defined partnerships that spawn future collaboration</li> <li>Attract new partners &amp; collaboration (Measured by developing a matrix of contributors)</li> <li>Formulate a plan to update maps periodically as part of long-term resource monitoring</li> <li>Transferability/ accessibility of data/product</li> <li>Leverage resources to complete benthic mapping in other areas of NY/NJ Bight</li> </ul> |                        |

## Appendix V - Breakout Matrices

### Breakout Session: Stewardship and Natural Resource Management

| Project Idea   | Actions  | Internal Resources  | External Resources Needed   | Next Steps Towards Implementing  | Responsible Parties (including "Champion")   | Timeline for Each Step   | Measurement of Success   |
|--|--|---|---|--|--|--|--|
| <b>Fire Island Bay Shoreline Restoration Project</b> | <ul style="list-style-type: none"> <li>Development of a Demonstration project of Bayside sediment processes</li> <li>Developed from NPS/TNC Bay Shoreline Erosion Symposium in 2007 – ready for next step</li> </ul> | <ul style="list-style-type: none"> <li>NPS has 250K for project + 65K from Department of Environmental Conservation</li> </ul>  | <ul style="list-style-type: none"> <li>DOS, DEC, Town of Brookhaven for permits and assistance in project design to meet permit needs</li> </ul>  | <ul style="list-style-type: none"> <li>Project Design</li> <li>Permitting</li> <li>Working with partners</li> <li>Pilot project for DEC's regulating process</li> <li>Pilot project for the Seamless Network (illustrate approach how to target areas for restoration)</li> <li>Determine "What" you are restoring to</li> </ul> | <ul style="list-style-type: none"> <li>NPS – Mike Bilecki</li> </ul>   | <ul style="list-style-type: none"> <li>Depending on funding outcome, project design by 2009</li> </ul>                     | <ul style="list-style-type: none"> <li>Project implemented</li> <li>Measured Benefits</li> </ul> |
| <b>Inventory of Protected Areas</b>                  | <ul style="list-style-type: none"> <li>Add local governments and NGO's</li> <li>Add terrestrial Component</li> <li>Determine compatible formats for data</li> </ul>  | <ul style="list-style-type: none"> <li>MPA Center – has base map with marine areas only</li> <li>Areas with regulatory protection, but no ownership (e.g. Planning Commission – Pinelands)</li> <li>TNC eco regional plans and conservation targets</li> <li>NJ has GIS data</li> </ul> | <ul style="list-style-type: none"> <li>Local Governments, NGO's, tribal and State data</li> <li>More NY involvement</li> <li>Regional Plan Association Maps (Terrestrial component)</li> <li>LI South Shore Estuaries and Reserves</li> <li>Needs to include contact info for management agency</li> <li>NJ landscape map (NJ DEP)</li> <li>Coastal Barrier Resource Maps (US Fish and Wildlife Service)</li> </ul> | <ul style="list-style-type: none"> <li>JC NERR will take on inventory of all GIS resources in Region</li> <li>JC NERR, RPA and NOAA will combine data on online resource</li> </ul>  | <ul style="list-style-type: none"> <li>Leads: <ul style="list-style-type: none"> <li>MPA Center,</li> <li>JC NERR</li> <li>NJ DEP</li> <li>NY-Parks, DEC, DOS, NYC DEP, RPA</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>Complete inventory within 1 year</li> <li>Data gathering within 8 months</li> </ul> | <ul style="list-style-type: none"> <li>Completed Inventory online</li> </ul>                     |
| <b>Gap Analysis</b>                                  | <ul style="list-style-type: none"> <li>Quick and Informal (do more rigorous one later) to guide land acquisition and marine protection (scoping)</li> </ul>  | <ul style="list-style-type: none"> <li>USFWS – Coastal Program reports to the NEP's</li> <li>NOAA Envior Sensitivity Maps (NOAA ORR Ed Levine)</li> <li>Aditol SAV working Group (Tom – USFWS)</li> <li>MPA center science workshops NERR</li> </ul>                                    | <ul style="list-style-type: none"> <li>Floodplain maps FEMA is remapping NY Minerals Management Service Lease Areas</li> <li>Long Island GIS working group (NY DEC)</li> <li>State utility rights of way</li> <li>DeFaeto MPA analysis (MPA Center)</li> <li>Acquisition Plans Land</li> <li>USFWS</li> </ul>   | <ul style="list-style-type: none"> <li>Conduct survey to identify all partner's management/resource priorities and obstacles</li> </ul>  |  |  |  |

**Appendix V - Breakout Matrices**

**Breakout Session: Stewardship and Natural Resource Management**

| Project Idea   | Actions   | Internal Resources  | External Resources Needed  | Next Steps Towards Implementing   | Responsible Parties (including "Champion")   | Timeline for Each Step | Measurement of Success  |
|--|---|---|--|---|--|------------------------|---|
| <p><i>Mini-seamless network focus area expansion of park into research partnership</i></p> | <ul style="list-style-type: none"> <li>• PILOT: Eastern Great South Bay Multi-Partner Focus Area to protect Marine Habitat</li> <li>• ID partners</li> <li>• ID resources</li> <li>• what are trends</li> <li>• ID needs</li> </ul> | <ul style="list-style-type: none"> <li>• Fire Island MPA study (Charlie Roman)</li> </ul>             | <ul style="list-style-type: none"> <li>• CELCP TNC Northwest Atlantic EIO regional assessment inventory &amp; gap info (Adrienne Harrison)</li> </ul>  | <ul style="list-style-type: none"> <li>• Determine research needs in order to determine closed activities</li> </ul>      |  |                        | <ul style="list-style-type: none"> <li>• New Management tools, regulations of offshore areas</li> </ul>   |
| <p><i>Manage Landscapes &amp; Communities to be responsive to environmental change</i></p> |   |   | <ul style="list-style-type: none"> <li>• Land Management agencies and Regulatory agencies</li> </ul>   |   |  |                        |   |
| <p><i>Non Point Source Impervious Surfaces</i></p>   | <ul style="list-style-type: none"> <li>• Strategic Matrix/ Survey</li> </ul>  | <ul style="list-style-type: none"> <li>• Existing projects strategic plan priorities needs</li> </ul> | <ul style="list-style-type: none"> <li>• Regulatory agencies need to obtain permits</li> <li>• NMFS, CORPS, EPA, NJ, NY need to build consensus as how to address cumulative impacts</li> </ul>  |   |  |                        | <ul style="list-style-type: none"> <li>• Understand partners and their priorities Start to mesh priorities</li> <li>• Political and financial support for restoration and land acquisition</li> </ul> |
| <p><i>Focus areas affected by climate change</i></p>                                       | <ul style="list-style-type: none"> <li>• USFS model combined with other sources will lead to next step</li> </ul>   |   | <ul style="list-style-type: none"> <li>• Hudson River : Some local gov'ts using LIDAR Nat. Audubon aerial photography</li> <li>• TNC has grant for South Shore of LI</li> <li>• Army Corps, USGS, NASA, gathering LIDAR data coast-wide</li> <li>• NY DEC</li> </ul> | <ul style="list-style-type: none"> <li>• Contract Corp/NASA etc. to relate interest in using this data for SLR</li> </ul> | <ul style="list-style-type: none"> <li>• Doug A. Invite the Corps, New York District via Environmental Analysis Branch</li> <li>• Hudson River NERR – Follow up meeting on coastal inundation (post June)</li> </ul> |                        | <ul style="list-style-type: none"> <li>• Climate change focus area identified</li> </ul>  |

## Appendix V - Breakout Matrices

### Breakout Session: Education and Outreach

#### “Conservation as Protection/Mitigation”

| Project Idea   | Message  | Internal Resources  | External Resources Needed  | Next Steps Towards Implementing   | Responsible Parties (including “Champion”)   | Timeline for Each Step - Overall: 18-24 Months  | Measurement of Success  |
|--|--|---|--|---|--|---|---|
| <p><b>Reaching the general public through interpretive materials</b></p> | <ul style="list-style-type: none"> <li>• “Wetlands are important to protect natural and human communities”</li> </ul>          | <ul style="list-style-type: none"> <li>• Coastal Heritage Trail</li> <li>• Interpretive Centers</li> <li>• Podcasts</li> <li>• Inundation Model Maps</li> <li>• CRSSA</li> <li>• Websites</li> <li>• BBNEP Grants and other matching grants</li> <li>• USFWS - NJFO Carlo Popolizio— Graphics Specialist</li> </ul>   | <ul style="list-style-type: none"> <li>• Funding</li> <li>• Scientific Basis for the Message</li> <li>• Economic Values of wetlands</li> <li>• NPS Conservation Institute Study</li> <li>• Recreational Values</li> <li>• Development of Action Options</li> </ul>   | <ul style="list-style-type: none"> <li>• Consistent, Concise Message Development</li> <li>• Branding the Message</li> <li>• Visualization Tools – Mapping, Flash Piece</li> <li>• Focus Group testing of attitudes, pilot messages</li> <li>• Create Communication Structure for the Group</li> <li>• Develop Evaluation Tool</li> <li>• Involve tourism in promotion &amp; education</li> </ul>  | <ul style="list-style-type: none"> <li>• Rutgers/JCNERR (lead)</li> <li>• Patti Reilly, NPS</li> <li>• Urban Coastal Institute</li> <li>• NJDEP (K. Plugh - Consultant)</li> </ul>   | <ul style="list-style-type: none"> <li>• Monthly communication (To start within the month of June)</li> </ul> | <ul style="list-style-type: none"> <li>• Ongoing partnerships developed</li> <li>• NY/NJ Bight Seamless network public perception survey on awareness of selected messages</li> <li>• Favorable land use decision/acquisition</li> <li>• Support for Habitat restoration political &amp; financial</li> </ul> |
| <p><b>Reaching the local elected officials</b></p>                       | <ul style="list-style-type: none"> <li>• Risk-wise decision-making and economic benefits/incentives to conservation</li> </ul> | <ul style="list-style-type: none"> <li>• JCNERR Coastal Training Program</li> <li>• Urban Coast Institute ‘resilient’ communities</li> <li>• CRSSA’s Inundation Mapping</li> <li>• TPL Publication</li> <li>• “Economic Benefits (...) and Public Finance document”</li> <li>• US Fish and Wildlife Economic Benefits of Refuges</li> <li>• TPL (2020 Study – Map of Towns Resources)</li> <li>• NOAA-CSC Habitat Priority Planner Tool</li> <li>• CELP (Coastal Estuarine Land Protection)</li> <li>• NJDEP “Economic Value of (...)”</li> </ul> | <ul style="list-style-type: none"> <li>• Same as Interpretive Message, plus...</li> <li>• Social Science Consultant</li> <li>• Trade off tool calculator for local governments</li> <li>• Alternative Scenario Mapping</li> <li>• League of Municipalities Collaboration</li> <li>• Buy-in from “Keep it Green” campaign</li> <li>• Link to State Programs Local Planning Agencies</li> <li>• EPA Training/Evaluation of Local Master Plans</li> </ul> | <ul style="list-style-type: none"> <li>• Same as Interpretive Message, plus...</li> <li>• Research Fellowship Options – Coastal Fellowships</li> <li>• Needs Assessment of Opportunities to Communicate (convenience)</li> <li>• ID Funding Resources</li> <li>• Engage Foundation Community</li> <li>• Identify Local Champions and Provide Training</li> <li>• Invite staff of elected officials to participate in conservation projects</li> <li>• Develop projects that engage/get feet wet for hands on experience</li> <li>• Identify funding issues and timing of opportunities</li> </ul> | <ul style="list-style-type: none"> <li>• JCNERR</li> <li>• CSC</li> <li>• Urban Coastal Institute</li> <li>• TPL (K. Haake)</li> <li>• State (NYS/DEL/NJ DEP) naturalists</li> </ul> |   |   |

## **VI. Acronym List**

|         |   |  |
|---------|---|--|
| COCMP   | – | Coastal Ocean Currents Monitoring Program            |
| CTP     | – | Coastal Training Program                             |
| DEP     | – | Department of Environmental Protection               |
| ERD     | – | Estuarine Reserves Division                          |
| FWS     | – | Fish and Wildlife Service                            |
| GIS     | – | Geographic Information Systems                       |
| GRF     | – | Graduate Research Fellowship Program                 |
| IMCS    | – | Institute of Marine and Coastal Sciences             |
| IOOS    | – | Integrated Ocean Observing System                    |
| JC NERR | – | Jacques Cousteau National Estuarine Research Reserve |
| KEEP    | – | K-12 Estuary Education Program                       |
| LISSEER | – | Long Island Sound South Shore Estuary Reserve        |
| MOA     | – | Memorandum of Agreement                              |
| MPA     | – | National Marine Protected Areas                      |
| NERRS   | – | National Estuarine Research Reserve System           |
| NJ      | – | New Jersey   |
| NMS     | – | National Marine Sanctuary Program                    |
| NOAA    | – | National Oceanic and Atmospheric Administration      |
| NPS     | – | National Park Service                                |
| NWR     | – | National Wildlife Refuge                             |
| NY      | – | New York   |
| OSA     | – | Ocean Science Applications                           |
| RPA     | – | Regional Planning Association                        |
| RS      | – | Remote Sensing                                       |
| SETs    | – | Sediment Elevation Tables                            |
| SWMP    | – | System-wide Monitoring Program                       |
| TPL     | – | Trust for Public Lands                               |
| USFWS   | – | U. S. Fish & Wildlife Service                        |
| USGS    | – | U. S. Geological Survey                              |





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# **Appendix H**

## **JC NERR Advisory Committee Charter**

## **Jacques Cousteau National Estuarine Research Reserve**

### **Advisory Committee Charter**

Recognized as stewards of coastal resources, the Jacques Cousteau National Estuarine Research Reserve Advisory Committee is comprised of senior level managers from federal, state and local partners. The committee will meet twice annually to help develop opportunities for collaboration among Reserve partners, define key areas for future investment, and to provide advice on programs, products and services.

Committee members are specifically charged with helping to advance the Reserve mission of science-based management through partnerships, leveraging resources, and providing guidance on emerging trends for protected area networks. JC NERR staff will communicate regularly with committee members, especially to exchange information on results of reserve programs. Reserve staff may establish informal ad hoc committees to help guide their respective efforts as necessary.

The Advisory Committee will also provide advice and guidance on the Management Plan for the JC NERR which is revised every five years.

# **Appendix I**

## **JC NERR Sector Accomplishments**

## **JC NERR Sector Accomplishments**

### **A. Research and Monitoring**

The JC NERR Research Program concentrated efforts on characterizing the environmental conditions and ecological processes within the MRGB watershed. Most notable was the conduct of a detailed assessment of eutrophic conditions of coastal bay waters in the JC NERR. The research and monitoring group is playing a significant role in understanding nutrient loading problems in New Jersey's estuaries and the remediation necessary to restore ecosystem health.

#### **1. System-wide Monitoring Program (SWMP)**

The JC NERR currently has five SWMP monitoring stations: four water-quality-monitoring datalogger stations (Lower Bank and Chestnut Neck in the Mullica River and Buoy 126 and Buoy 139 in Great Bay) and one weather-monitoring station located at the Richard Stockton College Marine Field Station at Nacote Creek. These stations monitor a suite of environmental parameters (temperature, conductivity, salinity, DO concentration, DO percent saturation, depth, pH, and turbidity for the water-monitoring stations, and temperature, humidity, atmospheric pressure, wind speed and direction, solar radiation, and precipitation at the weather-monitoring station) at fifteen minute intervals. Two of the water-monitoring stations (Chestnut Neck and Buoy 126) and the weather-monitoring station at Nacote Creek have been equipped with telemetry equipment that broadcasts data to a geostationary satellite server (GOES), which in turn interfaces with the NERRS CDMO (Central Data Management Office), which then posts these data to the World Wide Web.

JC NERR also monitors water nutrient levels at each of the four water-monitoring stations on a monthly basis. Water samples are collected over a 24-hour period via automated ISCO sampler and by traditional grab collection methods, processed and preserved, and then analyzed at Rutgers University. Finally, nearshore water-monitoring data from the LEO-15 station outside the Little Egg Inlet are available through Rutgers University.

#### **Benthic Research**

Benthic habitat characterization of estuarine environments in the JC NERR has been conducted since 2003. Benthic habitats were extensively sampled in the BB-LEH Estuary. This sampling involved collecting submerged aquatic vegetation (SAV), as part of a biomonitoring program, and sediment cores, utilizing quadrats, deploying sediment profile imaging camera systems, and using underwater videography. Several hundred benthic cores were taken in seagrass habitats to assess SAV aboveground and belowground biomass in the system. Habitats were investigated to establish long-term databases.

Benthic habitat quality in the estuary was investigated employing a sediment profile imaging camera to collect samples in summer 2006. This instrument was used to assess

the condition of bottom habitats, analyzing degradation caused by hypoxia and other stressors. The long-term goal is to generate benthic habitat quality indices for different areas of the estuary for making comparisons over time. Benthic grab sampling using a Young-modified Van Veen Grab has been conducted in JC NERR waters and is also scheduled for future benthic community characterization work.

### **Sediments Distribution and Composition**

Sediments have been collected and analyzed at numerous sampling sites in Great Bay and the BB-LEH Estuary as part of a larger effort to assess and characterize benthic environments in the JC NERR. Sediment size and percent organic matter are being collected throughout the Reserve system to determine if and how sediments influence biotic communities. Grab samplers and corers are being used to collect sediment samples in SAV beds, algal flats, and unvegetated bay bottom areas.

### **Zooplankton**

Five field sites have been established for biofouling monitoring to examine meroplankton, larval settlement, and epibenthic community structure. This work provides important data on zooplankton dynamics in JC NERR waters.

### **Submerged Aquatic Vegetation**

The JC NERR research and monitoring group completed a three year (2004-2006) SAV study in the BB-LEH Estuary, which characterized the abundance and distribution of seagrass beds in the system. This study, which included estuarine waters of the JC NERR, is the most comprehensive work ever conducted on seagrass habitat in New Jersey. This study generated a large database on the demographic characteristics and habitat change of seagrass in estuarine waters of the JC NERR. It also yielded valuable information on the effects of nitrogen enrichment on the species composition, frequency of occurrence, and potential impacts of benthic macroalgae on the eelgrass beds in bay waters. The results can be found in a report submitted to ERD in January 2007.

### **Establishing Critical Habitat Requirements of Living Aquatic Resources**

Studies are ongoing to determine habitat requirements of shellfish species (*Mercenaria mercenaria* and *Argopecten irradians*) under increasingly eutrophic conditions of the BB-LEH Estuary. Research is also ongoing to determine habitat requirements of biofouling populations in the JC NERR. In addition, investigations are ongoing with respect to assessing the environmental conditions necessary for the long-term success of seagrass populations in estuarine waters of the JC NERR, determining the impacts of nuisance and toxic algal blooms on seagrass beds and other critical habitat, and recommending to coastal Managers the necessary measures for remediation of damaged environments.

### **Nutrients and Non-Point Source Pollution**

Detailed research is being conducted on the eutrophication of the coastal bays in New Jersey. Nitrogen loading and its impact on SAV, algae, and fishery resources (e.g., shellfish populations) have been documented. Eutrophication is the most serious threat to the ecosystems of the coastal bays. Nutrient data have been collected extensively in the

BB-LEH Estuary since 2004 as part of benthic habitat characterization studies. Nitrogen levels in seagrass blades are being determined to establish a nitrogen loading index for the BB-LEH Estuary.

### **Fisheries**

Comprehensive studies are being conducted at the RMFS to determine the habitat requirements of resource species such as summer flounder, striped bass, and bluefish. Acoustic tracking of these species is playing an important role in documenting their habitat requirements.

The occurrence of bay scallops (*Argopecten irradians*) and other shellfish species has been investigated in JC NERR estuarine waters using underwater videographic imaging. This is a new technology not applied at other NERRS sites.

Finfish research has focused on acoustic tracking of recreational and commercial species, such as summer flounder (*Paralichthys dentatus*) and striped bass (*Morone saxatilis*). Research on the dynamics of other finfish species in the Great Bay and contiguous waters is ongoing. These studies have revealed detailed behavioral patterns of key finfish species in JC NERR waters.

### **Sustaining Resources Within Estuarine Ecosystems**

Databases are being compiled on the habitat requirements of seagrasses, shellfish, and recreationally and commercially important finfish populations. These databases will be used in future years to develop management strategies that will help sustain the resource species.

## **B. Stewardship**

### **1. Remote Sensing and Geographic Information Systems (GIS)**

As the primary source of GIS coordination for the Reserve, CRSSA has created and now maintains a web site to highlight produced maps, interactive mapping capabilities, and the JC NERR Coastal Resource Repository (CRR). CRSSA is also involved with several research projects within the JC NERR boundaries including: buildout analysis of the Mullica River Watershed, buildout analysis of the Barnegat Bay Watershed, land cover of New Jersey in 2000 using spot / landsat satellite data, mapping of submerged aquatic vegetation in BB-LEH, and mapping brown tide in the BB-LEH Estuary.

### **2. Buildout Analysis of the Mullica River Watershed and Barnegat Bay**

The Mullica River Watershed is located in the Pinelands ecosystem which currently contains a high percentage of unaltered land. However, due to its close proximity to the Atlantic City, Philadelphia, and New York City metropolitan areas there is great potential for future development. The Mullica River buildout analysis was conducted to determine the potential impact of past and future development on water resources. This project has three parts: 1) identifying past land use; 2) determining the potential of future

development; and 3) using indicators to assess the impacts of the past and potential future development on water demand and urban non point source pollution. While there is currently little development in the watershed, the buildout analysis indicates that a substantial portion of the land is available for future development. However, if growth is limited to the designated Pinelands' growth areas, the impacts to water resources will be minimized.

In the Barnegat Bay study the amount of development possible at build-out was quantified with the following variables: 1) number of dwelling units; 2) population; and 3) percent of impervious surface cover. The number of dwelling units and population are indicators of residential water demand, while impervious surface is an indicator of non point source pollution. Actions needed to protect the resources in the Barnegat Bay can be better identified by understanding the potential changes of these indicators.

### **3. Coastal Resource Repository**

Geographic Information Systems aid in the collection and analysis of spatial datasets. The main advantage of using GIS is the ability to integrate, query and synthesize geographic digital data. GIS has a wide range of potential applications in coastal resource management and land use planning. The CRR contains a comprehensive GIS databank incorporating data from a variety of sources (e.g. federal, state, local entities) that can be used by coastal decision makers to identify trends in spatial patterns. GIS can be used to foster science-based management decisions that involve the principles of best management practices. Data layers incorporated within the CRR include: State, Municipal, Federal and Watershed , U.S. Geological Survey Digital Topographic Maps, Streams, Lakes, Rivers, Aerial Photography, Submerged Aquatic, Vegetation , Satellite Imagery , Census , Land Use Land Cover, Elevation , Wetlands Soils , Place Names , Sewer Service Areas , Historical Imagery, And Zoning.

### **4. GIS WebPages**

#### **a. Brown Tide Webpage**

Several of our partners conducted a four-year study of potential contributing factors promoting brown tide blooms, caused by a minute alga, *Aureococcus anophagefferens* (*A. anophagefferens*), in New Jersey's coastal estuaries. The maps and computer animations of the results of this study were developed into an interactive web site, by the JC NERR. The purpose of this website is to distribute the spatial extent of brown tide blooms in as near real time as possible for coastal outreach. Researchers and the public can access and view the information from a remote location. The website graphically displays the spatial patterns of bloom, salinity, and temperature by date. Visit <http://www.crssa.rutgers.edu/projects/btide/> for more details.

#### **b. Submerged Aquatic Vegetation Mapping Webpage**

The Submerged Aquatic Vegetation Mapping Webpage was updated in the summer of 2004 (June and July) using PHP web designed by the GIS Coordinator/Field Researcher

at the JC NERR. CRSSA developed and hosts this website which synthesizes available mapped surveys concerning SAV in the BB-LEH system.

### **C. Coastal Training Program**

Coastal training programs include a variety of training programs, resources and outreach materials for the coastal management community in New Jersey. These efforts have enabled informed decision-making on coastal issues by transferring technical information to audiences that influence management of coastal resources. In 2006, the JC NERR updated its strategic plan for coastal training programs.

Prior to 2003, the JC NERR hosted a variety of coastal decision maker workshops.

#### **1. Small Motorized Watercraft Workshop 2000**

The JC NERR hosted science and management workshops to provide scientific research on the impacts of small motorized watercraft to habitats, living resources, chemistry and water quality. On November 7 and 8, 2000 at the Impacts of Motorized Boats on Shallow Water Systems workshop speakers throughout the country presented research results and management strategies. A second workshop convened on December 12 and 13, 2000 delivered successful management approaches from states, local governments and publicly managed lands.

#### **2. Stormwater Management Roundtables**

Chaired by the JC NERR, the Barnegat Bay Phase II Steering Committee has been conducting stormwater outreach and offering technical assistance for the past three years. These efforts have been concentrated in the Barnegat Bay watershed which consists of 34 municipalities in Ocean County and 4 municipalities in Monmouth County. During this time ten workshops/technical assistance opportunities have been offered to municipal staff, and elected and appointed officials within the watershed.

Evaluation results showed an increased understanding of stormwater management topics enabled municipalities within the Barnegat Bay Watershed to take the necessary steps to ensure compliance with their permits. A full evaluation of the stormwater outreach was conducted in spring 2007. These results can be found online at: [www.JCNERR.org/coastal\\_training](http://www.JCNERR.org/coastal_training).

#### **3. Coastal Hazards Mitigation Outreach**

The JC NERR, in partnership with the New Jersey State Police, Office of Emergency Management Services, Federal Emergency Management Agency (FEMA) and the NJ DEP, offered a CTP workshop on developing hazard mitigation plans for coastal municipalities. In light of hurricane Katrina and other recent coastal disasters this workshop was developed to meet the growing concerns of coastal municipalities regarding impacts of coastal storms.

As a follow-on program, a technical assistance seminar was conducted in the computer classroom at the JC NERR Coastal Center. A FEMA official demonstrated the use of their electronic hazard mitigation toolkit. Participants working in county-specific groups from Ocean, Monmouth and Essex Counties gained hands-on experience with the toolkit

and discussed preparation of mitigation plans. An outcome from these outreach sessions included an agreement between all thirty-four municipalities in Ocean County to work cooperatively on a multi-jurisdictional hazard mitigation plan.

#### **4. Protecting Our Wetlands through Education and Regulations**

The JC NERR offered a “Protecting Our Wetlands through Education and Regulations” (PROJECT POWER) workshop in partnership with the New York Aquarium and the NJ DEP Division of Land Use Regulations and the Coastal and Estuarine Land Use Compliance staff. A grant from the Environmental Protection Agency (EPA) enabled the New York Aquarium to partner with various educational associations throughout the coastal zone to deliver these workshops. A local workshop was delivered to local realtors and past wetland regulation violators. Presentations focused on the ecological and functional importance of wetlands, the NJ DEP freshwater and coastal wetland regulations, and compliance and enforcement issues. These audiences represented a new target group for the Reserve.

#### **5. Adopt-A-Storm Drain Municipal Assistance**

The JC NERR in partnership with the BBNEP implemented an Adopt-A-Storm Drain program in three towns within the watershed in 2007. A flyer was developed to promote the program to all residents. Towns adopting the program received global positioning systems and training on how to mark and map their storm drain inlets, individualized database programs for maintenance of storm drain adoption records and personalized storm drain labels.

#### **6. Online Training Courses**

##### **a. Understanding Land Use Regulations Online Course**

In order to maintain their licenses, local construction code officials are required to receive continuing education through the New Jersey Department of Community Affairs. Based on a needs assessment conducted in August 2006, construction code officials identified land use regulations as a highly desired topic for additional technical training. An online course was offered through the JC NERR, website ([www.JC NERR.org/coastal\\_training](http://www.JC NERR.org/coastal_training)). The five-week course was divided into five modules which included an overview and information pertaining to waterfront development, CAFRA, coastal and freshwater wetlands, stream encroachment and tidelands and map and data miner webquest. Due to the success of this course, four additional sessions have been offered.

##### **b. Flooding Hazards and Floodplain Management Online Course**

Based on the success of the Land Use Regulations Online Course and the results of the 2006 needs assessment, a second online course was developed and offered in March of 2007. This course covered the floodplain regulations and construction standards. In addition to construction code officials, the course was offered to state floodplain managers. **The modules included** an overview and information pertaining to forces of floods on buildings, floodplain mapping, design and construction standards, and administration of a local floodplain program.

## **7. Evaluation of Submerged Aquatic Vegetation (SAV) Habitat in Southern New Jersey Workshop**

The JC NERR, in partnership with the NJ DEP, developed a day-long workshop to provide the most current and relevant scientific data regarding SAV to the NJ DEP Land Use Regulations and Enforcement staff. Hosted at Island Beach State Park, the workshop highlighted the importance of SAV as a habitat, its biology and the major impacts affecting SAV. An update on the current state of knowledge on the restoration of SAV was given. Overviews of GIS products available for mapping SAV from CRSSA were provided. An explanation of a scientific model to predict SAV habitat, techniques on evaluating SAV habitat in the winter were also presented. Participants went on a field trip to SAV habitats in Island Beach State Park.

## **8. CTP Workshops 1999-2007**

### **1999**

- Water Supply Issues and Uncertainties in the Atlantic Coastal Region – April 20 - 21
- Environmental Planning for Coastal Decision Makers – August 31
- Ecological Indicators for Salt Marsh Restoration in the Mid-Atlantic Bight - December 8

### **2000**

- Small Motorized Watercraft Workshops  
Scientific Symposium – November 7 - 8  
Management Workshop – December 12 - 13
- Microbial Communities And Salt Marsh Health – December 8

### **2001**

- Coastal Redevelopment – January 30
- Bioremediation Of Petroleum Contaminated Salt Marshes – May 16

### **2002**

- Planning for the Future of the Cohansey Watershed – May 8 - 9
- Evaluation of Submerged Aquatic Vegetation in Southern, NJ – May 20

### **2003**

- Beach and Dune Management – February 14
- CAFRA Regulations – April 15
- Hydrology of Wetlands – May 5
- Coastal Wetland Vegetation Identification – June 10 - 11
- Stormwater Management - June 11
- Shoreline Stabilization - June 23 - 24

### **2004**

- Stabilization of Difficult Sites – January 26 - 27
- Phase II Municipal Stormwater Regulations Overview - January 29
- Freshwater Wetlands – March 24
- Municipal GIS Applications – March 25 - 26
- Impacts to Coastal Systems Symposium – April 7 - 8
- Coastal Project Review - April 14
- Overview of Municipal Stormwater Permitting Program - June 23
- Low Impact Design Roundtable and Field Trip - October 27

## **2005**

- Writing Your Municipal Stormwater Management Plan Seminar - February 28
- Question and Answer Session with the NJDEP for DPW Personnel - March 8
- Goose Management - March 10
- Freshwater Wetlands - March 16
- Seminar for Municipal Officials: Understanding Land Use Regulations and Enforcement
  - Burlington County College - Mount Laurel Center - April 5
  - Parvin State Park – Vineland - April 7
  - Rutgers University - Institute of Marine and Coastal Sciences - April 12
  - Ocean County Library - Lacey Township - April 19
  - Richard Stockton College - Galloway Township - April 21
- Introduction to GIS - April 19
- Coastal Project Review - April 21
- Onsite Wastewater Disposal Systems - May 4, 11, and 18
- Introduction to Wetlands - May 12
- Success Stories in Stormwater Management - September 29

## **2006**

- Stormwater Mitigation Workshop - February 17
- Understanding Land Use Regulations Online Course – March 20
- Stormwater Technology Conference - March 23
- Understanding Hazard Mitigation Planning - April 18
- Understanding Land Use Regulations Online Course – May 15
- Hazard Mitigation Planning: Technical Assistance Seminar - May 17
- Introduction to Wetlands - May 31
- Introduction to Coastal Erosion - June 7
- Coastal Project Review - June 14
- Freshwater Wetlands Regulations - June 21
- Goose Management - June 28
- Project POWER: Protecting Our Wetlands Through Education and Regulation - October 12
- Understanding Land Use Regulation Online Course – October 16
- Blue Card Stormwater Basin & Soil Health Training - November 1 and 8
- Stormwater Management for Planning, Zoning and Land Use Boards - November 15

## **2007**

- Adopt-A-Storm Drain: Municipal Assistance Program - March 20
- Understanding Land Use Regulations Online Course - April 16
- Cooperative Institute for Coastal and Estuarine Environmental Technology - Stormwater Road Trip to the Wells NERR in Maine - May 17 and 18
- The Effects of Climate Change on Our Local Estuaries - June 9
- The Changing Landscape of the Barnegat Bay Coastal System – June 30
- Adopt-A-Drain Technical Assistance Program – July 17
- Understanding Land Use Regulations Online Course – October 8
- Managing Visitor Use Training – October 15 –17
- LIDAR Use in NJ – October 17

## **D. K-12 Education**

The education program uses current science and technological assets of the JC NERR to develop innovative programs and products that meet the needs of K-12 educators and their students.

### **1. K-12 Education - Marine Activities, Resources & Education (MARE) in New Jersey**

In 1994, Rutgers IMCS adopted an interdisciplinary K-8 marine science curriculum called MARE as a valuable source of information and inspiration for creative, hands-on teaching. This interdisciplinary, whole-school program engages teachers, students, parents, administrators and the community in the transformation of elementary and middle schools into dynamic laboratories for the study of the ocean. The program, created in 1991 by the Lawrence Hall of Science at the University of California - Berkeley, has been successfully implemented in hundreds of inland and coastal schools nationally. MARE is specifically designed to improve science instruction for all students while promoting equity, language acquisition, environmental awareness, and academic excellence.

The MARE program has achieved the following results since its inception in New Jersey in 1994: 1) Approximately 3,650 educators have been directly trained as Leadership Teams through the annual six-day MARE Summer Institute; 2) Approximately 12,000 K-6 educators have received training or became involved in the program through turn-key training opportunities conducted by Summer Institute participants or MARE Master Trainers; 3) Approximately 150 Ocean Week Celebrations have been conducted in elementary schools throughout the state; 4) Dozens of student field trips associated with the MARE program have been supported; and 5) More than 20 pedagogical workshops and collaborative projects including “Bay Grasses for Classes” and the “Tidal Marsh Assessment Protocol” project have been conducted.

#### **a. MARE Summit: Celebrating 10 Years of MARE Success**

The JC NERR in partnership with Rutgers University delivered the MARE program for 10 years. To celebrate this achievement, the JC NERR organized a MARE Summit: A Ten-Year Celebration of Success. This four-day conference featured select MARE educators who developed novel teaching strategies, resources, and/or lesson plans for MARE. The teachers presented their adaptations of MARE, tips for implementation of MARE as a whole school program, and unique and innovative ways of customizing MARE to fit any school setting.

A MARE Best Practices Guide was developed based on the information that MARE teachers shared during the Summit. The Best Practices Guide serves as a resource guide for both new and veteran MARE schools.

#### **b. Tracking the Success of the MARE Program**

The JC NERR has received support from the Geraldine R Dodge Foundation and Research for Better Schools (Mid-Atlantic Eisenhower Consortia – Philadelphia, PA) to conduct MARE program training and evaluate the impact of the program on students and teachers. Evaluation efforts have included pre- and post- Institute surveys, follow-up interviews and focus groups, and most recently, an attempt to determine the impact of the program on the ultimate audience – the students. The strength of the New Jersey MARE program is its ability to improve educator competence and confidence in facilitating learning both in science and across subjects.

- **1999 MARE Evaluation**

The JC NERR staff and WordCraft, Inc. conducted follow-up interviews, focus groups, and a written survey to determine the impact of the MARE program on educators that had attended the Summer Institute during the period of 1997-1999. Results of the evaluation indicated that, as a direct result of MARE, 85% of the teachers polled are now using other non-text book methods for teaching science, 70% responded their students have shown a greater interest in science, and the overwhelming majority indicated MARE Ocean Week is a successful school and community event.

- **2006 MARE Evaluation**

Positive changes have been documented for schools implementing MARE through rigorous evaluation programs with the JC NERR and Word Craft, Inc. Examples of these performance metrics include: shifts to non-text book methods for teaching science, increases in parental involvement, and greater student interest in science as a result of MARE being used in their school. Evaluation results also suggest that MARE enhances teacher competence and confidence in facilitating science learning.

A summary of evaluation results include:

- **Impacts of MARE on student knowledge of marine science concepts using a technique known as concept mapping™.** Test results from 24 classes of 3rd and 5th grade students indicate 1) long-time MARE student users showed significantly more complex thinking about the ocean (for example, tides) than control groups, and 2) the MARE program helped 5th grade students with lower elementary school proficiency assessment science test scores perform as well on the concept maps as 5th grade students with higher elementary school proficiency assessment science scores. Results of the student evaluation indicate that teachers and schools vary greatly in their implementation of MARE, and that this variation had an impact on student concept maps. That raised a question about measuring the program's success: How best to measure the impact of MARE on New Jersey students when the program was different in each school? Implementation was recognized as an issue that had to be assessed to ensure the continued success of MARE.
- **Assessing Successful Implementation of MARE.** The greatest strengths of MARE are strong high student interest (activities and content) and the ability to unite teachers within a school and the school with its community. Future evaluation strategies are being explored to assess performance of the MARE

program. These are: 1) assessing how teachers have adapted curricular materials, and 2) how teachers have incorporated their ideas into new MARE materials. An instructional systems design model will continue to be used to gather and analyze data to develop MARE programs/products that match users' needs. This ensures that program/product development is effective and efficient.

## **2. The Coastal Ocean Observation Laboratory (COOL) Classroom**

The JC NERR education staff with support from the National Ocean Partnership Program and the help of a group of scientists, technicians, school administrators, and educators, developed a series of instructional modules for use on the Internet known as the COOL Classroom ([www.coolclassroom.org](http://www.coolclassroom.org)). These modules are designed to capitalize on the technology and data associated with the New Jersey Shelf Observing System to develop critical thinking and analytical skills among middle and high school students. Using the modules, students participate in the same predictive process used by scientists through the comprehension of basic scientific principles as applied to marine science, accessing real-time oceanographic data, analyzing data patterns and trends, and predicting ocean conditions.

The COOL Classroom site began as a series of professional development workshops in 1998 and 1999, where educators learned about the data and technologies associated with the research of the New Jersey Shelf Observing System. Participants helped to develop several online lesson plans over the two-year period, and a basic web site was developed to host the lessons. Evaluation results from the workshops in 1998-99 indicated that participants were more comfortable with integrating technology into their lesson plans following the training, but were less comfortable with using real-time scientific data with their students.

In 1999, additional support was secured from National Ocean Partnership Program and an advanced web site was developed through a collaboration of educators, scientists and the JC NERR education staff. The COOL Classroom site was formally launched in an advanced draft state in the spring of 2002, and has since been piloted twice with classroom educators. The latest pilot, involving 20 educators from around the country, was completed during April – June 2003.

The COOL Classroom site continues to be improved and updated. The launch of a newly improved COOL Classroom website is scheduled for spring 2008.

## **3. Shore Bowl**

Since 2000, the JC NERR has engaged high school students in the study of coastal and ocean sciences through the Shore Bowl, a high school academic competition focused on ocean-related topics. These topics include the biology, chemistry, physics and geology of the oceans, as well as navigation, geography, and related history and literature. The Shore Bowl is one of 23 regional competitions that comprise the National Ocean Sciences Bowl, sponsored by the Consortium for Oceanographic Research and Education. Each year, the Shore Bowl provides the opportunity for up to 16 teams to

compete for a variety of prizes and awards, including the right to compete in the national competition.

#### **4. National Estuaries Day**

On behalf of National Estuaries Day, the JC NERR has conducted programs to engage the local citizenry in a better understanding of their estuarine resources, and the mission and programs of the Reserve. National Estuaries Day is an interagency campaign to celebrate the importance of estuaries and the need to protect them. Local communities across the country celebrate their estuaries with a variety of special events, many of which are hosted by Reserves within the NERR system.

The JC NERR has gone beyond a local celebration of National Estuaries Day by participating in EstuaryLive, a series of live Internet video broadcasts from several Reserves and National Estuary Program sites around the country. The live field trips are available to educators, students, and the public via any computer with an Internet connection, and participants can interact with on-camera personalities in real time via e-mail. The JC NERR has participated in the live broadcasts each fall from 2001 to 2005, involving scientists, educators and students in the event. The live JC NERR broadcast has traditionally featured the flora, fauna, research, and cultural history of the Reserve estuarine habitats.

#### **E. Public Outreach and Interpretation**

The education and public outreach program uses current science and technological assets of the JC NERR to develop innovative education programs and products that meet the educational needs of primary audiences including K-12 educators and their students, and the general public or watershed community (i.e., the demographic interested in the environment and science and likely to visit partner institutions such as the Cape May Nature Center, Tuckerton Seaport, and Forsythe Refuge).

##### **1. Lunch and Learn**

A suite of family and public education programs are being offered by the JC NERR and its watershed partners. These programs focus on the research, cultural history and habitats of the MRGB watershed. Participants learn about the research happening “in their own backyard” and experience the watershed and the estuary through field-based education programs. These monthly programs focus on “critters” in the estuary. Participants are encouraged to bring along their lunch and learn from the speakers, who are experts in their respective fields. Presentations last an hour and include a question and answer session.

##### **2. Lunch and Learn Programs 2005-2007**

###### **2005**

- Striped Bass Tagging and Tracking - January 19
- Crabs, Birds, and the Tuckerton Seaport - February 23
- Dolphin Research Project- March 16

###### **2006**

- Striped Bass Tagging and Tracking - January 18

- Tagging and Tracking Terrapin Turtles - February 15
- Pound Fishing Along the Jersey Shore - March 15
- Are You Crabby? - Research Behind Local Blue Claw and Green Crabs - April 19
- Menhaden Fishing and Chanteys -October 6
- Return Osprey - November 8
- Striper Tracker - End of the Year Report -December 6

## **2007**

- Little Egg Harbor Bay Hard Clam Study-January 17
- The History of Clam Aquaculture in Tuckerton - February 21
- Ecology of Blue Crabs - March 14
- New Jersey's Pound Fishing and Gallery Tour - April 11

### **3. Swat 'N Paddle Kayak Race**

The JC NERR in partnership with the Pinelands Watershed Alliance and the Great Bay Paddlers sponsored a Swat 'N Paddle Kayak Race on August 25, 2007. Fourteen racers participated in this event. Paddlers raced from First Bridge Marina through the marsh ecosystem that makes up the Great Bay Boulevard Wildlife Management Area.

### **4. Rutgers University Marine Field Station Annual Open House**

The Annual Rutgers University Marine Field Station Open House is held every year in the fall. Marine biologists and oceanographers inform the attendees of the scientific research conducted in local bays and estuaries and how this scientific data relates to their daily lives. Visitors also tour this historic former Coast Guard Station and learn about the history of facility. Attendance varies, but typically ranges from 300 – 600 participants. Additional activities surrounding the Open House have included photographic tours of the Reserve, touch tanks, and birding trips.

### **5. Recreational Programs 2005-2007**

#### **2005**

- Mullica River – Great Bay Watershed Bus Tour - April 16 and October 1
- Great Bay Blvd. Birding and Hiking -September 17
- Painting with Kathy Johnston - June 11
- Outdoor Photography with Frank Tenner - July 17
- Nature Illustrations and Observations with Kathy Johnston - August 12

#### **2006**

- An Evening with Horseshoe Crabs and Red Knots - June 13
- Great Bay Blvd. Walking and Birding - May 20

#### **2007**

- Great Bay Blvd. Birding Tour with Fred Lesser From Ocean County Parks - May 5
- JC NERR Watershed Bus Tour – September 14
- A Nature Hike in Bass River State Forest – October 6
- Birding Tour at the Edwin B. Forsythe National Wildlife Refuge – October 13
- A Historical Walking Tour at Batsto Village – October 20

### **6. “Life on the Edge” Exhibit at the Tuckerton Seaport**

The "Life on the Edge" (LOE) exhibit opened to the public in July 2002 on the upper level of the Visitor Center at Tuckerton Seaport. This facility enables the general public as well as K-12 school children to explore the many habitats of this National Estuarine Research Reserve. Over 20,000 visitors journey from the headwaters of the Mullica River through the forested Pinelands into the open marshes and wetlands of the Great Bay and out into the open ocean without getting their feet wet each year at the exhibit.

The Life on the Edge (LOE) interpreter continues to develop and deliver a broad range of science based educational services to school groups, scouts, campers, home schooled families and adults. These theme-based programs introduce scientific issues and advancements important to the mission of the JC NERR and its partners. The interpreter continues to broaden the public's understanding of estuarine research and the importance of proper management of the local watershed and estuary. Visitors are given opportunities to examine the connection to the environment and community. The interpreter continues to foster participation in the stewardship and protection of natural resources of the coastal zone.

Audiences at the LOE Exhibit continue to be provided with context and interpretive messages that present the LOE exhibit as the gateway to the Reserve. By presenting JC NERR estuarine science visitors understand estuarine environments, coastal watersheds, coastal management issues, and their role as stewards of the environment. They also understand how human activities affect the coastal environments and how informed choices can protect the value and beauty of area. They also gain knowledge on key issues associated with coastal management such as eutrophication, habitat loss and alteration, climate change, sea level rise and storm surge, and resource conservation. All visitors are provided with information on recreational access and opportunities throughout the Reserve.

#### **F. Volunteer Contributions**

The JC NERR benefits from the large population of retired citizens in Ocean County interested in volunteer opportunities. A core group of 60 volunteers supports a diverse array of research, education and stewardship programs, projects, and services. This active group has contributed more than 7050 volunteer hours since 2000.

Volunteers support many of the education, research, and stewardship programs at the JC NERR, RUMFS, IMCS, and the Barnegat Bay Shellfish Restoration Program. A "Back-Burner" program which features volunteers taking work home has been implemented and well received by those individuals whose schedules prohibit them from working on site. Take home projects included preparation of power point slides and transcription of audio files, photos and news articles.

An annual volunteer recognition event honors volunteers who give so generously of their time, knowledge and talent to support the mission of the JC NERR. A Volunteer of the Year plaque is presented to the volunteer who is outstanding in a variety of activities. All volunteers received a Certificate of Appreciation. Pins are presented to those who contributed 25+ hours.

## **Appendix J**

# **JC NERR Staff Publications and Presentations**

## JC NERR Staff Publications and Presentations

### Publications

#### Books and Special Journal Volumes

- Kennish, M. J. (Editor). 2007. Eutrophication of Estuarine and Shallow Coastal Marine Systems. *Ecological Applications*, Special Issue, Volume 17, Number 5. 196 p.
- Kennish, M. J. 2004. *Estuarine Research, Monitoring, and Resource Protection*. CRC Press, Boca Raton, Florida, 297 p.
- Kennish, M. J. (Editor). 2004. NERRS Research and Monitoring: A Nationally Integrated Program. *Journal of Coastal Research*, Special Issue No. 45, 243 p.
- Kennish, M. J. (Editor). 2002. Impacts of motorized watercraft on shallow estuarine and coastal marine environments. *Journal of Coastal Research*, Special Issue No. 37, 202 p.
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New Jersey Boaters's Pumpout Guide (IMS)  
<http://www.dbcrrsa.rutgers.edu/ims/pumpout/viewer.htm>

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- Auermuller, L. M., M. J. Kennish, and E. Simms. 2004. Impacts to coastal systems: a symposium on nutrient enrichment in New Jersey coastal bays. 20th Annual Meeting, NOAA, National Estuarine Research Reserve System, Kennebunkport, Maine, October 17 - October 22, 2004.
- Kennish, M. J. 2004. Barnegat Bay-Little Egg Harbor Estuary: case study of a highly eutrophic coastal bay system. Rutgers Conference on Impacts to Coastal Systems, Douglass College, New Brunswick, New Jersey, April 7 and 8, 2004.
- Kennish, M. J., S. M. Haag, G. P. Sakowicz, and R. Tidd. 2004. Assessment of seabed morphology in Great Bay, New Jersey using side-scan sonar imaging. 49<sup>th</sup> Annual Meeting, New Jersey Academy of Science, Fairleigh Dickinson University, Madison, New Jersey, April 3, 2004.
- Kennish, M. J., S. M. Haag, G. P. Sakowicz, and R. Tidd. 2003. Research overview of the Jacques Cousteau National Estuarine Research Reserve. 19<sup>th</sup> Annual Meeting, National Estuarine Research Reserve System, Charleston, South Carolina, October 25 - October 30, 2003.
- Haag, S. M., R. G. Lathrop, and M. J. Kennish. 2003. Benthic habitat mapping: Jacques Cousteau NERR and Barnegat Bay NEP. 19<sup>th</sup> Annual Meeting, National Estuarine Research Reserve System, Charleston, South Carolina, October 25 - October 30, 2003.
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- Kennish, M. J. and S. M. Haag. 2003. Monitoring and research in the Jacques Cousteau National Estuarine Research Reserve. 48<sup>th</sup> Annual Meeting, New Jersey Academy of Science, Fairleigh Dickinson University, Madison, New Jersey, April 5, 2003.
- Kennish, M. J. and S. M. Haag. 2003. Environmental future of estuaries. Invited lecture, 5<sup>th</sup> International Conference on Environmental Future, Zurich, Switzerland, March 25, 2003.

- Kennish, M. J. 2003. Summary of environmental future of estuaries, salt marshes, and mangroves. Invited lecture, 5<sup>th</sup> International Conference on Environmental Future, Zurich, Switzerland, March 27, 2003.
- Haag, S. and M. J. Kennish. 2003. Habitats of the Jacques Cousteau NERR. Research Coordinators Meeting, National Estuarine Research Reserve Program, NOAA, University of Delaware, Lewes, Delaware, February 24, 2003.
- Kennish, M. J., S. M. Haag, G. P. Sakowicz, and R. Tidd. 2003. Research overview of The Jacques Cousteau National Estuarine Research Reserve. 17th Annual Meeting, National Estuarine Research Reserve System, Charleston, South Carolina, October 25 - October 30, 2003.
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- Kennish, M. J. 2002. Evaluating the success of SAV restoration. Evaluation of Submerged Aquatic Vegetation (SAV) in Southern New Jersey, Workshop Sponsored by the Office of Coastal Planning (NJDEP), Jacques Cousteau National Estuarine Research Reserve, and Island Beach State Park, Interpretive Center, Island Beach State Park, New Jersey, May 20, 2002.
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- Kennish, M. J. 2001. Chemical contaminant studies in the Barnegat Bay-Little Egg Harbor Estuary. First Monitoring Workshop, Barnegat Bay National Estuary Program, Georgian Court College, October 17, 2001.
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- Kennish, M. J. 2000. Summary of the impacts of motorized boats on shallow water systems. Workshop 2 on Impacts of Motorized Boats on Shallow Water Systems, December 12-13, 2000, Rutgers University, New Brunswick, New Jersey.
- De Luca M. P. 2007. Delivering Real-time Estuarine Data for Multiple Uses, Coastal Zone 2007, July 2007, Portland, Oregon.
- De Luca M. P. 2007. Application of Coastal Observing Information to Enhance Coastal Community Resiliency, Coastal Geotools Conference, March 2007, Myrtle Beach, SC.
- De Luca M. P. 2006. IOOS, NERRS and Partners: Supporting Coastal Resource Management within the Mid-Atlantic Region, Coastal Program Managers Meeting, March 2006, Washington, DC.
- De Luca M. P. 2005. Development of IOOS Pilot Projects for the National Estuarine Research Reserve System. Coastal Zone 2005, July 2005, New Orleans, LA.
- De Luca m. P. 2004. Performance Criteria to Measure Ecosystem-based Management in the NERRS, Annual Meeting of the Coastal Society, May 2004, Newport, RI.
- De Luca M. P. 2003. Personnel Trends, Education Policy and Emerging Roles of Federal and State Natural Resources Agencies, Conference Sponsored by the Renewable Natural Resources Foundation, March 2003, Washington, DC.
- Ragone Calvo, L.M. MSX, The Chesapeake Experience. Scotian Pride, The Annual Meeting of the Canadian Aquaculture Association. Halifax N.S., Canada. January 2003.
- Ragone Calvo, L.M. An update on QPX (Quahog Parasite Unknown) in Virginia. Annual East Coast Commercial Fishermen's and Aquaculture Trade Exposition. Ocean City, MD, January 31-February 2, 2003.
- Ragone Calvo, L.M. QPX in Virginia. QPX Technical Workshop. WHOI Sea Grant Program and the Southeastern Massachusetts Aquaculture Center. Cape Cod, MA, April 19-20, 2002
- Calvo, L.M. Seeding the Future—Project PORTS: Promoting Oyster Restoration Through Schools. 11<sup>th</sup> International Conference on Shellfish Restoration, Charleston, South Carolina. November 19-22, 2008.

Calvo L.M. Students Today, Stewards Tomorrow - Promoting Oyster Restoration Through Schools. 64<sup>th</sup> Annual Northeast Fish and Wildlife Conference held at Galloway, New Jersey, April 27-30.

Calvo, L.M. Project PORTS: Promoting Oyster Restoration Through Schools. DuPont Clear into the Future, Delaware Estuary Research and Restoration Symposium, Wilmington, Delaware, May 29.

Calvo, L. R. Engaging students in Delaware Bay Oyster Restoration—Promoting Oyster Restoration Through Schools: Project PORTS. 2007 joint Meeting Delaware Estuary Science Conference and Environmental Summit, Cape May, NJ January 22-24, 2007.

Ragone Calvo, L.M. R. Elston, K.S. Reece, and E.M. Bureson. Investigations of an isonema-like flagellate causing mortality in larval hard clams, *Mercenaria mercenaria*. 95th Annual Meeting of the National Shellfisheries Association, New Orleans, Louisiana. April 13-17, 2003.

Carnegie, R.B., M.D. Camara, L.M. Ragone Calvo, K.S. Reece, P.M. Gaffney. Development of a single nucleotide polymorphism (SNP) marker set for the hard clam, *Mercenaria mercenaria*. 95th Annual Meeting of the National Shellfisheries Association, New Orleans, Louisiana. April 13-17, 2003.

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Ragone Calvo, L.M. and E.M. Bureson. A decade of disease. Annual Meeting of the National Shellfisheries Association, Mystic, Connecticut., April 14-18, 2002.

Ragone Calvo, L.M. and E.M. Bureson. A model of within host parasite dynamics of the oyster parasite *Perkinsus marinus*: simulation of effects of temperature and salinity. Triennial Meeting of the World Aquaculture Society, the National Shellfisheries Association and the Fish Culture Section of the American Fisheries Society, Orlando, Florida, January 21-25, 2001

Stokes, N.A., L.M. Ragone Calvo, K. Apakupakul, E.M. Bureson, I. Sunila, R. Smolowitz. Validation of DNA-based molecular diagnostics for the hard clam parasite QPX (Quahog Parasite Unknown) and the oyster parasite SSO (*Haplosporidium costale*). Triennial Meeting of the World Aquaculture Society, the National Shellfisheries Association and the Fish Culture Section of the American Fisheries Society, Orlando, Florida, January 21-25, 2001

Psuty, N.P. and T.M. Silveira, 2008. Objectives and Techniques of Shoreline Monitoring: Examples from the US National Park Service and the US Geological

Survey. Measurement and Assessment of Changes along Mobile Coastlines. University of Aberdeen, Scotland, St Fergus, May 19.

Psuty, N.P., and T.M. Silveira, 2008. Trend in Foredune Crestline Displacement, Fire Island National Seashore, 1976-2005. Association of American Geographers, Boston, Mass. April 17.

Silveira, T.M., Carapuço, A.M., Andrade, C. and Andrade, F., 2008;. High Frequency beach Changes in a Low-Energy Sand Spit (Troia, Portugal). Association of American Geographers, Boston, Mass. April 17.

Psuty, N. P., 2008. Global Climate Change: Opportunities for Coastal Foredune Development (Keynote Address). Changing Perspectives in Coastal Dune Management. Liverpool Hope University, Liverpool, UK, March 31-April 3.

Psuty, N. P.; Martinez, M. L.; and Lopez-Portillo, J., 2008. Interaction of Alongshore Sediment Transport and Coastal Lagoon Habitats, Laguna La Mancha, Veracruz, Mexico. Interdisciplinary Conference on The Littoral: Challenge, Dialogue, Action. Lille, France, January 17.

Psuty, N. P., 2008. Community Resilience and Global Change (Keynote Address). Interdisciplinary Conference on The Littoral: Challenge, Dialogue, Action. Lille, France, January 16.

Silveira, T.; Andrade, F.; Pinto, I.V.; Magalhães, A.P. and Cabedal, V., 2007. Enchimento de praia para protecção das ruínas romanas de Tróia: projecto e acompanhamento arqueológico. II Encontro de Arqueologia da Arábida. Setúbal, Portugal. November 16-17.

Psuty, N. P., 2006. Consideration of Sea-Level Rise in Driving Changes Along Coastal New Jersey. 25th Annual International Submerged Lands Management Conference. Red Bank, New Jersey, October 16.

Carapuço, A.M.; Silveira, T.; Gomes, N. and Andrade, F., 2006. Definition of target areas for potential coastal sand dune restoration (Tróia, Portugal). In: Eds. Tubielewicz, A., Eurocoast Association. Coastal Innovations and Initiatives, Littoral 2006, Book III - Coastal Environment, Processes and Evolution, 32-36. September 18-20, Gdansk, Poland.

Silveira, T.; Carapuço, A.M. and Andrade, F., 2006. Beach morphodynamics and sedimentary changes in a natural meso-tidal beach at a daily frequency (Tróia, Portugal). In: Eds. Tubielewicz, A., Eurocoast Association. Coastal Innovations and Initiatives, Littoral 2006, Book II - Coastal Dynamics, Geomorphology and Protection, 36-42. September 18-20, Gdansk, Poland.

- Psuty, N. P., and Pace, J. P., 2005. A Perspective on Sediment Manipulation: Evolving Approaches to Managing Sediment Budget. International Association of Geomorphologists, Zaragoza, Spain, September.
- Psuty, N. P., Guo, Q., and Pace, J. P., 2005. Sedimentation and Geomorphological Evolution of a Flood Tidal Delta, Great Egg Harbor Bay, New Jersey, Association of American Geographers, Denver, April.
- Psuty, N. P., 2005. Concepts of Coastal Geomorphological Evolution: A Primer for Tracking Change. George Wright Society, Philadelphia, March.
- Pace, J. P., and Psuty, N. P., 2005. Using LIDAR Topographic and Photographic Data for Dune Template Design at the Fire Island National Seashore. George Wright Society, Philadelphia, March.
- Psuty, N.P., 2008. Discussion Leader, Wrap-up Session, Workshop on Creating a Seamless Network of Protected Shores. Sponsored by the National Park Service. Rutgers University, New Brunswick, NJ. May 14.
- Silveira, T.M., 2008. "Development and Application of Protocols for Monitoring of Shoreline Position". Three-Year Review, Northeast Coastal and Barrier Network, National Park Service, Kingston, Rhode Island, May 20.
- Psuty, N.P., 2008. "Global Climate Change, Climate Friendly Parks: Impacts at the Coast". Climate Friendly Parks Workshop, Watch Hill, Fire Island National Recreation Area, July 9.
- Psuty, N.P., 2008. "Coastal Geomorphological Response to Sea-Level Rise". New York State Sea Level Rise Task Force Meeting, New York City, September 15.
- Silveira, T.M., 2008. "Coastal investigations and sediment management: Portugal and Sandy Hook, New Jersey". NOAA's James J. Howard Marine Sciences Laboratory Seminar Series. Sandy Hook, NJ, May 8.
- Psuty, N.P., 2007. USA: Current trends in adaptation. Workshop on The Green Paper: Current Trends in Adaptation to Climate Change. Universitat Autònoma de Barcelona, Spain, November 30.
- Psuty, N.P., 2007. Sea-Level Rise in New Jersey, Association of New Jersey Environmental Commissions Workshop, Mercer County Community College, Oct. 12.

- Psuty, N.P., 2007. Sea-Level Rise along Monmouth County, Monmouth County Environmental Commission Round Table, Brookdale Community College Oct. 10.
- Psuty, N.P., 2007. Sea-Level Rise and Sediment Management: Response of the Coast to the Threat of Rising Seas and Global Warming. Rutgers University Mini-Symposium, May 14.
- Psuty, N.P., 2007. Sea-Level Rise in New Jersey. Brookdale Community College, Environmental Symposium. March 29.
- Psuty, N.P., 2007. Emerging Strategies for Coastal Shoreline Management in the National Parks, Geography Graduate Program Series, Rutgers University, March 2.
- Psuty, N.P., 2006. Adaptation Options for Coastal Hazards. Lecture, Princeton University, October 12.
- Psuty, N.P., 2006. 'Impacts of Sea-Level Rise along Coastal New Jersey'. Governor's Conference on Impacts of Global Climate Change. Trenton, NJ, September 25.
- Psuty, N.P., 2005. "Procedures for Shoreline Change Monitoring", Northeast Coastal Barrier Network, National Park Service, December 7.
- Reding, Melanie. Pinelands Summer Teacher Institute: "Issues Facing our Estuaries"
- Reding, Melanie. Ocean County Rotary: "The Jacques Cousteau National Estuarine Research Reserve"
- Reding, Melanie. "Marine Mammals and the Estuary" at Bass River State Forest 2008
- Auermuller, Lisa. 2007. CZ 07 - CTP Performance Measurement System.
- Auermuller, Lisa. Training NJ Municipalities to 'Think Outside Their Box'.
- Auermuller, Lisa. NERRA 2006 - Facilitated Integration, More Than Just a Buzz Word.
- Kozic, J., 2004, New Volunteer Opportunities: Expanding Field Work. Volunteer Appreciation Dinner, Tuckerton, NJ.
- Kozic, J., 2005, NOAA Recognition of Outstanding Service. Volunteer Appreciation Dinner, Tuckerton, NJ.
- Kozic, J., 2006, Re-Clamming the Bay. Volunteer Appreciation Dinner, Tuckerton, NJ.
- Kozic, J., Pinelands High School PTA.

Kozic, J., Tuckerton Beach Association.

Kozic, J., Sea Oaks Country Club.

Kozic, J., Little Egg Harbor Senior Citizen Information Expo.

Scott, I. L., Bass River State Park.

Scott, I. L., Little Egg Harbor Rotary Club.

Scott, I.L., New Jersey Commerce & Economic Growth Commission.

Scott, I.L., Congressional Site Visit-2005, 2006, 2007.

Petruzzelli, Gina. 7<sup>th</sup> Annual Shore Bowl.

Petruzzelli, Gina. Wharton State Forest Earth Day.

Petruzzelli, Gina. NOAA Hurricane Hunter Plane, Cape May Airport.

Petruzzelli, Gina. Lanoka Harbor Elementary School annual Career Day.

Petruzzelli, Gina. Little Egg Harbor Senior Expo.

Petruzzelli, Gina. Ocean Fun Days.

## **Appendix K**

### **JC NERR Staff Professional and Community Service**

**JC NERR Staff**  
**Professional / Community Service**

Along with reserve program responsibilities, the JC NERR staff is involved not only in site-specific activities and service, but also serves the larger NERRS community through workgroup participation in NERRS and NERRA-related initiatives. Further, the staff serves their communities as well through volunteer appointed and elected offices.

**Mike De Luca, Manager**

NERRA Committees:

- Member Executive board
- Chair, Legislative Affairs Committee

NERRS Committees:

- Chair, IOOS Workgroup
- Past Chair, Strategic Planning Committee
- Land Acquisition Workgroup
- Telemetry Workgroup
- Expansion Workgroup
- Chair, Ad Hoc Caucus on Community Resiliency

Community Service:

- Co-Chair, Science and Technical Committee, Barnegat Bay National Estuary Program
- Governing Board, Delaware Estuary Program

Awards:

- NERRS/NERRA National Award for Outstanding Contributions
- President's Merit Award

**Mike Kennish, Research Coordinator**

NERRS Committees:

- Biological Monitoring Workgroup
- Benthos sub-workgroup
- SAV-Emergent Mapping sub-workgroup
- Graduate Research Fellowship Committee
- Research Matrix Workgroup

Professional Committees:

- USEPA National Estuaries Experts Workgroup
- Advisory Council of the New Jersey Academy of Science
- Executive Committee of the New Jersey Academy of Science
- Permanent Land Protection Technical Focus Group of the Pinelands Commission
- New Jersey Water Monitoring Coordinating Council
- New Jersey Water Monitoring Coordinating Council Workshop Steering Committee
- Science and Technical Advisory Committee of the Barnegat Bay National Estuary Program
- Ocean County Stormwater Management Committee

- Member of the Science Advisory Committee for the Jacques Cousteau National Estuarine Research Reserve.

**Scott Haag, GIS Specialist/Field Researcher**

NERRS Committees:

- National Estuarine Research Reserve Habitat Mapping Working Group

Professional Committees:

- New Jersey Digital Elevation Task Force
- Barnegat Bay Scientific and Technical Advisory Committee

**Gregg Sakowicz, SWMP Technician/Field Researcher**

NERRS Committees:

NERRS CDMO Technical Advisory Committee

**Lisa Auermuller, Coastal Training Program**

NERRS Committees:

- Strategic Committee
- Past Co-Chair, CTP Oversight Committee
- Chair, Performance Measurement Workgroup
- CTP External Evaluation Workgroup
- KEEP Market Analysis and Needs Assessment Workgroup

Community Service:

- Little Egg Harbor Environmental Commission (Co-chair)

**N. P. Psuty, Watershed Coordinator-North**

Professional Committees:

- Member, Geographical Sciences Committee, National Research Council, National Academy of Sciences.
- Representative of Rutgers University to restoration of building on Fort Hancock, Sandy Hook, for Coastal and Marine Field Station, Institute of Marine and Coastal Sciences.
- Member, Habitat Evaluation Project, Fire Island to Montauk Point, U.S. Army Corps of Engineers, New York District
- Technical Consultant, North Atlantic Region, National Park Service, Department of the Interior
- Technical Representative for Rutgers University, North Atlantic Coast Cooperative Ecosystems Studies Unit, National Park Service, Dept of the Interior
- Secretary, Commission on Coastal Systems, International Geographical Union
- Member, Editorial Board, Quaestiones Geographicae, Poznan, Poland
- Consulting Board, Finisterra, Revista Portuguesa de Geografia, Lisbon, Portugal
- Member, Scientific Committee, Thalassas, Vigo, Spain
- Member, Editorial Board, Journal of Coastal Research
- Member, Editorial Board, Coastal Management Journal

Awards:

- Norbert P. Psuty. National Park Service Director's Award for Natural Resource Research in the National Parks, 2006, April, 2007.
- Norbert P. Psuty. Natural Resource Research Award for 2006, Northeast Region, National Park Service, May, 2007.
- Norbert P. Psuty. Senior Scientist, Fulbright Scholars Program (support to serve as advisor to developing programs in coastal inquiry and education), 2007-2011.
- Norbert P. Psuty. Visiting Scholar, Department of Geography, Universitat Autònoma de Barcelona, April-June, 2006.

**Melanie Reding, Education Coordinator**

NERRS Committees:

- 2008 Annual Meeting Education Agenda Planning Committee
- 2009 Education/CTP Joint Sector Meeting Agenda Planning Committee  
Community Education Workgroup
- KEEP: Market Analysis and Needs Assessment Workgroup

Professional Committees:

- NJMEA 2009 Teach at the Beach Planning Committee
- Pinelands Commission's Education Advisory Council
- Pinelands Preservation Alliance Science/Policy Forum Committee

Professional Affiliations:

- National Association of Interpretation (NAI)
- New Jersey Marine Educator Association (NJMEA)
- Association of New Jersey Environmental Educators (ANJEE)
- Rancocas Conservancy

Community Service:

- Volunteer, New Jersey Conservation Foundation
- Volunteer, Marine Mammal Stranding Center
- EPA Environmental Education Grant Reviewer

**Josephine Kozić, Volunteer and Events Coordinator**

NERRA committees:

- NGO/Friends Committee

Community Service:

- Volunteer, Annual Gun & Decoy Show
- Volunteer, Church Annual Carnival
- Volunteer, Church usher

Awards:

- 2007 NOAA Environmental Hero Award

**Ida Louise Scott, Interpretive Docent**

NERRA Committees:

- NGO/Friends Committee

Community Service:

- NJMEA (New Jersey Marine Educator Association)

Awards:

- Rutgers University Cooperative Extension Environmental Stewards Training Project Proposal [Green Maps] chosen as "one of the best" at the 2006 class graduation ceremony.
- CIG awarded at the Rookery Bay NERR in 2004

**Gina Petruzzelli, Public Outreach Coordinator**

Community Service:

- Tuckerton Environmental Commission June 2005- October 2006
- Swat N' Paddle Kayak Race Committee

**Appendix L**

**Public Comments**

A public announcement appeared in the October 16, 2009 legal section of the Asbury Park Press informing the local community of the required comment period associated with the Jacques Cousteau National Estuarine Research Reserve Management Plan. No comments were received.

An announcement was also posted to the Federal Register, Volume 74, No. 212 on Wednesday, November 4, 2009. No comments were received.