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Land Use Management
Water Monitoring and Standards
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PARTIAL SANITARY SURVEY OF

SHELLFISH GROWING AREA DB1

THE DELAWARE BAY FROM

MAURICE RIVER COVE TO ARTIFICIAL ISLAND

1999 – 2003

May 2005

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PARTIAL SANITARY SURVEY OF SHELLFISH GROWING AREA DB1 THE DELAWARE BAY FROM MAURICE RIVER COVE TO ARTIFICIAL ISLAND

1999 - 2003

New Jersey Department of Environmental Protection
BRADLEY M. CAMPBELL
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TABLE OF CONTENTS

TABLE OF FIGURES

TABLE OF TABLES

EXECUTIVE SUMMARY

This report is a Partial Sanitary Survey of Shellfish Growing Area DB1; the Delaware Bay from Maurice River Cove to Artificial Island. The water quality data presented in this report were collected between October 1999 and September 2003. The water quality of this shellfish growing area is not good in all areas. Most of the sampling stations are in compliance with the *Approved*, *Seasonally Approved (Nov – Apr)*, *Special Restricted*, and *Prohibited* shellfish classification for this area, as specified by the National Shellfish Sanitation Program (NSSP) criteria (USPHS, 1999 Revision). However, one of the sampling stations (Sampling Station 3847E) in this shellfish growing area was out of compliance with the existing shellfish growing water classification criteria. Approximately 224 acres of shellfish waters around Sampling Station 3847E in the Maurice River Cove need to be downgraded from the *Seasonally Approved (Nov – Apr)* to the *Special Restricted* shellfish classification. The reason for the decline in water quality around this sampling station is unknown, but the Bureau of Marine Water Monitoring will be collecting water samples in the Maurice River/ Maurice River Cove area to determine the source.

INTRODUCTION

PURPOSE

This report is part of a series of studies having a dual purpose. The first and primary purpose is to comply with the guidelines of the National Shellfish Sanitation Program (NSSP) that are established by the Interstate Shellfish Sanitation Conference (ISSC). Reports generated under this program form the basis for classifying shellfish waters for the purpose of harvesting shellfish for human consumption. As such, they provide a critical link in protecting human health.

The second purpose is to provide input to the Integrated Water Quality Monitoring and Assessment Report, which is prepared pursuant to Sections 305(b) and 303(d) of the Federal Clean Water Act (P.L. 95-217). The information contained in the growing area reports is used for the 305b portion of the Integrated Report, which provides an assessment to Congress every two years of current water quality conditions in the State's major rivers, lakes, estuaries, and ocean waters. The reports provide valuable information for the 305(b) portion of the Integrated Report, which describes the waters that are attaining state designated water uses and national clean water goals; the pollution problems identified in surface waters; and the actual or potential sources of pollution. Similarly, the reports utilize relevant information contained in the 305(b) portion of the Integrated Report, since the latter assessments are based on instream monitoring data (temperature, oxygen, pH, total and fecal coliform bacteria, nutrients, solids, ammonia and metals), land-use profiles, drainage basin

characteristics and other pollution source information.

From the perspective of the Shellfish Classification Program, the reciprocal use of water quality information from reports represent two sides of the same coin: the growing area report focuses on the estuary itself, while the 305(b) portion of the report describes the watershed that drains to that estuary.

The Department participates in a cooperative National Environmental Performance Partnership System (NEPPS) with the USEPA which emphasizes ongoing evaluation of issues associated with environmental regulation, including assessing impacts on waterbodies and measuring improvements in various indicators of environmental health. The shellfish growing area reports are intended to provide a brief assessment of the growing area, with particular emphasis on those factors that affect the quantity and quality of the shellfish resource. The shellfish growing area reports provide valuable information on the overall quality of the saline waters in the most downstream sections of each major watershed. In addition, the reports assess the quality of the biological resource and provide a reliable indicator of potential areas of concern and/or areas where additional information is needed to accurately assess watershed dynamics.

HISTORY

As a brief history, the NSSP developed from public health principles and program controls formulated at the original conference on shellfish sanitation called by the Surgeon General of the United States Public Health Service in 1925. This conference was called after oysters were implicated in causing over 1500 cases of typhoid fever and 150 deaths in 1924. The tripartite cooperative program (federal, state and shellfish industry) has updated the program procedures and guidelines through workshops held periodically until 1977. Because of concern by many states that the NSSP guidelines were not being enforced uniformly, a delegation of state shellfish officials from 22 states met in 1982 in Annapolis, Maryland, and formed the ISSC. The first annual meeting was held in 1983 and continues to meet annually at various locations throughout the United States.

The NSSP *Guide for the Control of Molluscan Shellfish* sets forth the principles and requirements for the sanitary control of shellfish produced and shipped in interstate commerce in the United States. It provides the basis used by the Federal Food and Drug Administration (FDA) in evaluating state shellfish sanitation programs. The five major points on which the state is evaluated by the FDA include:

1. The classification of all actual and potential shellfish growing areas as to their suitability for shellfish harvesting.
2. The control of the harvesting of shellfish from areas that are classified as restricted, prohibited or otherwise closed.
3. The regulation and supervision of shellfish resource recovery programs.

4. The ability to restrict the harvest of shellfish from areas in a public health emergency, and
5. Prevention of the sale, shipment or possession of shellfish that cannot be identified as being produced in accordance with the NSSP and have the ability to condemn, seize or embargo such shellfish.

FUNCTIONAL AUTHORITY

The authority to carry out these functions is divided between the Department of Environmental Protection (DEP), the Department of Health and Senior Services, and the Department of Law and Public Safety. The Bureau of Marine Water Monitoring (BMWM), under the authority of N.J.S.A. 58:24, classifies the shellfish growing waters and administers the special resource recovery programs. Regulations delineating the growing areas are promulgated at N.J.A.C. 7:12 and are revised annually. Special Permit rules are also found at N.J.A.C. 7:12 and are revised as necessary.

The Bureau of Shellfisheries, in the Division of Fish and Wildlife, issues harvesting licenses and leases for shellfish grounds under the Authority of N.J.S.A. 50:2 and N.J.A.C. 7:25. This bureau, in conjunction with the BMWM, administers the Hard Clam Relay Program.

The Bureau of Law Enforcement in the DEP, Division of Fish and Wildlife, and the Division of State Police, in the Department of Law and Public Safety, enforce the provisions of the statutes and rules mentioned above.

The Department of Health and Senior Services is responsible for the certifications of wholesale shellfish establishments and, in conjunction with the BMWM, administers the depuration program.

The division of authority between the three agencies can be seen in Figure 1.

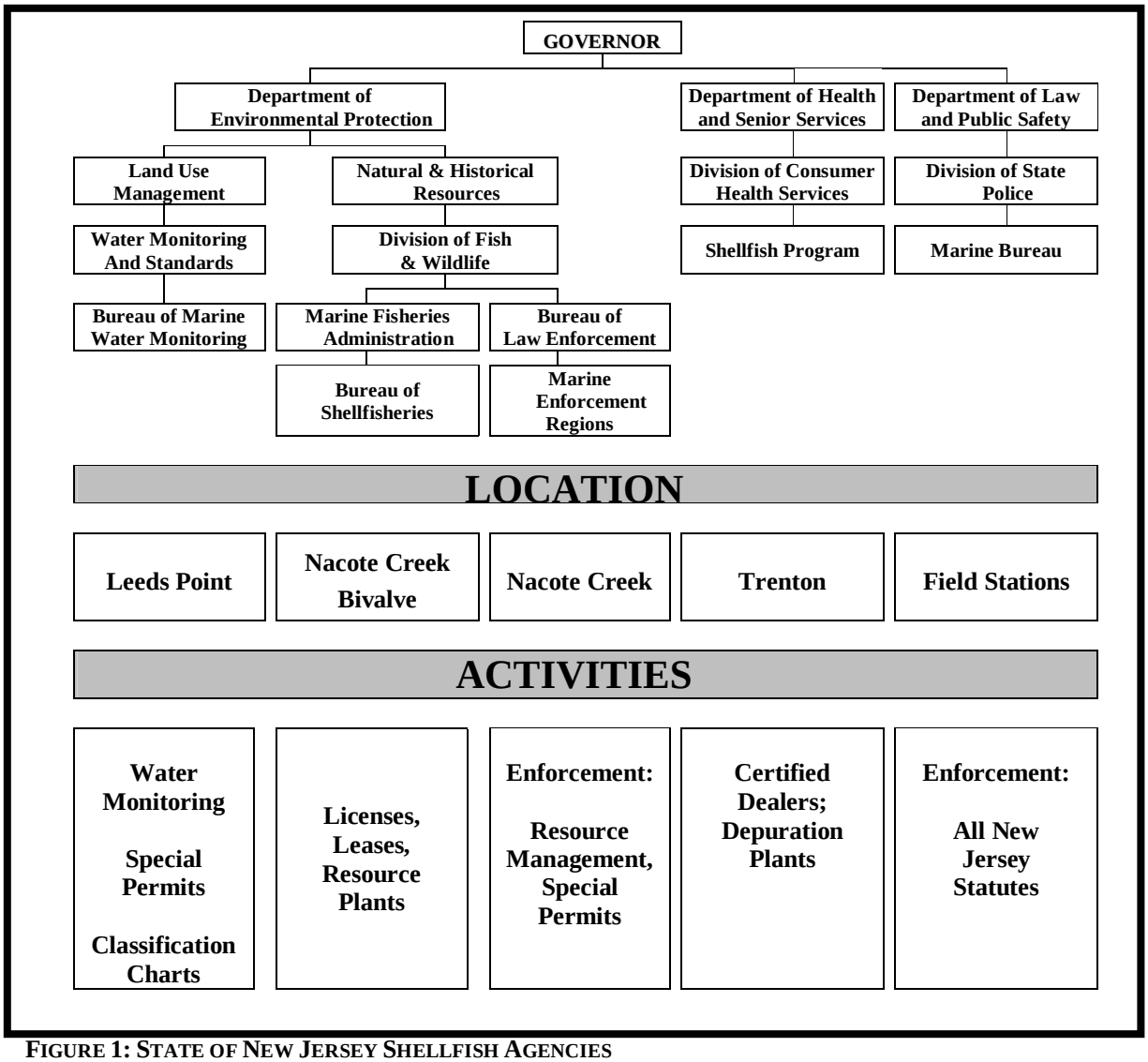

FIGURE 1: STATE OF NEW JERSEY SHELLFISH AGENCIES

IMPORTANCE OF SANITARY CONTROL OF SHELLFISH

Emphasis is placed on the sanitary control of shellfish because of the direct relationship between pollution of shellfish growing areas and the transmission of diseases to humans. Shellfish borne infectious diseases are generally transmitted via a fecal-oral route. The pathway is complex and quite circuitous. The cycle usually begins with fecal contamination of the shellfish growing waters. Sources of such contamination are many and varied. Contamination reaches the waterways via storm water runoff from urban and agricultural areas and from direct discharges such as wastewater treatment facilities.

Clams, oysters and mussels pump large quantities of water through their bodies during the normal feeding process. During this process the shellfish also concentrate microorganisms, which may include pathogenic microbes, and toxic heavy metals/chemicals. It is imperative that a system is in place to reduce the

human health risk of consuming shellfish from areas of contamination.

Accurate classifications of shellfish growing areas are completed through a comprehensive sanitary survey. The principal components of the sanitary survey report include:

1. An evaluation of all actual and potential sources of pollution,
2. An evaluation of the hydrography of the area and
3. An assessment of water quality. Complete intensive Sanitary Surveys are conducted every 12 years with interim narrative evaluations (Reappraisals) completed on a three-year basis. If major changes to the shoreline or bacterial quality occur, then the intensive report (Sanitary Survey) is initiated prior to its l2 year schedule. Also, if only a section of a growing area is either upgraded or downgraded from its current shellfish classification, a partial intensive report (Partial Sanitary Survey) is conducted for that shellfish growing area. Annual Reviews are written on a yearly basis for each shellfish growing area.

The following narrative constitutes this bureau's assessment of the above mentioned components to comply with the three year reappraisal. Additionally, a partial shoreline survey was completed for the purpose of upgrading and reclassifying a portion of the shellfish growing waters of Shellfish Growing Area DB1: The Delaware Bay from Maurice River Cove to Artificial Island.

GROWING AREA PROFILE

LOCATION AND DESCRIPTION

Shellfish Growing Area DB1: The Delaware Bay from Maurice River Cove to Artificial Island is a shellfish growing area located in the southwestern part of New Jersey. This shellfish growing area borders the shoreline of the Delaware Bay from the Maurice River Cove in Maurice River Township, Cumberland County and extends northwest to Artificial Island in Lower Alloways Creek Township, Salem County. The northwestern edge of this shellfish growing area is located at the border between New Jersey and Delaware, which is on a line extending from a point about 7.5 miles west of Egg Island Point and going southeast to a point about 7.3 miles west of Cape May Point. The southwestern edge of this shellfish growing area is located at the border between this growing area and Shellfish Growing Area DB3 (The Delaware Bay Offshore – Cross Ledge, Deadmans & Brandywine Shoal) (see Figures 2 and 3). This shellfish growing area also includes Hope Creek, Stow Creek, the Cohansey River, Back Creek, Cedar Creek, Nantuxent Creek, Dividing Creek, the Maurice River, and smaller tidal tributaries. The primary shellfish classifications of this growing area are *Approved*, *Seasonally Approved (Nov – Apr)*, *Special Restricted*, and *Prohibited* and the approximate size of this shellfish growing area is 84,984 acres.

The *Seasonally Approved (Nov. – Apr.)* waters are located in the Nantuxent Cove, the Back Creek area, the lower Cedar Creek area, the lower Nantuxent Creek area, Beadons Cove, the Oranoaken Creek area, the lower Dividing Creek area, and the Maurice River Cove outside Oranoaken Creek, Dividing Creek, and the Maurice River Cove outside the Maurice River. The *Special Restricted* waters are located in the area of the Delaware Bay inshore and extending from Artificial Island to Mad Horse Creek, the Fishing Creek area, the Mad Horse Creek area, the Stow Creek area, Cohansey Cove, the upper Nantuxent Creek area, Dyer Cove, Dyer Creek, Padgett Creek, Sow and Pigs Creek, Beadons Creek, Fortescue Creek, the Straight Creek area, The Glades area, the upper Dividing Creek area, and the lower Maurice River and part of Maurice Cove. The *Prohibited* waters are located in the Hope Creek area, the Cohansey River area, the Middle Marsh Creek area, the upper Cedar Creek area, and the upper Maurice River area. The *Approved* waters are located in the Delaware Bay from Stow Creek to the Maurice River Cove, excluding the areas already mentioned above.

The municipalities on the shore of this shellfish growing area include Maurice River Township, Commercial Township, Millville City, Downe Township,

Lawrence Township, Fairfield Township, Hopewell Township, and Greenwich Township in Cumberland County and Lower Alloways Creek Township in Salem County. The locations of these municipalities are shown in Figures 2 and 3, and the population statistics for the surrounding municipalities are shown in Table 1.

In Cumberland County, Riggins Ditch, the Maurice River, Dividing Creek, Oranoaken Creek, Straight Creek, Fishing Creek, Fortescue Creek, Beadons Creek, Sow and Pigs Creek, Padgett Creek, Dyer Creek, Nantuxent Creek, Cedar Creek, Back Creek, Oyster Gut, Middle Marsh Creek, Drumbo Creek, the Cohansey River, Cabin Creek, Fishing Creek, and Jacobs Creek drain into this shellfish growing area (see Figures 4, 5, 6, 7, 8, 9, and 10). In Salem County, Stow Creek, Muddy Creek, Cherry Tree Creek, Lower Deep Creek, Mad Horse Creek, Fishing Creek, Hope Creek, and the Delaware River drain into this shellfish growing area (see Figure 11).

This shellfish growing area can be found on Chart 10 of the "2004 State of New Jersey – Shellfish Growing Water Classification Charts" (NJDEP, 2002). Figures 12 and 13 show the current classification of this shellfish growing area.

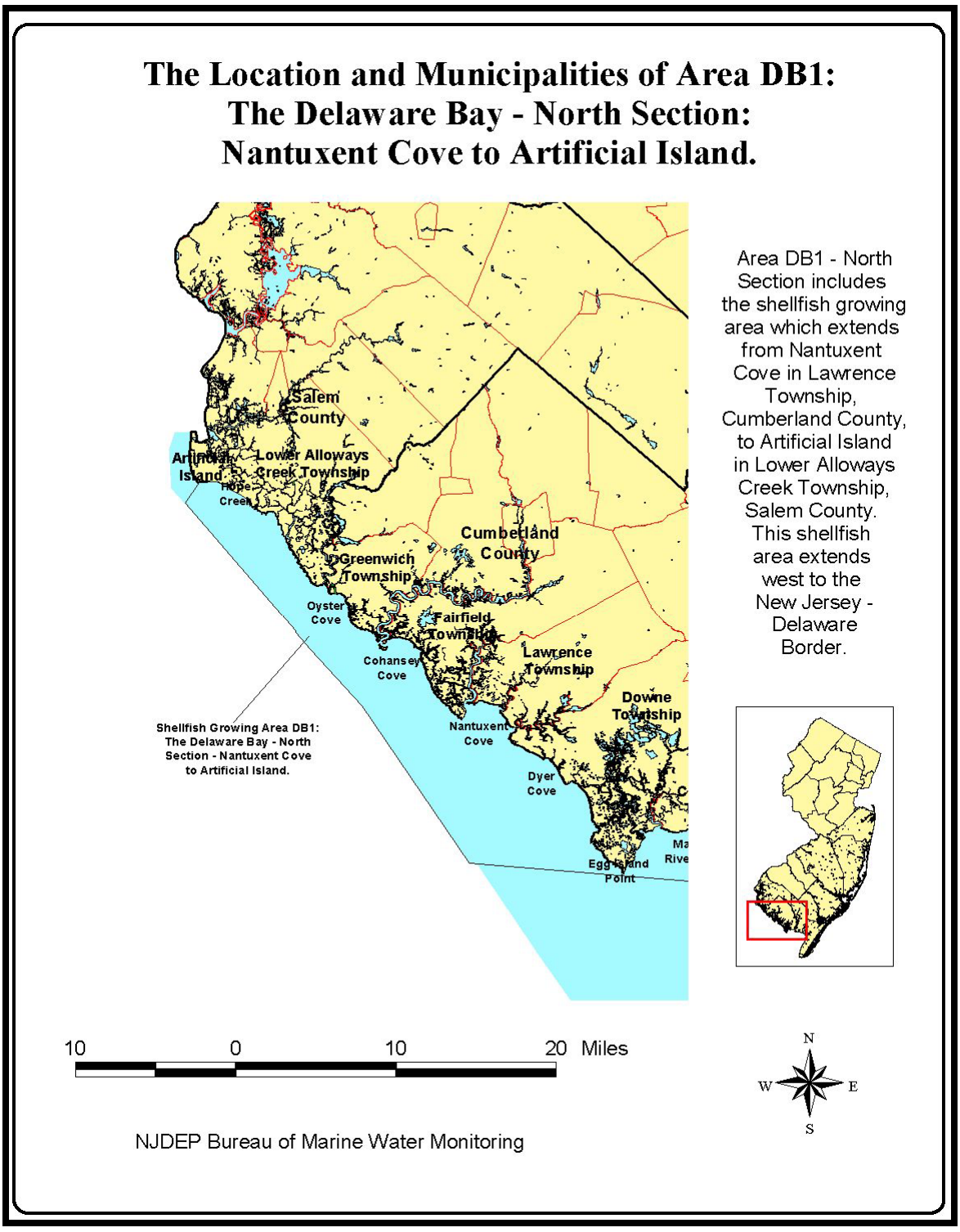

FIGURE 2: LOCATION AND MUNICIPALITIES OF SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

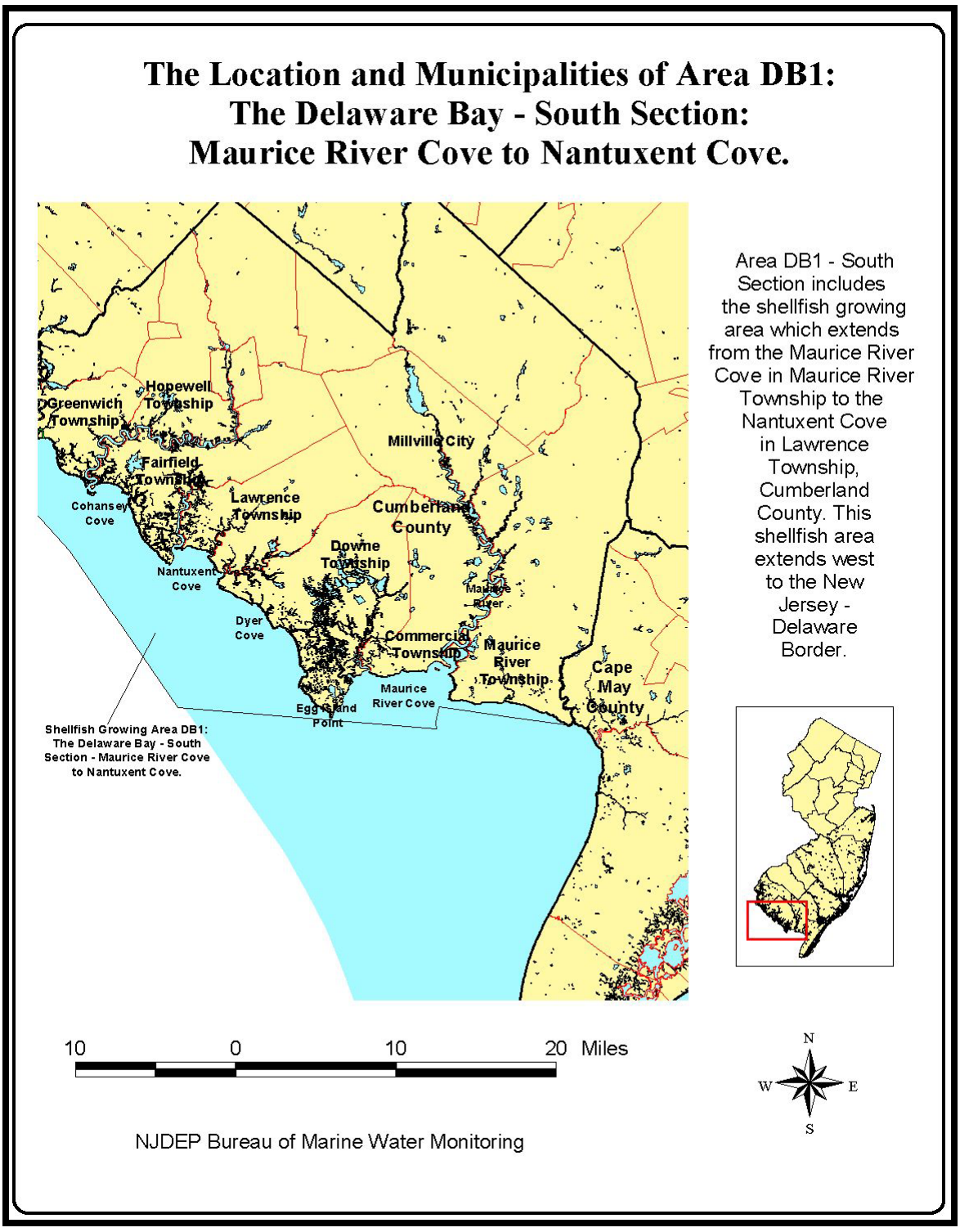

FIGURE 3: LOCATION AND MUNICIPALITIES OF SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

TABLE 1: POPULATION STATISTICS FOR MUNICIPALITIES ADJACENT TO SHELLFISH GROWING AREA DB1– THE DELAWARE BAY - MAURICE RIVER COVE TO ARTIFICIAL ISLAND BAY (NJ DEPARTMENT OF LABOR, 2001)**.**

Community	Area (sq. mi.)	Population		Population Change 1990 to 2000		Population Density	
		2000	1990	Number	Percent	2000	1990
Maurice River Township (Cumberland County)	93.525	6,928	6,648	280	4.2%	74	71
Commercial Township (Cumberland County)	32.598	5,259	5,026	233	4.6%	161	154
Millville City (Cumberland County)	44.011	26,847	25,992	855	3.3%	610	587
Downe Township (Cumberland County)	53.195	1,631	1,702	-71	-4.2%	31	32
Lawrence Township (Cumberland County)	37.516	2,721	2,433	288	11.8%	72	65
Fairfield Township (Cumberland County)	42.274	6,283	5,699	584	10.2%	149	135
Hopewell Township (Cumberland County)	30.309	4,434	4,215	219	5.2%	146	139
Greenwich Township (Cumberland County)	18.001	847	911	-64	-7.0%	47	51
Lower Alloways Creek Township (Salem County)	47.181	1,851	1,858	-7	-0.4%	39	39

FIGURE 4: BRIDGE OF THE PORT NORRIS – MAURICETOWN ROAD THAT EXTENDS OVER THE MAURICE RIVER. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 8:54 A.M.

FIGURE 5: MAURICE RIVER BEHIND THE BIVALVE PACKING COMPANY IN MAURICE RIVER TOWNSHIP, CUMBERLAND COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 9:10 A.M.

FIGURE 6: DIVIDING CREEK IN DOWNE TOWNSHIP, CUMBERLAND COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 9:26 A.M.

FIGURE 7: FORTESCUE CREEK IN DOWNE TOWNSHIP, CUMBERLAND COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 10:33 A.M.

FIGURE 8: NANTUXENT CREEK IN LAWRENCE TOWNSHIP, CUMBERLAND COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 10:48 A.M.

FIGURE 9: NANTUXENT COVE FROM BAY POINT IN LAWRENCE TOWNSHIP, CUMBERLAND COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 11:12 A.M.

FIGURE 10: COHANSEY RIVER (AT LOW TIDE) BEHIND FAIRTON MARINA IN FAIRFIELD TOWNSHIP, CUMBERLAND COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 11:42 A.M.

FIGURE 11: STOW CREEK IN LOWER ALLOWAYS CREEK TOWNSHIP, SALEM COUNTY. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 12:56 P.M.

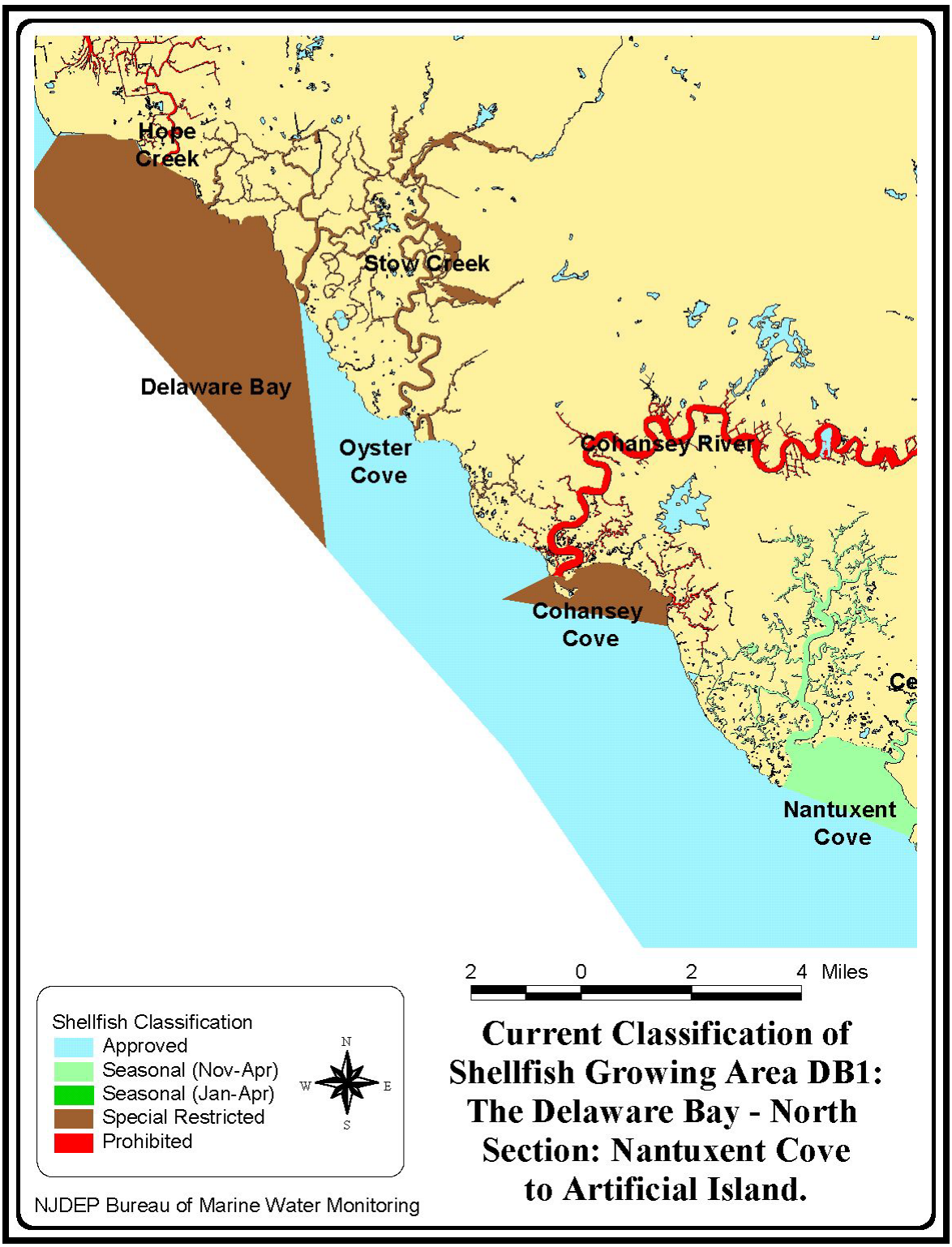

FIGURE 12: CURRENT CLASSIFICATION OF SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

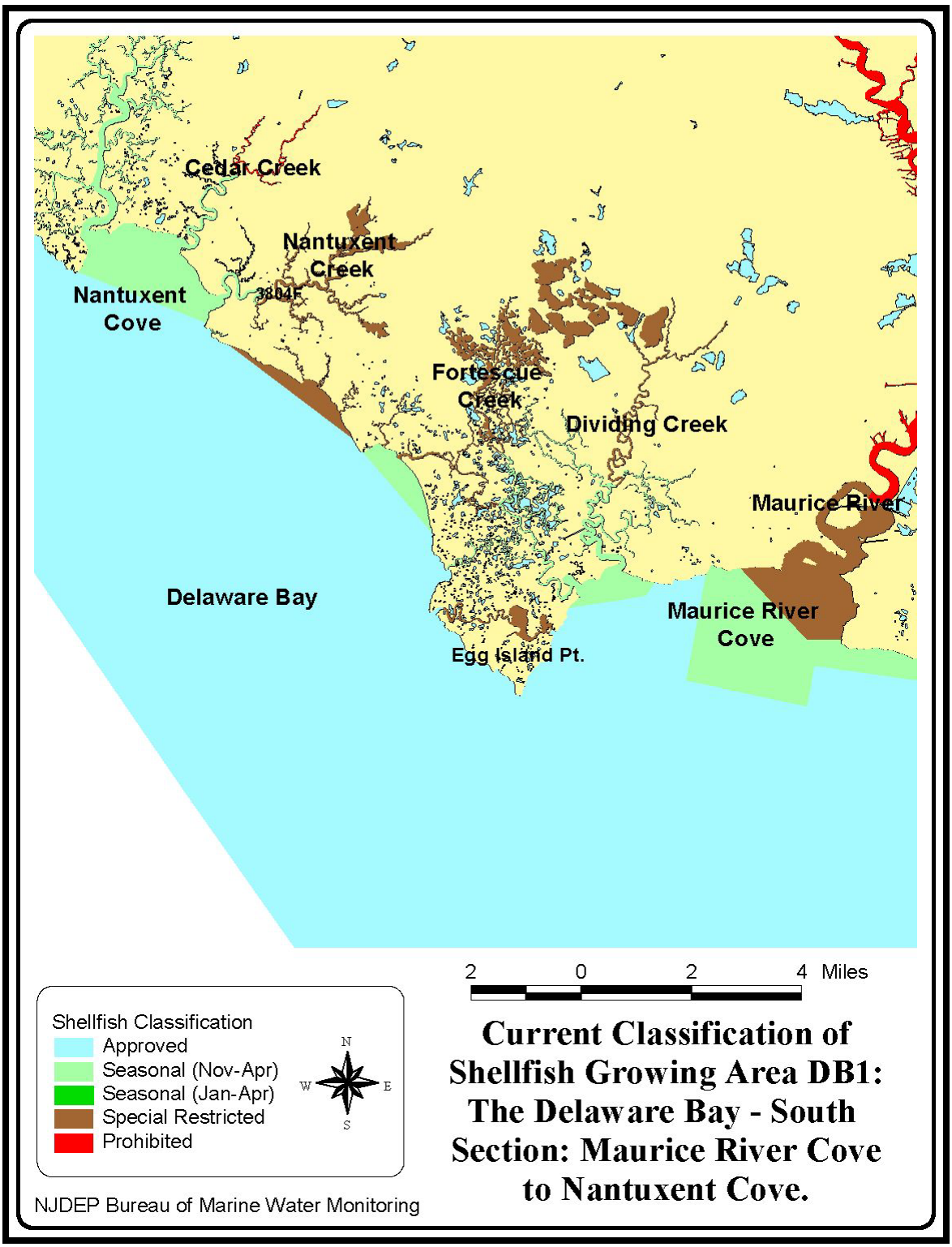

FIGURE 13: CURRENT CLASSIFICATION OF SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

HISTORY OF GROWING AREA CLASSIFICATION

There have been significant changes to the shellfish water classification for the Maurice River Cove and Dividing Creek areas over the past 16 years. In this period of time, there have been 5 reports written to downgrade the shellfish water classification in this area.

In April 1997, a reappraisal was written for the Delaware Bay from Artificial Island to the Maurice River Cove, using water data from 1990 to 1996, and approximately 1,522 acres of *Approved* shellfish waters in the Maurice River Cove and 194 acres of *Approved* shellfish waters in Dividing Creek were downgraded to the *Seasonally Approved (Nov. – Apr)* shellfish classification. This downgrade was based on elevated total and fecal coliform levels at six sampling stations; two stations located in the mouth of Dividing Creek and four stations located in the Maurice River Cove.

In 1996, 615 acres of *Seasonally Approved (Nov – Apr)* shellfish waters in the Maurice River Cove and Dividing Creek were downgraded to the *Special Restricted* shellfish classification. This downgrade was based on elevated total and fecal coliform levels at several sampling stations located adjacent to the channel at the mouth of the Maurice River.

In 1990, 389 acres of *Approved* shellfish waters in the Maurice River Cove were downgraded to the *Seasonally Approved (Nov – Apr)* shellfish classification, and 350 acres of *Approved* shellfish waters in the Maurice River Cove were downgraded to the *Seasonally Approved (Nov – Apr)* shellfish classification in 1988.

In June 2003, a sanitary survey was written for this shellfish growing area and approximately 235 acres of shellfish waters around the Maurice River Cove were downgraded from the *Approved* to the *Seasonally Approved (Nov – Apr)* shellfish classification. This downgrade in water quality of the Maurice River Cove was included in the 2003 Annual Review of Shellfish Growing Area DB1, using water data from 1999 to 2003. At the request of the New Jersey Shell Fisheries Council, Delaware Bay Section, additional water samples will be collected in the Maurice River and Maurice River Cove to identify the source or cause of the continued decline in the water quality of this area.

METHODS

Water sampling was performed in accordance with the Field Procedures Manual (NJDEP, 1992).

Approximately 4,806 water samples were collected for total and fecal coliform bacteria between 1999 and 2003 and analyzed by the three - tube MPN method according to APHA (1970). Figures 14 and 15 show the shellfish growing water quality monitoring stations in the Delaware Bay from Maurice River Cove to Artificial Island. Approximately 152 stations are monitored during each year in marine water sampling assignment areas 315, 327, 332, 357, and 362. Water quality sampling, shoreline and watershed surveys were conducted in accordance with the NSSP *Guide for the Control of Molluscan Shellfish*, 1999 Revision (USPHS, 1999 Revision).

Data management and analysis was accomplished using database applications developed for the Bureau. Mapping of pollution data was performed with the Geographic Information System (GIS: ARCVIEW®).

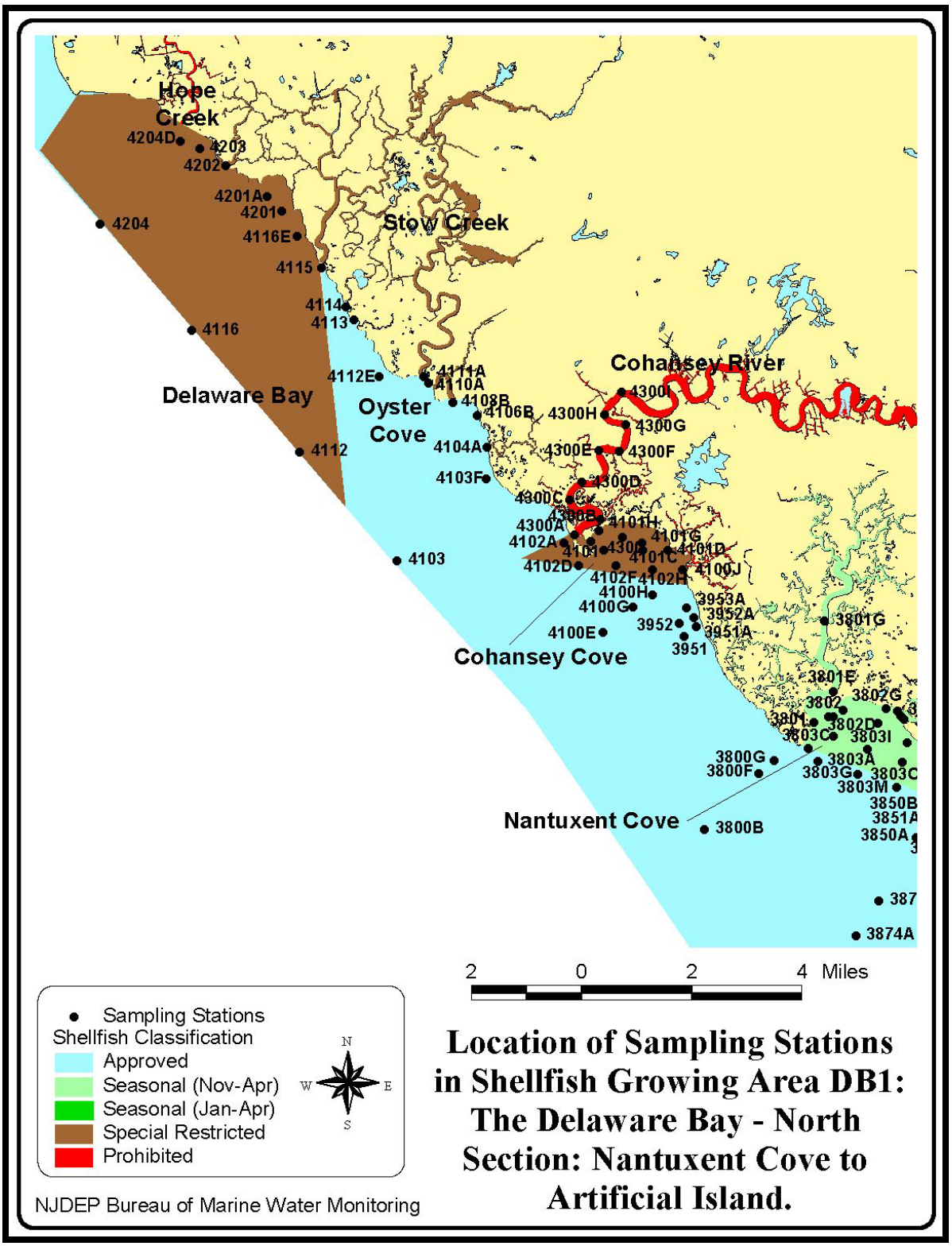

FIGURE 14: SAMPLING STATIONS IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

FIGURE 15: SAMPLING STATIONS IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

BACTERIOLOGICAL INVESTIGATION AND DATA ANALYSIS

The water quality of each growing area must be evaluated before an area can be classified as *Approved, Seasonally Approved (November to April), Seasonally Approved (January to April), Special Restricted,* or *Prohibited*. Criteria for bacterial acceptability of shellfish growing waters are provided in NSSP *Guide for the Control of Molluscan Shellfish*, 1999 Revision (USPHS, 1999 Revision).

SAMPLING STRATEGY

The State Shellfish Control Authority has the option of choosing one of two water monitoring sampling strategies for each growing area.

The Adverse Pollution Condition (APC) strategy requires that a minimum of five samples be collected each year under conditions that have historically resulted in elevated coliforms in the particular growing area. The results must be evaluated by adding the individual station sample results to the preexisting bacteriological sampling results to constitute a data set of at least 15 samples for each station. The adverse pollution conditions usually are related to tide, and rainfall, but could be from a point source of pollution or variation could occur during a specific time of the year (Connell, 1991).

The Systematic Random Sampling (SRS) strategy requires that a random sampling plan be in place before field sampling begins. This strategy can only be used in areas that are not affected by point sources of contamination. A minimum of six samples per station are to be collected each year and added to the database to obtain a sample size of 30 for statistical analysis.

The Delaware Bay from Maurice River Cove to Artificial Island is sampled using the Adverse Pollution Condition strategy year-round for all of the sampling stations in this area (Assignments 315, 327, 332, 357, and 362).

NSSP CRITERIA

Each shellfish producing state is directed to adopt either the total coliform criterion or the fecal coliform criterion. While New Jersey bases its growing water classifications on the total coliform criterion, it does make corresponding fecal coliform determinations for each sampling station. These data are viewed as adjunct information and are not directly used for classification.

The criteria were developed to ensure that shellfish harvested from the designated waters would be free of pathogenic (disease-producing) bacteria. Each classification criterion is composed of a measure of the statistical ‘central

tendency' (geometric mean) and the relative variability of the data set. For the Adverse Pollution Condition sampling strategy, variability is expressed as the percentage that exceeds the variability criteria (see Table 2). For the Systematic Random Sampling Strategy, variability is expressed as the 90th percentile (see Table 3).

Areas to be *Approved* under the *Seasonal* classification must be sampled and meet the criterion during the time of the year that it is approved for the harvest of shellfish.

TABLE 2: CRITERIA FOR ADVERSE POLLUTION CONDITION SAMPLING STRATEGY

	Total Coliform Criteria		**Fecal Coliform Criteria**	
	Geometric mean (MPN/100 mL)	**No more than 10% of sample can exceed (MPN/100 mL)**	**Geometric mean (MPN/100 mL)**	**No more than 10% of sample can exceed (MPN/100 mL)**
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

TABLE 3: CRITERIA FOR SYSTEMATIC RANDOM SAMPLING STRATEGY

	Total Coliform Criteria		**Fecal Coliform Criteria**	
	Geometric mean (MPN/100 mL)	**Estimated 90th percentile (MPN/100 mL)**	**Geometric mean (MPN/100 mL)**	**Estimated 90th percentile (MPN/100 mL)**
Approved Water Classification	70	330	14	49
Special Restricted Water Classification	700	3300	88	300

SHORELINE SURVEY

CHANGES SINCE LAST SURVEY

The shoreline survey that was performed by the author for this area on May 6, 2004 determined that there have been no changes to the area bordering this shellfish growing area since the 2003 Sanitary Survey of Shellfish Growing Area DB1, Artificial Island to East Point.

LAND USE

The major land use patterns for the municipalities adjacent to this shellfish growing area are mainly wetland areas, agricultural areas, and forest areas, with some urban and rural areas interspersed between them. The urban areas border this shellfish growing area to the north and northeast, while the rural areas are interspersed throughout the surrounding municipalities. The rural areas in these municipalities are connected to private septic systems, while most of the urban areas are connected to public sewer systems. Figures 16 and 17 show the land use patterns for the surrounding shoreline of this area.

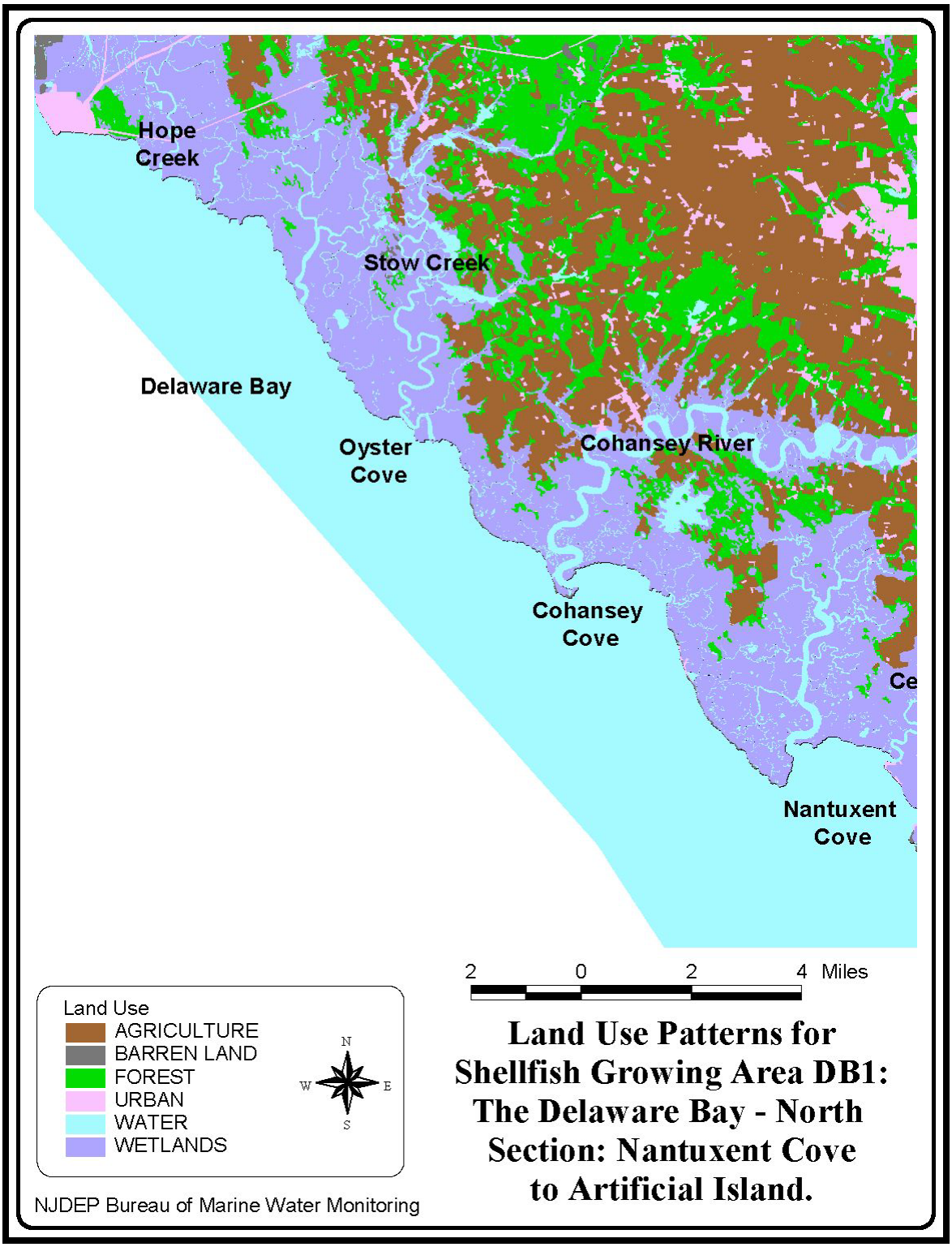

FIGURE 16: LAND USE PATTERNS FOR SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

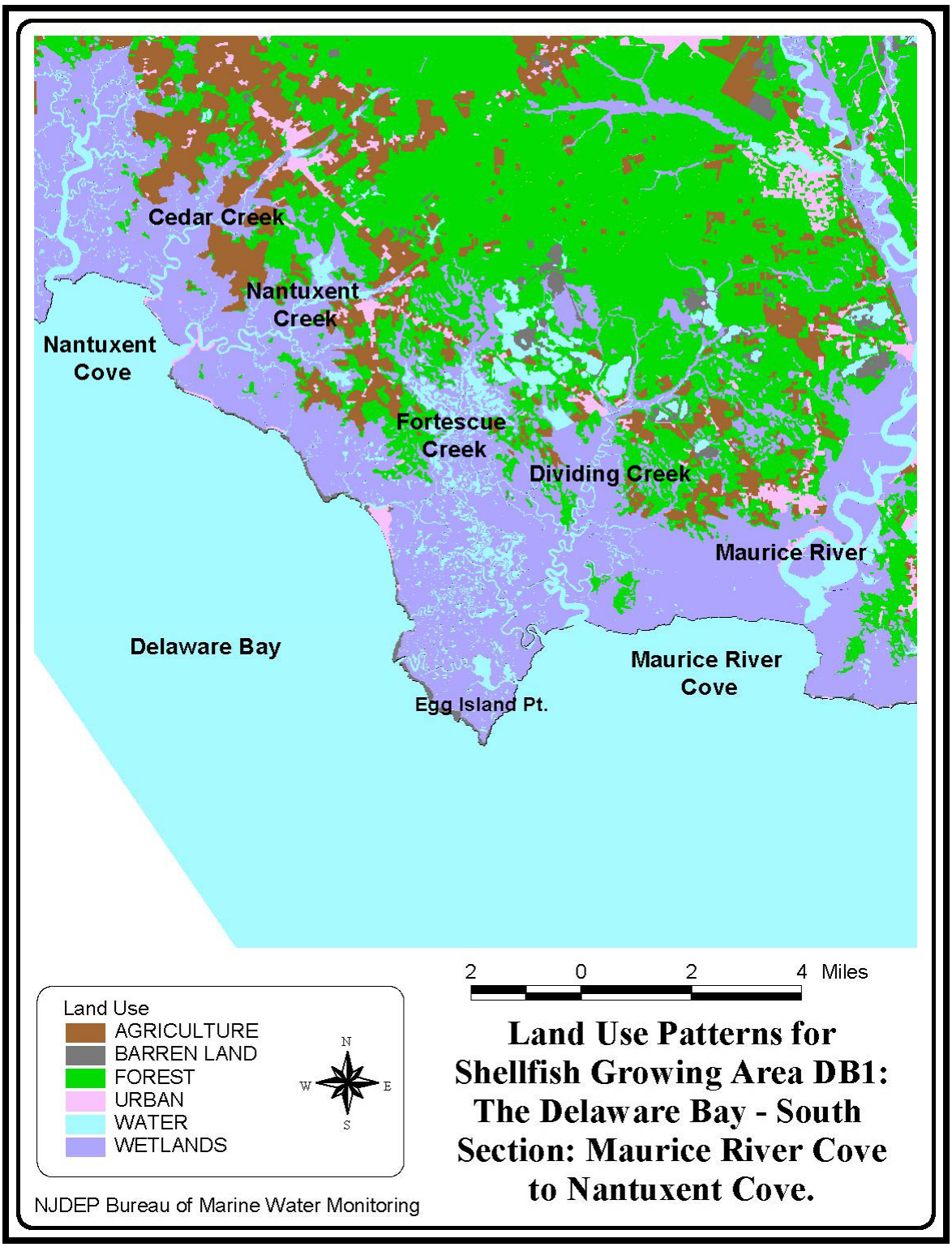

FIGURE 17: LAND USE PATTERNS FOR SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

EVALUATION OF BIOLOGICAL RESOURCES

This growing area has a wide diversity of biological resources. Hard clams (*Mercenaria Mercenaria*) exist in low abundance and are privately and commercially harvested (Morris, 1975, Gosner, 1978). In New Jersey for 2002, the shellfish landings for hard clams were 1,542,445 pounds harvested for an exvessel value of $6,402,616 (NJDEP, 2004). The eastern oyster (*Crassostrea virginica*) exists in medium abundance in the Delaware Bay, and has a long history of its commercial and economic importance in the Delaware Estuary (Morris, 1975, Gosner, 1978, Matassino, et al, 2002). In New Jersey for 2002, the shellfish landings for oysters were 379,284 pounds harvested for an exvessel value of $1,852,523 (NJDEP, 2004).

In 1999, New Jersey harvested 76,789,849 pounds of shellfish meat, with an exvessel value of $61,136,981. For New Jersey, the 2000 shellfish landings total were 84,723,999 pounds of shellfish meat for an exvessel value of $75,087,167, the 2001 shellfish landings total were 88,611,198 pounds of shellfish meat for an exvessel value of $83,523,782, and the 2002 shellfish landings total were 90,768,652 pounds of shellfish meat for an exvessel value of $88,136,826. These shellfish species include blue crabs (*Callinectes sapidus*), blue crabs – peelers, hard clams (*Mercenaria mercenaria*), soft clams (*Mya arenaria*), mussels (Family: Mytilidae), bay scallops (*Aequipecten irradians*), oysters (*Crassostrea virginica*), ocean quahogs (*Arctica islandica*), surf clams (*Spisula solidissima*), and sea scallops (*Placopecten magellanicus*) (NJDEP, 2004, NJDEP, 2003, Morris, 1975, Gosner, 1978). However, this report primarily focuses on bivalve mollusks, such as clams, quahogs, oysters, and mussels, and does not include crustaceans, such as blue crabs.

The cities of Port Norris and Bivalve, along the Maurice River in Cumberland County, were once known as the hub of the Delaware Bay oyster industry, and Bivalve was once recognized to be the oyster capital of the world for its oyster production and processing industries (see Figure 21). Their oyster industry processed and delivered thousands of pounds of oysters to markets all over the eastern coast of the United States (Flemlin and Tweed, 2000, Matassino, et al, 2002).

The population of oysters in the Delaware Bay has fluctuated widely. In the early 1900's, annual oyster landings were from one million to two million bushels. However, in the 1950's, the oyster population was reduced dramatically by the disease MSX, which is caused by the parasite *Haplosporidium nelsoni*. Only 49,000 bushels of oysters were harvested in the Delaware Bay in 1960. There was a gradual increase in the numbers of oysters harvested in the late 1960's and early 1970's. Then, in 1990, a new

disease named Dermo was found to be spreading among the oyster population on the eastern side of the Delaware Bay and it caused heavy losses of both planted and seeded oysters. Dermo is caused by the parasite *Perkinsus marinus*. In 1988, juvenile oyster disease (JOD) also became a serious problem for oyster nurseries in the northeastern Atlantic region. The causative agent for JOD is unknown (Guo, Dr. Ximing, and Dr. John Kraeuter, 2000).

The Haskin Shellfish Research Laboratory of Rutgers University has attempted to develop disease resistant strains of oysters that show a resistance to MSX (see Figure 20). Their long-term oyster-breeding program has managed to genetically produce a disease resistant strain of oysters for MSX, and they have also managed to genetically produce an oyster with some resistance to Dermo. These disease resistant oysters are the main production line for the Atlantic Cape Fisheries oyster farm in Cape May (Guo and Kraeuter, 2000).

The bacteria *Vibrio parahaemolyticus* (*Vp*) also causes illness from eating infected raw oysters, clams, and mussels. An outbreak of *Vibrio parahaemolyticus* entertitus occurred in July 2002 from oysters harvested in the Delaware Bay, and portions of the Delaware Bay were closed for shellfish harvesting from July 29 to August 9, 2002.

The 2003 *Vibrio parahaemolyticus* (*Vp*) monitoring of oysters from the Delaware Bay was performed by the Bureau of Marine Water Monitoring, from May 28 through Sept. 22, 2003, for over 20 sampling days. A total of 42 oyster samples (sample consists of the homogenate of 12 animals) from two harvest areas in the Delaware Bay were collected and analyzed during the 2003 season. Overall, *Vp* levels detected during the 2003 season were the lowest levels detected during our 3 year *Vp* monitoring program. All sample results were significantly below the National Shellfish Sanitation Program (NSSP) guidelines. New for the 2003 monitoring season was the initiation of two (2) studies to ascertain the effects of post-harvest time/temperature on *Vp* levels. The preliminary results of these studies indicate that the use of tarps to shade the product and the use of spray to promote evaporational cooling are effective in reducing post-harvest *Vp* levels. These studies continued during the 2004 season.

The Delaware Bay also contains the world's largest population of horseshoe crabs (*Linulus polyphemus*) (see Figure 19). In New Jersey for 2001, the landings for horseshoe crabs were 1,098,980 pounds harvested for an exvessel value of $246,217 (NJDEP, 2004). However, since horseshoe crabs are used as bait for catching eels and conch, and their natural habitat is gradually being lost to development and shoreline retreat, the population of horseshoe crabs has been declining. Migrating shorebirds also feed on the eggs of nesting horseshoe crabs, which also contributes to their decline in population numbers (Matassino, et al., 2002).

Blue crabs (*Callinectes sapidus*) are also found in the waters of the Delaware Bay and they are commercially and recreationally harvested from these waters. In New Jersey for 2002, the landings of blue crabs were 5,999,612 pounds harvested for an exvessel value of $6,173,797 (NJDEP, 2004). However, the primarily focus of this

report is bivalve mollusks, such as clams, quahogs, oysters, and mussels, and does not include crustaceans, such as blue crabs or horseshoe crabs.

Striped bass (*Morone saxatilis*) and American shad (*Alosa sapidissima*) are also an important biological resource in the Delaware Bay and Delaware River (Matassino, et al., 2002). Both of these species of fish are commercially and recreationally harvested in the waters of this shellfish growing area, since this area is also utilized for fishing and boating. In 1991, the striped bass was classified as a gamefish in New Jersey, and this status prevents the commercial harvest or sale of this first coastal saltwater species designated as such in New Jersey (Bochenek, 2000).

The Delaware Bay is also located along the Atlantic Flyway, an important migratory corridor for wildlife populations of shorebirds. This area is considered to be one of the largest stopover locations along the Atlantic Flyway, with an estimated 425,000 to 1,000,000 migratory shorebirds converging and feeding in the Delaware Bay Estuary. Red Knot, Dunlin, Ruddy Turnstone, Sanderling, Semi-Palmated Sandpiper, and other species of shorebirds use the Delaware Bay Estuary as an important resting and feeding area, and they are known to consume large quantities of horseshoe crab eggs (certain species of shorebirds can and will eat thousands of horseshoe crab eggs in a single day) (Matassino, et al., 2002).

The wetlands bordering this shellfish growing area also contain the Corsons Wildlife Management Area, the Heislerville Wildlife Management Area, the Turkey Point Fish & Wildlife Management Area, the Egg Island Berrytown Wildlife Management Area, the Fortescue Wildlife Management Area, the Nantuxent Wildlife Management Area, the New Sweden Wildlife Management Area, the Dix Fish & Wildlife Management Area, the Osborn Fish & Wildlife Management Area, and the Mad Horse Creek Wildlife Management Area. Figure 22 shows the marsh vegetation at the Turkey Point Fish & Wildlife Management Area.

FIGURE 18: GULLS IN THE MAURICE RIVER, NORTH OF EAST POINT. PHOTOGRAPH WAS TAKEN ON MAY 6, 2004 AT 11:16 A.M.

FIGURE 19: HORSESHOE CRABS ON THE SHORE OF THE MAURICE RIVER, NORTH OF EAST POINT. PHOTOGRAPH WAS TAKEN ON MAY 6, 2004 AT 11:14 A.M.

FIGURE 20: THE HASKIN SHELLFISH RESEARCH LABORATORY IN BIVALVE. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 9:14 A.M.

FIGURE 21: BIVALVE PACKING COMPANY, BIVALVE. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 9:11 A.M.

FIGURE 22: MARSH VEGETATION AT THE TURKEY POINT FISH & WILDLIFE MANAGEMENT AREA, EAST OF DIVIDING CREEK. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 9:39 A.M.

IDENTIFICATION AND EVALUATION OF POLLUTION SOURCES

There are eight permitted municipal point source discharges in Area DB1 (The Delaware Bay – Maurice River Cove to Artificial Island). Three of these municipal point sources discharge industrial wastewater from their cooling systems directly into the Delaware Bay. They are: 1) the PSE&G Hope Creek Nuclear Generating Station wastewater discharge pipe, 2a) the PSE&G Salem 1 Nuclear Generating Station wastewater discharge pipe, and 2b) the PSE&G Salem 2 Nuclear Generating Station wastewater discharge pipe (see Table 4 and Figure 21). The Hancock's Bridge Sewage Treatment Plant discharges residential wastewater directly into Alloways Creek, the Canton Village Sewage Treatment Plant discharges residential wastewater directly into Stow Creek, the Cumberland County Municipal Utilities Authority Facility discharges residential wastewater directly into the Cohansey River, the Millville Sewage Authority Facility discharges residential wastewater directly into the Maurice River, and the Bayside State Prison discharges residential wastewater directly into Riggins Ditch (see Table 4, and Figures 21 and 22). All of these creeks and tributaries flow into the Delaware Bay and are part of this shellfish growing area.

There are several indirect ground water discharges, known contaminated sites, and solid waste landfills located in this shellfish growing area (see Figures 23, 24, 25, 26, 27, and 28). However, there is no evidence that they currently impact the shellfish growing water quality (APHA, 1995).

TABLE 4: DIRECT WASTEWATER DISCHARGES TO SHELLFISH GROWING AREA DB1: THE DELAWARE BAY - MAURICE RIVER COVE TO ARTIFICIAL ISLAND.

Map Key	Discharge	Waste Type	Waste Quantity
1	PSE & G Hope Creek Nuclear Generating Station	Industrial Wastewater from Cooling System	48.2 MGD
2a 2b	PSE & G Salem 1 Nuclear Generating Station PSE & G Salem 2 Nuclear Generating Station	Industrial Wastewater from Cooling System	30.24 MGD
3	Hancock's Bridge Sewage Treatment Plant	Residential Wastewater	26.0 to 30.0 TGD
4	Canton Village Sewage Treatment Plant	Residential Wastewater	12.0 to 15.0 TGD
5	Cumberland County Municipal Utilities Authority Facility	Residential Wastewater	7.0 MGD
6	Millville Sewage Authority Facility	Residential Wastewater	5.0 MGD
7	Bayside State Prison	Residential Wastewater	0.67 MGD

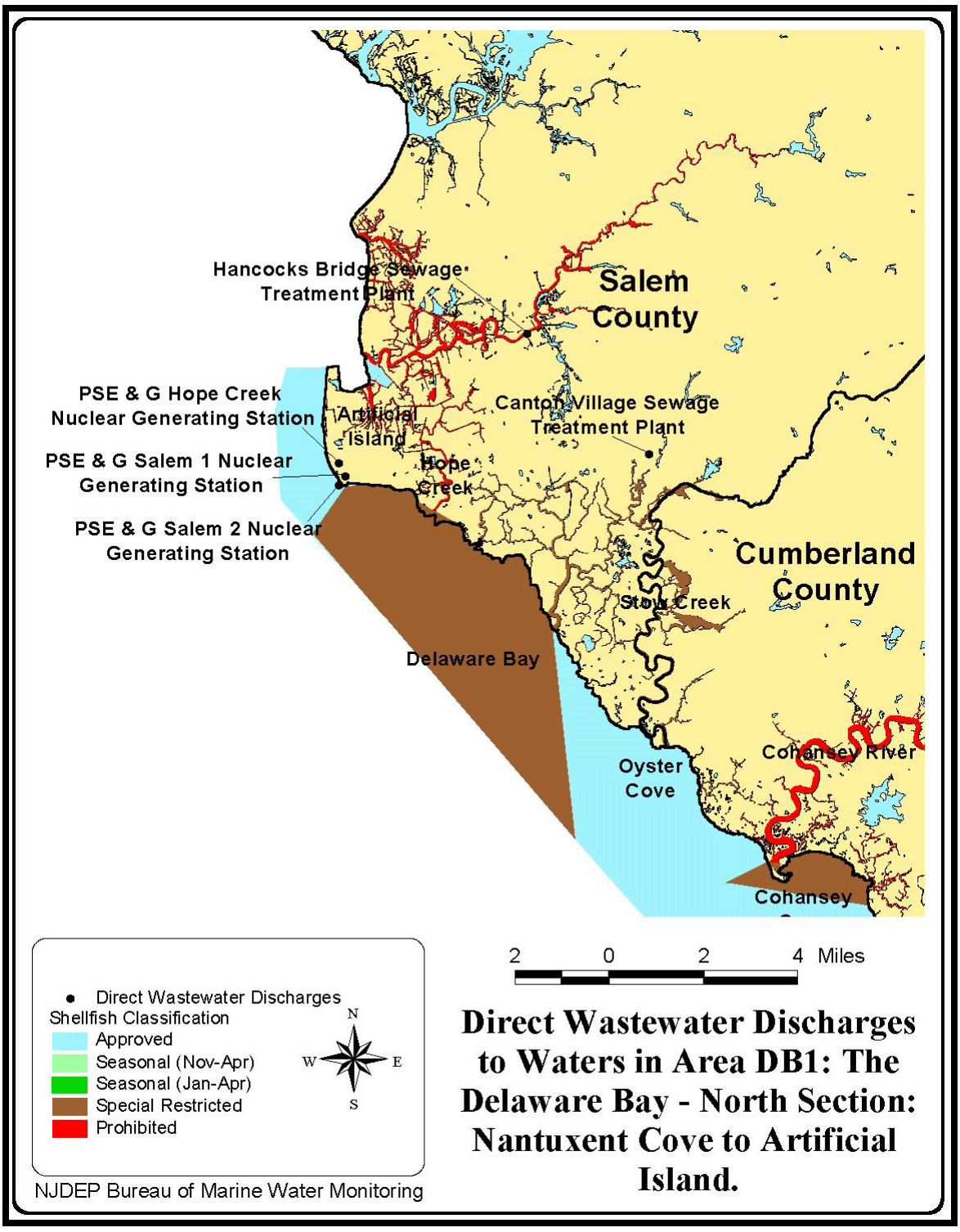

FIGURE 23: DIRECT WASTEWATER DISCHARGES TO WATERS IN AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

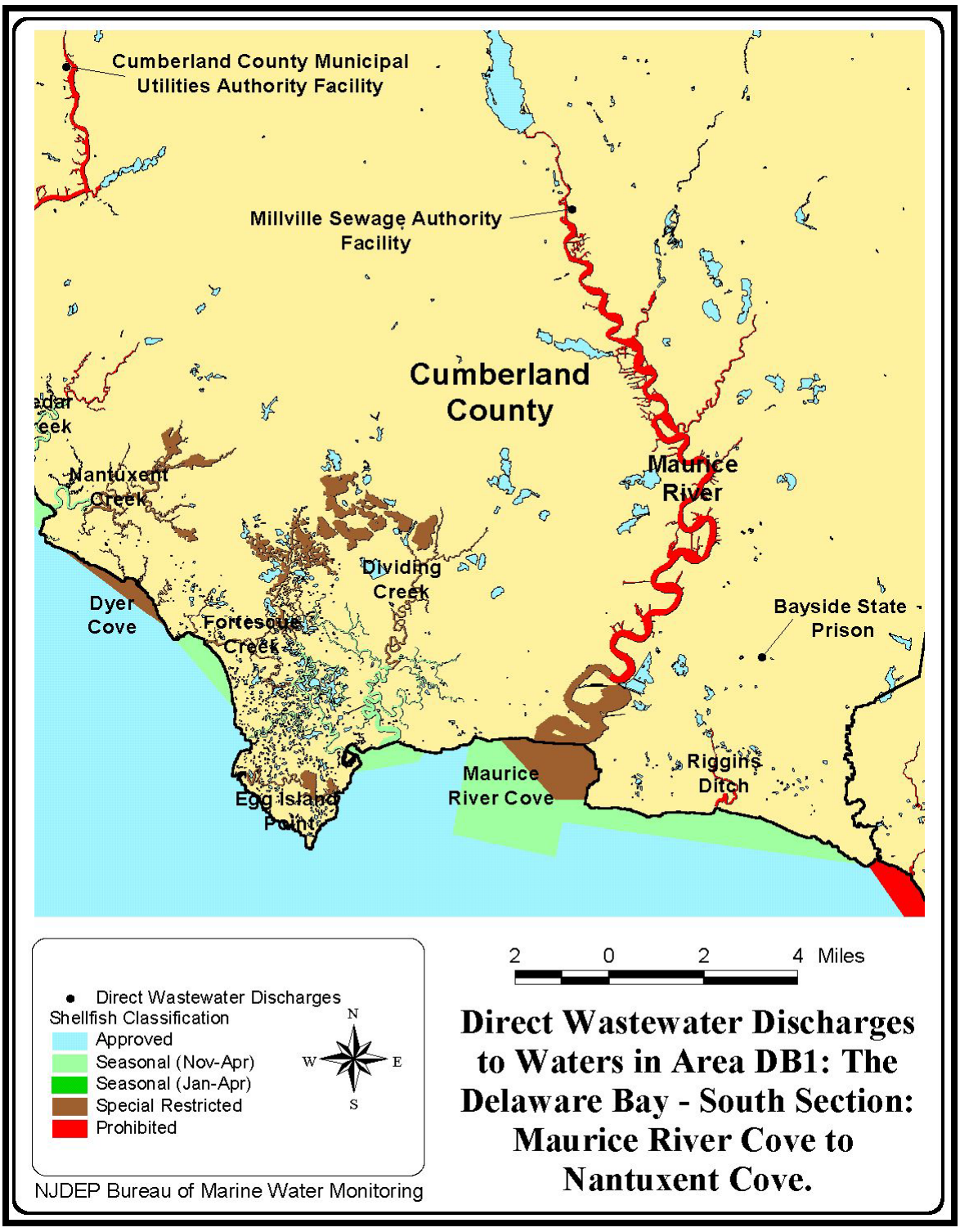

FIGURE 24: DIRECT WASTEWATER DISCHARGES TO WATERS IN AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

INDIRECT DISCHARGES

There are many indirect ground water discharges located in this shellfish growing area (see Figures 23 and 24). The major concentrations of these indirect ground water discharges are located along the Maurice River in Maurice River Township and Commercial Township, to the north of Dividing Creek in Downe Township, to the north of Nantuxent Creek and Cedar Creek in Lawrence Township, along the Cohansey River in Fairfield Township and Greenwich Township, and to the north of Stow Creek in Lower Alloways Creek Township, Salem County.

This shellfish growing area, which extends from the Maurice River Cove to Artificial Island, has several known contaminated sites located in the adjacent areas (see Figures 25 and 26). The major concentrations of these known contaminated sites are located along the Maurice River in Maurice River Township and Commercial Township, to the north and southeast of Dividing Creek in Downe Township, along the Cohansey River in Fairfield Township and Greenwich Township, and to the north of Stow Creek and Hope Creek in Lower Alloways Creek Township, Salem County. Most of these known contaminated sites are now closed.

There are many solid waste landfills that are located adjacent to this shellfish growing area (see Figures 27 and 28). These solid waste landfills are located along the Maurice River in Maurice River Township and Commercial Township, to the north of Fortescue Creek in Downe Township, to the north of the Nantuxent Creek in Lawrence Township, along the Cohansey River in Fairfield Township, and to the north of Stow Creek in Lower Alloways Creek Township, Salem County.

The indirect ground water discharges, the currently active known contaminated sites, and the solid waste landfills have the potential to impact the water quality of this shellfish growing area. Therefore, the water quality in the Delaware Bay from Artificial Island to the Maurice River Cove is constantly monitored to determine the presence or absence of these contaminants (APHA, 1995).

FIGURE 25: INDIRECT GROUND WATER POTENTIALLY DISCHARGING TO AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

FIGURE 26: INDIRECT GROUND WATER POTENTIALLY DISCHARGING TO AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

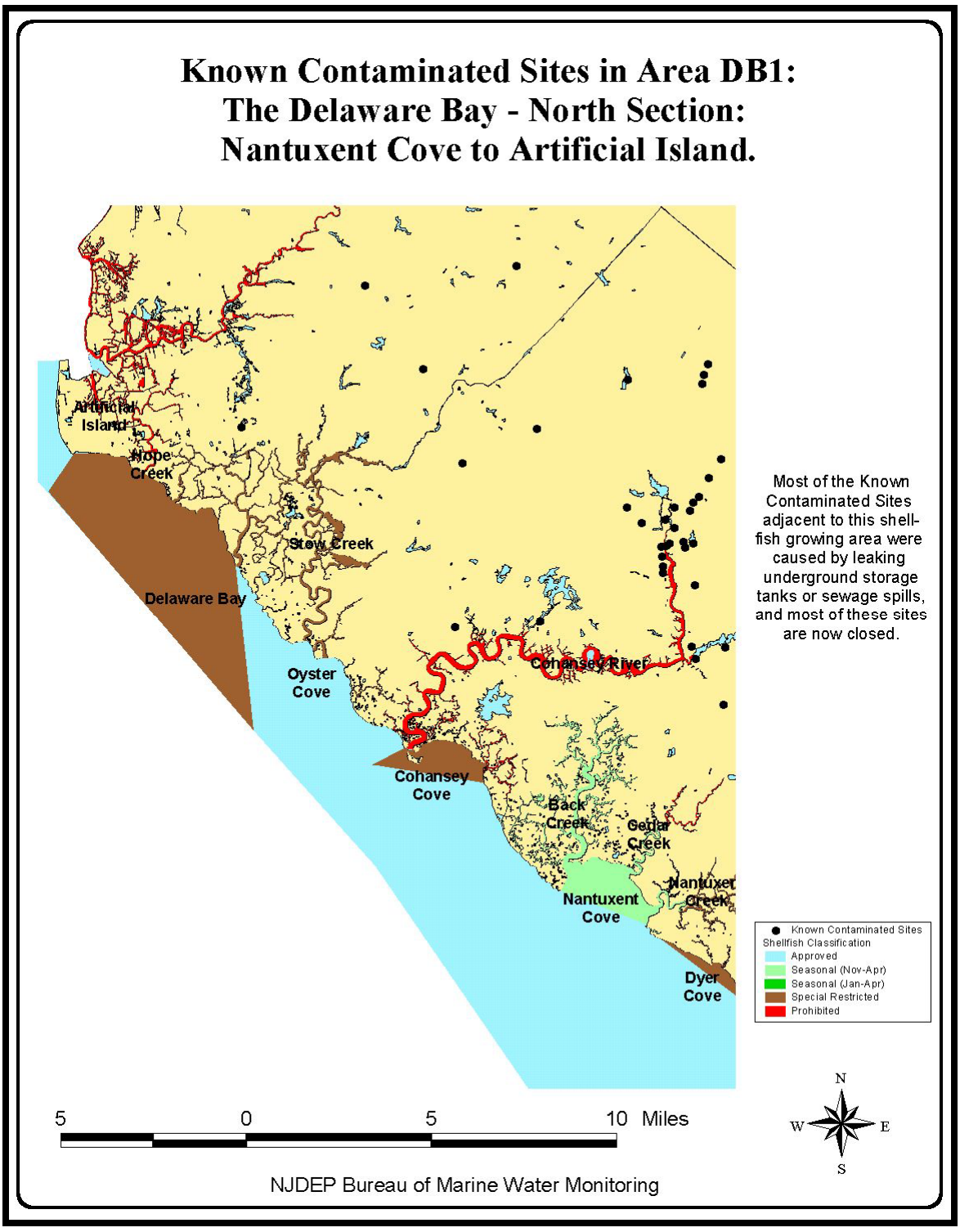

FIGURE 27: KNOWN CONTAMINATED SITES IN AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

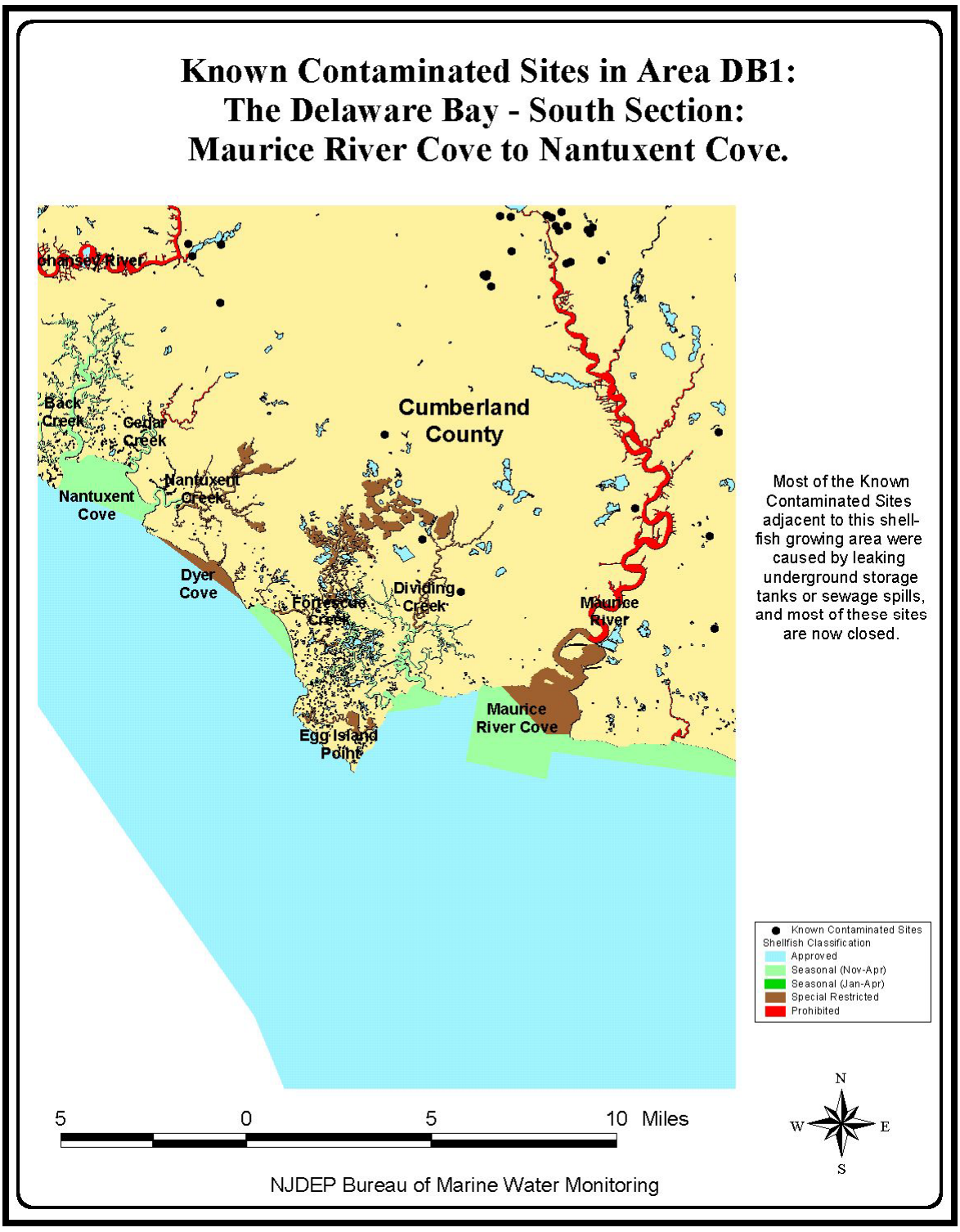

FIGURE 28: KNOWN CONTAMINATED SITES IN AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

FIGURE 29: SOLID WASTE LANDFILLS IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

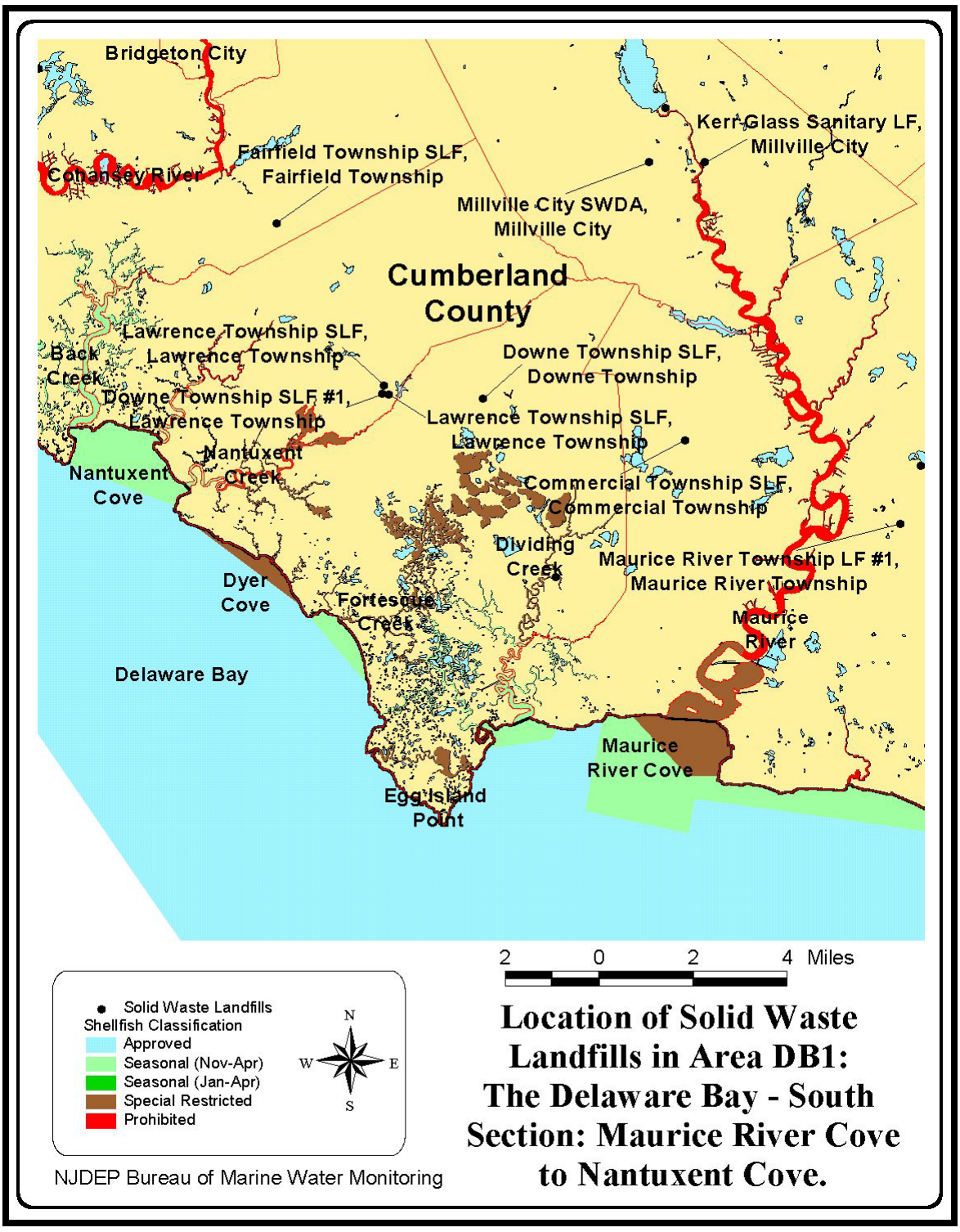

FIGURE 30: SOLID WASTE LANDFILLS IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

STORMWATER INPUTS

Information on stormwater discharges was not available from either State or County sources. Therefore, information on the locations of the stormwater outfalls in Salem and Cumberland Counties that drain into this shellfish growing area could not be included in this report.

MARINAS

Marina facilities have the potential to affect the suitability of shellfish growing areas for the harvest of shellfish. The biological and chemical contamination associated with marina facilities may be of public health significance. New Jersey defines a marina as "any structure (docks, piers, bulkheads, floating docks, etc.) that supports five or more boats, built on or near the water, which is utilized for docking, storing, or otherwise mooring vessels and usually but not necessarily provides services to vessels such as repairing, fueling, security, or other related activities" and designates the confines of the marina as *Prohibited* for the harvest of shellfish. Adjacent waters are classified using a dilution analysis formula.

It is recognized by the NSSP *Guide for the Control of Molluscan Shellfish* (USPHS, 1999 Revision) that there are significant regional differences in all factors that affect marina pollutant loading. The manual therefore allows each state latitude in applying specified occupancy and discharge rates. The NSSP guidelines assume the worst case scenario for each factor.

EQUATION 1: MARINA BUFFER EQUATION. (ADAPTED FROM FDA, 1989):

$$BufferRadius(ft) = \sqrt{\frac{2x10^{9}(FC/person/day)x2(person/boat)x[(.25slips \geq 24') + (0.065 \times slips < 24')]x2}{140000(FC/M^{3})xdepth(ft)x0.3048(M/ft)x\pi x2(tides/day)}} x3.28(ft/M)$$

Explanation of terms in equation:

Fecal coliform per person per day:	2×10^{9}
Number of people per boat:	2
For slips able to accommodate boats > 24 feet (combination of factors yields multiplier of 0.25):	
Number of slips occupied:	50%
Number of boats occupied:	50%
For boats < 24':	6.5% discharge waste
Angle of shoreline:	180^{o}, which results in factor of 2
Number of tides per day:	2
Depth in meters:	depth in feet x conversion factor
Water quality to be achieved:	140000 FC/meter ^{3}
Convert meters to feet:	3.28

Marina buffer zones may be calculated using the formula above (see Equation 1), or may be determined using a dilution analysis computer program developed by the State of Virginia and the USFDA. The formula above considers only dilution and occupancy rates. The computer program, which is used for complex configurations where the formula is unlikely to provide the needed accuracy, also considers tidal exchange and bacterial die-off.

There are 28 marinas in Shellfish Growing Area DB1, the Delaware Bay from Maurice River Cove to Artificial Island, as shown in Table 5 and Figures 29 and 30. The waters enclosed by the marina (the marina basin) are classified as *Prohibited*. Depending on the size of the marina, the water quality, flushing rates, and the depth of the water, water immediately adjacent to each marina may be classified as *Prohibited*, *Special Restricted*, or *Seasonally Approved* (no harvest during summer months when the marina is active). Marina buffer zones were calculated using the New Jersey Marina Buffer Equation (see Equation 1). The size of each buffer zone is shown in Table 5. Figures 31, 32, 33, and 34 show four of the marinas located in this shellfish growing area.

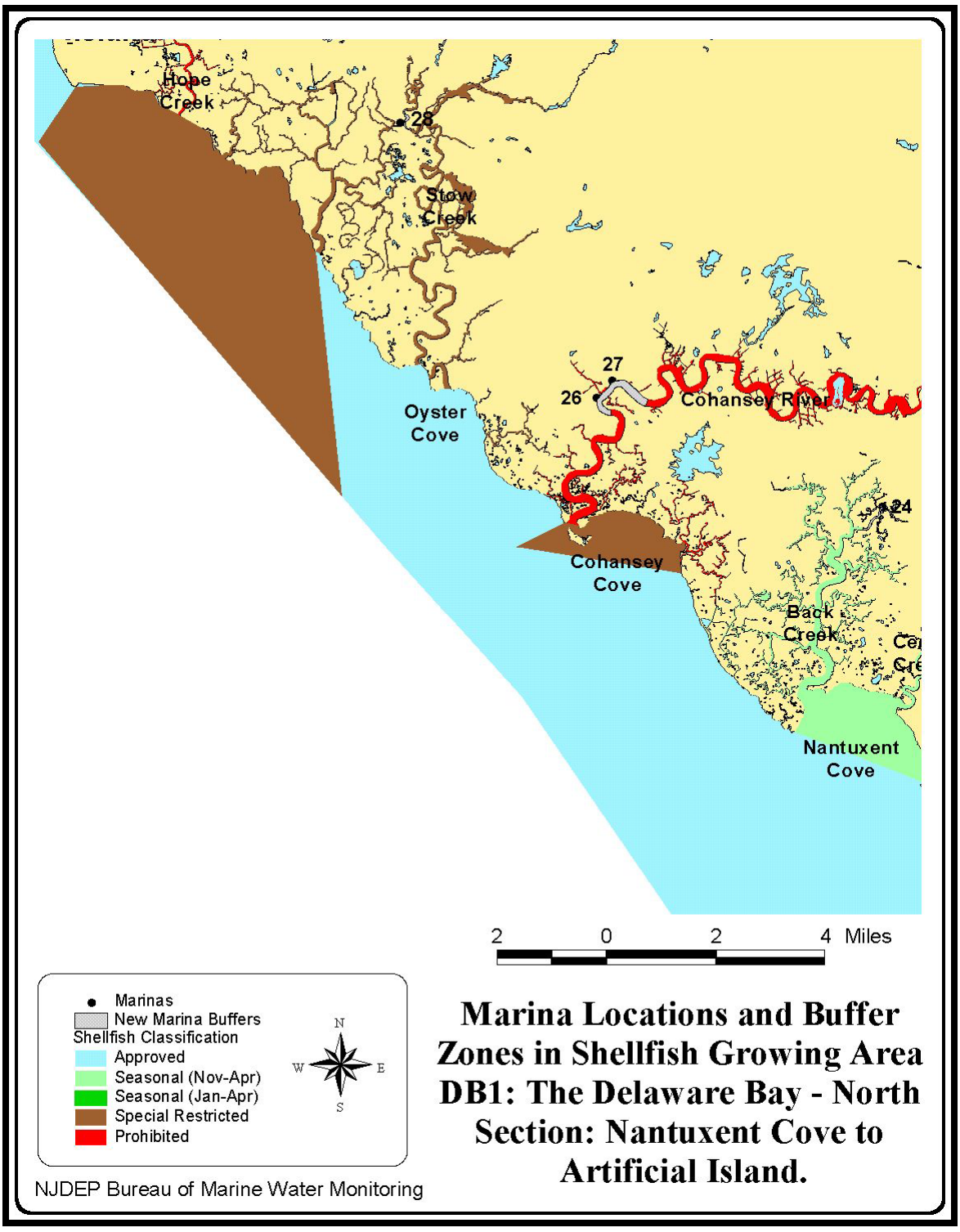

FIGURE 31: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

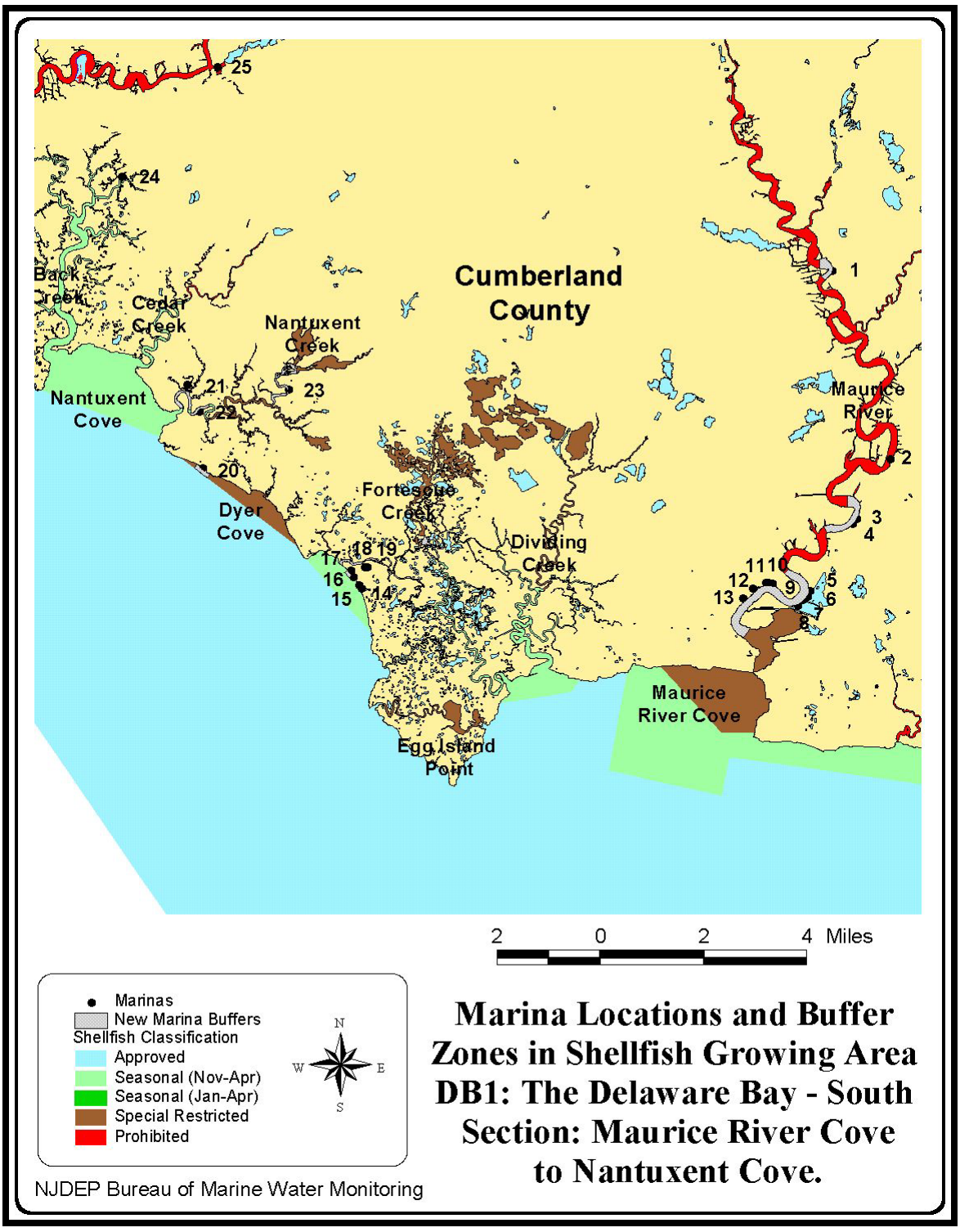

FIGURE 32: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

TABLE 5: MARINA FACILITIES LOCATED IN SHELLFISH GROWING AREA DB1: THE DELAWARE BAY - MAURICE RIVER COVE TO ARTIFICIAL ISLAND.

Map Key	Marina Name	Location	# of Wet Slips Total / Boats > 24 ft.	Size of Buffer Area (radius; feet)	Depth (ft)
1	Spring Garden Marina	Maurice River Township	45/23	1073	2
2	Cox's Penny Hill Marina	Maurice River Township	17/5	208	15
3	Boat World Marina	Maurice River Township	140/70	841	10
4	4 Star Marina	Maurice River Township	75/75	776	10
5	Anchor Marina	Maurice River Township	94/47	727	9
6	Haase Marina	Maurice River Township	25/10	352	9
7	Driftwood Marina	Maurice River Township	45/10	413	9
8	Popeye's Marina	Maurice River Township	115/55	793	9
9	Robinson's Marina	Commercial Township	75/13	510	9
10	Port Norris Marina	Commercial Township	200/55	862	10
11	Port Norris South Marina	Commercial Township	200/40	809	10
12	Sail Loft Marina	Commercial Township	19/3	253	9
13	Long Reach Marina	Commercial Township	200/15	750	9
14	Hook, Line, and Sinker Marina	Downe Township	No slips (rentals). Launch from rails	-----	Beach Front
15	Fortescue Pavilion Marina (marina was closed and up for sale during shoreline survey on June 7, 2003).	Downe Township	Dry dock 50. No slips (rental and private). Launch from rail.	-----	Beach Front
16	Borkowski's Triangle Marina	Downe Township	No slips (rentals). Launch from rails.	-----	Beach Front
17	Double A Marina	Downe Township	16/0	289	4
18	Fortescue State Marina	Downe Township	125/70	1163	5
19	Higbee's Marina	Downe Township	20/0	289	5
20	Gandy's Beach Marina	Downe Township	60/0	500	5
21	Nantuxent WMA	Lawrence Township	60/60	829	7
22	Money Island Marina	Downe Township	60/0	423	7
23	Sundog Marina	Downe Township	60/60	829	7
24	Husteds Landing Marina	Fairfield Township	85/25	807	5

Map Key	Marina Name	Location	# of Wet Slips Total / Boats > 24 ft.	Size of Buffer Area (radius; feet)	Depth (ft)
25	Fairton Marina (marina was closed and locked up during shoreline survey on June 7, 2003).	Fairfield Township	0/0 (ramp to members only).	-----	12
26	Hancocks Harbor Marina	Greenwich Township	125/63	727	12
27	Greenwich Boat Works	Greenwich Township	250/125	1026	12
28	Mad Horse Creek WMA	Lower Alloways Creek Township	15/15	415	7

FIGURE 33: LOCATION OF POPEYE'S MARINA IN THE MAURICE RIVER. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 8:26 A.M.

FIGURE 34: LOCATION OF FORTESCUE STATE MARINA IN THE FORTESCUE CREEK. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 10:33 A.M.

FIGURE 35: LOCATION OF SUNDOG MARINA IN THE NANTUXENT CREEK. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 10:49 A.M.

FIGURE 36: LOCATION OF HANCOCKS HARBOR MARINA ON THE COHANSEY RIVER. PHOTOGRAPH WAS TAKEN ON JUNE 7, 2003 AT 12:33 P.M.

HYDROLOGY AND METEOROLOGY

PATTERNS OF PRECIPITATION

Precipitation patterns in the coastal areas of New Jersey are typical of the Mid-Atlantic coastal region (see Table 6). Typical summer storms are localized storms associated with thunderstorms. Winter storms are frequently associated with northeasters. Hurricanes can occur during the summer and early fall.

TABLE 6: AVERAGE MID-ATLANTIC STORM EVENT INFORMATION. SOURCES: USEPA; US DEPARTMENT OF COMMERCE

Annual Average Number of Storms	60
Average Storm Event Duration	10 hours
Average Storm Event Intensity	0.08 – 0.09 inches/hour
Average Storm Event Volume	0.65 inches

Although the average storm event lasts approximately 10 hours, with an accumulation of 0.65 inches, it is not unusual for an individual storm volume to be 2 – 3 inches. Note the data below that show the 2-year return 6-hour storm event to be between two (2) and three (3) in inches, while the 2-year 24-hour return volume varies between three (3) and four (4) inches (see Table 7). Storm volumes greater than approximately 3.5 – 4.0 inches are much less frequent.

TABLE 7: STORM EVENT VOLUME FOR 2-YEAR STORM EVENT RECURRENCE (SOURCE: USGS**)**

Location	2-Year, 1-Hour Rainfall	2-Year, 6-Hour Rainfall	2-Year, 24-Hour Rainfall
Millville	1.33	2.33	3.02
Cape May	1.33	2.41	3.10
Atlantic City	1.47	2.67	3.65
Long Branch	1.55	3.02	4.15
Newark	1.21	2.34	3.25
Sandy Hook	1.37	2.73	3.68

The duration and volume of storm events can also be depicted as frequency histograms. This graphical depiction (shown below in Figure 35 for Shellfish Growing Area DB1 with measurements taken at the NOAA Millville Municipal Airport station in Millville, NJ, for the time period from 1993 to 2003) provides insight into the frequency of cumulative precipitation of a given size.

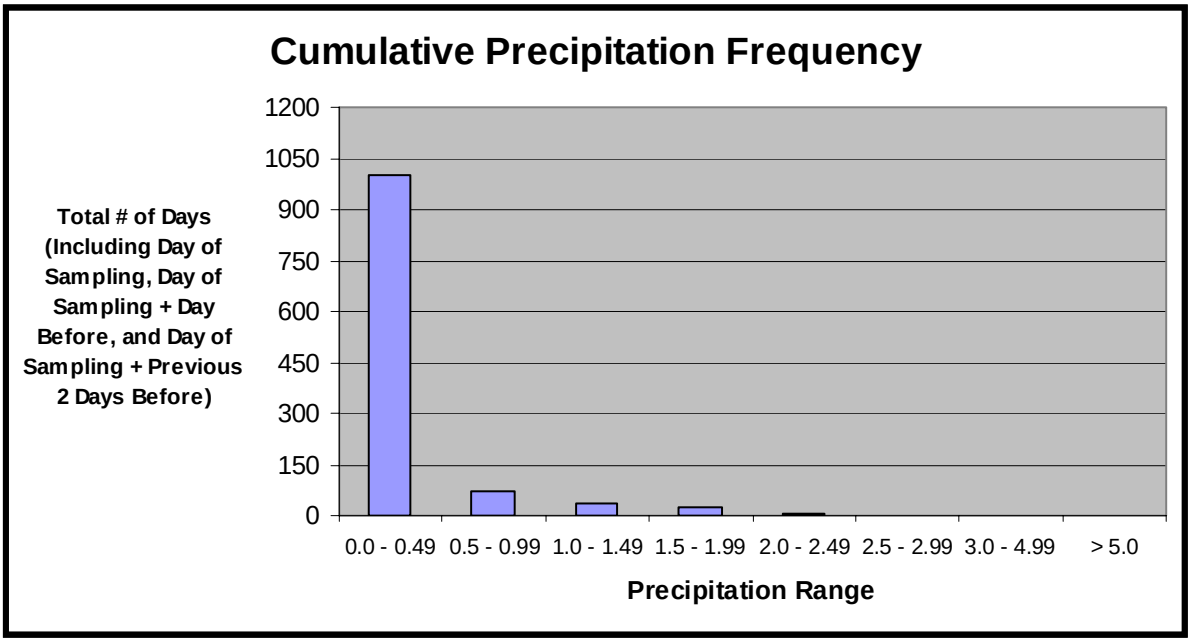

FIGURE 37: STORM EVENT FREQUENCY HISTOGRAM (1993-2003) (SOURCE: NOAA CLIMATIC DATA)

HYDROLOGY

Shellfish Growing Area DB1 – the Delaware Bay from Maurice River Cove to Artificial Island typically has depths ranging from 1 feet to 32 feet (MLW). Table 8 shows the mean range of tides for the shorelines surrounding this shellfish growing area. The tidal cycle is semidiurnal, with two high tides and two low tides in a 24 hour, 50 minute period. The Maurice River, Dividing Creek, Oranoaken Creek, Straight Creek, Fishing Creek, Fortescue Creek, Beadons Creek, Sow and Pigs Creek, Padgett Creek, Dyer Creek, Nantuxent Creek, Cedar Creek, Back Creek, Oyster Gut, Middle Marsh Creek, Drumbo Creek, the Cohansey River, Cabin Creek, Fishing Creek, and Jacobs Creek drain into this shellfish growing area in Cumberland County (USDI-GS, 1977-Port Norris, USDI-GS, 1977-Fortescue, USDI-GS, 1982-Cedarville, USDI-GS, 1972-Ben Davis Point, USDI-GS, 1977-Bombay Hook). Stow Creek, Muddy Creek, Cherry Tree Creek, Lower Deep Creek, Mad Horse Creek, Fishing Creek,

Hope Creek, and the Delaware River drain into this shellfish growing area in Salem County (USDI-GS, 1977-Canton, USDI-GS, 1981-Taylors Bridge). Tidal flushing occurs through the Cape May Channel (USDI-GS, 1972-Cape May).

This shellfish growing area was sampled with an ebb tide preference for Assignment Area 332 (Dividing Creek and Maurice River Cove). Ebb and flood tides describe the horizontal motions associated with the fall and rise of the tide in restricted regions along the coast. Tidal currents can affect the water quality of a shellfish growing area because hydrographic and meteorological characteristics, such as tidal amplitude and type, water circulation patterns, depth, salinity, stratification characteristics, rainfall patterns and intensity, and prevailing winds may affect the distribution of pollutants in a specific area (Ingmanson and Wallace, 1989). This is why an evaluation of pollution sources and hydrographic characteristics are used to evaluate the water quality in a shellfish growing area.

Precipitation inputs to this area for the period 1999 through 2003 are shown in Table 9, and the Storm Event Frequency Histogram for this area from 1993 through 2003 are shown in Figure 35. There have been no significant changes in hydrology since the last sanitary survey report was written in 2003. The primary weather station for this area is the Millville Municipal Airport in Millville. The secondary weather stations for this area are the Cape May Station, the Atlantic City International Airport Station in Pomona, and the Seabrook Farms Station in Bridgeton. The secondary station data are used when data from the primary station are incomplete.

TABLE 8: TABLE OF MEAN RANGE OF TIDES FOR THE SHORELINES SURROUNDING AREA DB1: THE DELAWARE BAY - MAURICE RIVER COVE TO ARTIFICIAL ISLAND.

Location:	**Township:**	**County:**	**Mean Range of Tide (MLW)**
From: Thompsons Beach	Maurice River Township	Cumberland	5.7 feet
To: Oranoaken Creek	Downe Township	Cumberland	
From: Oranoaken Creek	Downe Township	Cumberland	5.9 feet
To: Cedar Creek	Lawrence Township	Cumberland	
From: Cedar Creek	Lawrence Township	Cumberland	6.0 feet
To: Cohansey River	Fairfield Township	Cumberland	
From: Cohansey River	Fairfield Township	Cumberland	5.8 feet
To: Jacobs Creek	Greenwich Township	Cumberland	
From: Jacobs Creek	Greenwich Township	Cumberland	6.0 feet
To: Alloway Creek	Lower Alloways Creek Township	Salem	

TABLE 9: CLIMATOLOGICAL DATA

Rainfall Recorded at NOAA's Millville Airport Station, Millville, NJ.

Sampling Date	Precipitation in Inches		
	Day of Sampling	Day of Sampling + Day Before	Day of Sampling + Previous 2 Days Before
10/1/1999	0.000	0.650	0.650
10/5/1999	0.000	0.460	0.470
10/6/1999	0.000	0.000	0.460
10/7/1999	0.000	0.000	0.000
10/20/1999	0.950	0.950	1.000
10/28/1999	0.000	0.000	0.000
12/3/1999	0.000	0.000	0.000
12/13/1999	0.060	0.060	0.060
12/15/1999	0.000	1.310	1.370
1/3/2000	0.000	0.000	0.000
1/7/2000	0.000	0.000	0.000
3/13/2000	0.000	0.310	0.450
3/14/2000	0.000	0.000	0.310
3/15/2000	0.000	0.000	0.000
3/28/2000	0.080	0.080	0.080
3/30/2000	0.000	0.000	0.080
4/4/2000	0.580	0.580	0.590
4/11/2000	0.010	0.010	0.380
4/25/2000	0.240	0.240	0.240
4/26/2000	0.000	0.240	0.240
4/27/2000	0.040	0.040	0.280
4/28/2000	0.000	0.040	0.040
5/16/2000	0.000	0.000	0.010
5/22/2000	0.380	0.560	0.740
5/31/2000	0.000	0.000	0.010
6/2/2000	0.000	0.000	0.000
6/12/2000	0.010	0.010	0.010
6/14/2000	0.020	0.020	0.030
6/26/2000	0.530	0.530	0.530
6/28/2000	2.030	2.040	2.57
7/10/2000	0.010	0.010	0.010
7/11/2000	0.000	0.010	0.010
7/12/2000	0.000	0.000	0.010
7/24/2000	0.020	0.020	0.270
7/27/2000	0.300	0.930	1.090
7/28/2000	0.000	0.300	0.930
8/7/2000	0.250	0.250	0.250
8/8/2000	0.000	0.250	0.250
8/10/2000	0.000	0.030	0.030
8/11/2000	0.000	0.000	0.030
8/18/2000	0.420	0.420	0.420
8/22/2000	0.010	0.010	0.020
9/5/2000	0.000	0.320	0.480

Sampling Date	Precipitation in Inches		
	Day of Sampling	Day of Sampling + Day Before	Day of Sampling + Previous 2 Days Before
9/6/2000	0.000	0.000	0.320
9/14/2000	0.010	0.010	0.010
9/18/2000	0.000	0.000	0.000
9/22/2000	0.000	0.000	0.000
10/3/2000	0.000	0.000	0.000
10/4/2000	0.000	0.000	0.000
10/5/2000	0.000	0.000	0.000
10/24/2000	0.000	0.000	0.000
11/8/2000	0.000	0.000	0.000
11/9/2000	0.000	0.000	0.000
11/28/2000	0.020	0.360	1.910
12/4/2000	0.000	0.000	0.000
12/5/2000	0.000	0.000	0.000
12/6/2000	0.000	0.000	0.000
12/7/2000	0.005	0.005	0.005
1/16/2001	0.005	0.135	0.135
1/24/2001	0.000	0.000	0.005
1/29/2001	0.000	0.010	0.015
2/7/2001	0.000	0.000	1.250
2/8/2001	0.000	0.000	0.000
3/26/2001	0.110	0.110	0.110
3/27/2001	0.000	0.110	0.110
3/28/2001	0.000	0.000	0.110
4/2/2001	0.020	0.020	0.030
4/3/2001	0.000	0.020	0.020
4/9/2001	0.160	0.300	0.300
4/16/2001	0.020	0.290	0.290
4/17/2001	0.110	0.130	0.400
4/30/2001	0.000	0.000	0.000
5/1/2001	0.000	0.000	0.000
5/3/2001	0.000	0.000	0.000
5/4/2001	0.000	0.000	0.000
5/7/2001	0.000	0.000	0.000
5/8/2001	0.000	0.000	0.000
5/17/2001	0.000	0.000	0.000
6/5/2001	0.010	0.010	0.015
6/18/2001	0.000	1.770	1.790
6/19/2001	0.000	0.000	1.770
6/20/2001	0.000	0.000	0.000
6/26/2001	0.000	0.000	0.005
6/27/2001	0.000	0.000	0.000
7/16/2001	0.000	0.000	0.000
7/17/2001	0.000	0.000	0.000
7/27/2001	0.000	0.380	0.380

Sampling Date	Precipitation in Inches		
	Day of Sampling	Day of Sampling + Day Before	Day of Sampling + Previous 2 Days Before
7/31/2001	0.000	0.000	0.070
8/1/2001	0.000	0.000	0.000
8/2/2001	0.000	0.000	0.000
8/3/2001	0.000	0.000	0.000
8/14/2001	0.000	1.280	1.290
8/16/2001	0.000	0.000	0.000
9/12/2001	0.000	0.000	0.040
9/18/2001	0.000	0.000	0.000
9/24/2001	0.060	0.060	0.060
10/01/2001	0.090	0.250	0.250
10/4/2001	0.000	0.000	0.000
10/22/2001	0.000	0.000	0.000
10/23/2001	0.000	0.000	0.000
11/1/2001	0.000	0.000	0.000
11/2/2001	0.000	0.000	0.000
11/26/2001	0.005	0.865	0.870
11/27/2001	0.000	0.005	0.865
12/10/2001	0.000	0.000	0.090
12/14/2001	0.000	0.000	0.000
12/19/2001	0.000	0.030	0.080
1/7/2002	0.005	0.010	0.010
1/8/2002	0.000	0.005	0.010
1/9/2002	0.005	0.005	0.010
1/30/2002	0.005	0.005	0.005
2/4/2002	0.010	0.010	0.010
2/6/2002	0.000	0.000	0.010
2/7/2002	0.250	0.250	0.250
3/15/2002	0.000	0.000	0.160
3/18/2002	0.670	0.800	0.800
3/19/2002	0.000	0.670	0.800
3/26/2002	0.620	0.620	0.620
4/1/2002	0.070	0.780	0.780
4/12/2002	0.090	0.090	0.100
4/15/2002	0.010	0.010	0.010
4/18/2002	0.000	0.000	0.440
4/19/2002	0.000	0.000	0.000
5/6/2002	0.030	0.040	0.070
5/7/2002	0.000	0.030	0.040
5/29/2002	0.000	0.000	0.000
5/31/2002	0.180	0.190	0.190
6/6/2002	1.120	1.410	1.410
6/18/2002	0.180	0.180	0.190
6/20/2002	0.010	0.090	0.270
8/1/2002	0.000	0.000	0.000

Sampling Date	Precipitation in Inches		
	Day of Sampling	Day of Sampling + Day Before	Day of Sampling + Previous 2 Days Before
8/2/2002	0.000	0.000	0.000
8/13/2002	0.000	0.000	0.000
8/14/2002	0.000	0.000	0.000
8/16/2002	0.000	0.000	0.000
8/22/2002	0.000	0.000	0.000
8/26/2002	0.000	0.000	1.740
8/27/2002	0.010	0.010	0.010
9/3/2002	0.000	0.030	0.060
9/10/2002	0.000	0.000	0.000
9/13/2002	0.000	0.000	0.000
9/17/2002	0.000	0.000	0.000
9/19/2002	0.000	0.000	0.000
9/20/2002	0.010	0.010	0.010
10/1/2002	0.000	0.010	0.010
10/2/2002	0.000	0.000	0.010
11/21/2002	0.330	0.330	0.340
12/11/2002	0.880	0.880	0.880
12/12/2002	0.000	0.880	0.880
12/13/2002	0.720	0.720	1.600
3/11/2003	0.000	0.000	0.000
3/13/2003	0.010	0.010	0.010
3/17/2003	0.200	0.400	0.400
3/26/2003	0.310	0.310	0.310
3/27/2003	0.000	0.310	0.310
4/21/2003	0.000	0.000	0.000
4/22/2003	0.010	0.010	0.010
4/30/2003	0.000	0.000	0.000
5/2/2003	0.000	0.000	0.000
5/5/2003	0.010	0.010	0.010
5/7/2003	0.180	0.180	0.190
5/30/2003	0.000	0.000	0.050
6/5/2003	0.090	0.510	0.600
6/10/2003	0.000	0.000	0.000
6/23/2003	0.000	0.000	0.000
6/24/2003	0.000	0.000	0.000
6/25/2003	0.000	0.000	0.000
7/7/2003	0.000	0.000	0.550
7/8/2003	0.000	0.000	0.000
7/9/2003	0.140	0.140	0.140
7/10/2003	1.760	1.900	1.900
8/5/2003	0.660	1.010	1.010
8/6/2003	0.190	0.850	1.200
8/7/2003	0.420	0.610	1.270
8/18/2003	0.000	0.070	0.190

Sampling Date	Precipitation in Inches		
	Day of Sampling	Day of Sampling + Day Before	Day of Sampling + Previous 2 Days Before
8/22/2003	0.790	0.790	0.800
9/9/2003	0.000	0.010	0.010
9/26/2003	0.000	0.010	0.010
9/30/2003	0.000	0.000	0.050

WATER QUALITY STUDIES

BACTERIOLOGICAL QUALITY

The statistical summaries for this shellfish growing area, which is sampled according to the Adverse Pollution Condition (APC) strategy, are listed in Table 10. This shellfish growing area is composed of five assignment areas, Assignment 315 (Cohansey Cove to Artificial Island), Assignment 327 (Money Island to East Point), Assignment 332 (Dividing Creek and Maurice River Cove), Assignment 357 (Ben Davis Point to Cohansey Cove), and Assignment 362 (Nantuxent Cove). Assignments 315 and 357 are sampled using APC sampling strategy year-round. Assignment 327 is sampled using APC sampling strategy year-round, with a water sample taken once a month from October to April and two runs taken during the summer. Assignment 332 is sampled using APC sampling strategy year-round, with a water sample taken once a month and under ebb tide conditions. Assignment 362 is sampled using APC sampling strategy for the winter months, with a water sample taken once a month from November to April and the remainder to be collected during the summer from May to October. Figures 14 and 15 show all of the 152 sampling stations in this area.

The raw data listings for each sampling station in accordance with the National Shellfish Sanitation Program (NSSP) criteria are given in the Appendix. There was one sampling station (3847E) that exceeded the NSSP criteria applicable to the classification of these waters (see Table 2 for the criteria applied) (USPHS, 1999 Revision). The shellfish waters around sampling station 3847E exceeded the *Approved* shellfish classification, with 12.8% of the 47 samples collected year-round exceeding a geometric mean of 330, and 16.7% of the 24 samples collected during the winter exceeding a geometric mean of 330. Since not more than 10% of the sample can exceed a geometric mean of 330, the waters around this sampling station will be downgraded to the *Special Restricted* shellfish classification.

TABLE 10 : WATER QUALITY SUMMARY (10/01/1999 – 9/30/2003).

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3800B	A	Surface	4.1	0.0%	15	3.7	0.0%	11	5.2	0.0%	4
3800F	A	Surface	4.5	0.0%	15	4.6	0.0%	11	4.1	0.0%	4
3800G	A	Surface	8.1	0.0%	15	10.4	0.0%	11	4.1	0.0%	4
3801	S	Surface	12.4	4.2%	48	16.2	4.2%	24	9.4	4.2%	24
3801B	S	Surface	9.8	0.0%	48	11.0	0.0%	24	8.8	0.0%	24
3801C	S	Surface	8.7	2.1%	48	10.5	0.0%	24	7.2	4.2%	24
3801E	S	Surface	15.3	0.0%	48	27.6	0.0%	24	8.4	0.0%	24
3801G	S	Surface	25.0	2.1%	48	43.9	4.2%	24	14.3	0.0%	24
3802	S	Surface	7.8	0.0%	48	9.7	0.0%	24	6.3	0.0%	24
3802D	S	Surface	8.6	2.1%	48	13.6	4.2%	24	5.4	0.0%	24
3802G	S	Surface	10.3	2.1%	48	14.8	0.0%	24	7.2	4.2%	24
3803	A	Surface	8.8	0.0%	27	10.6	0.0%	20	5.2	0.0%	7
3803A	A	Surface	6.9	0.0%	26	7.9	0.0%	20	4.5	0.0%	6
3803C	S	Surface	9.9	0.0%	48	9.7	0.0%	24	10.1	0.0%	24
3803G	A	Surface	8.2	0.0%	27	9.0	0.0%	20	6.4	0.0%	7
3803I	S	Surface	7.8	0.0%	48	9.4	0.0%	24	6.5	0.0%	24
3803M	A	Surface	8.3	0.0%	27	10.7	0.0%	20	4.1	0.0%	7
3803O	S	Surface	9.1	2.1%	48	9.6	0.0%	24	8.6	4.2%	24
3803Q	S	Surface	9.6	0.0%	48	17.7	0.0%	24	5.2	0.0%	24
3804	A	Surface	11.9	3.7%	27	15.8	5.0%	20	5.3	0.0%	7
3804B	S	Surface	15.7	2.1%	48	23.2	0.0%	24	10.6	4.2%	24
3804C	S	Surface	8.7	2.1%	48	10.8	0.0%	24	6.9	4.2%	24
3804D	S	Surface	14.3	2.1%	48	19.3	0.0%	24	10.5	4.2%	24

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3804E	S	Surface	11.5	2.1%	47	17.4	4.2%	24	7.5	0.0%	23
3804F	SR	Surface	24.0	4.2%	48	51.7	4.2%	24	11.1	4.2%	24
3804T	S	Surface	10.6	0.0%	27	12.1	0.0%	20	7.2	0.0%	7
3805	S	Surface	9.6	0.0%	48	14.7	0.0%	24	6.3	0.0%	24
3805A	S	Surface	11.7	2.0%	48	16.8	0.0%	24	8.1	0.0%	24
3805B	S	Surface	11.3	0.0%	48	21.5	0.0%	24	5.9	0.0%	24
3805F	S	Surface	17.1	4.2%	48	40.1	8.3%	24	7.3	0.0%	24
3805M	S	Surface	19.4	4.2%	48	30.9	8.3%	24	12.2	4.0%	24
3840	S	Surface	13.9	0.0%	47	12.1	0.0%	23	15.9	0.0%	24
3840B	S	Surface	14.9	0.0%	47	21.5	0.0%	23	10.4	0.0%	24
3840C	S	Surface	13.5	0.0%	47	16.7	0.0%	23	11.0	0.0%	24
3840D	S	Surface	13.9	2.1%	47	18.1	0.0%	23	10.8	4.2%	24
3840E	S	Surface	17.5	0.0%	47	24.5	0.0%	23	12.7	0.0%	24
3840G	S	Surface	20.6	2.2%	46	35.0	4.5%	22	12.7	0.0%	24
3840I	S	Surface	19.6	2.4%	47	20.5	0.0%	23	18.8	4.3%	24
3840J	S	Surface	19.5	4.3%	47	23.3	0.0%	23	16.5	8.3%	24
3840K	SR	Surface	24.0	6.4%	47	24.1	0.0%	23	23.9	12.5%	24
3840L	S	Surface	23.5	6.4%	47	32.7	13.0%	23	17.2	0.0%	24
3840M	SR	Surface	18.2	0.0%	47	25.5	0.0%	23	13.2	0.0%	24
3841A	S	Surface	14.1	0.0%	46	15.0	0.0%	22	13.4	0.0%	24
3841B	S	Surface	12.2	0.0%	46	12.0	0.0%	22	12.5	0.0%	24
3841C	S	Surface	20.0	2.2%	46	24.5	4.5%	22	16.7	0.0%	24
3841D	S	Surface	14.4	2.1%	47	21.4	4.3%	23	9.9	0.0%	24
3841F	S	Surface	14.2	2.1%	47	19.6	0.0%	23	10.5	4.2%	24
3841G	S	Surface	15.5	2.1%	47	24.2	4.3%	23	10.1	0.0%	24

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3841H	S	Surface	17.7	0.0%	47	22.4	0.0%	23	14.0	0.0%	24
3841I	S	Surface	21.6	6.4%	47	31.1	8.7%	23	15.3	4.2%	24
3841J	S	Surface	30.2	8.5%	47	35.9	8.7%	23	25.6	8.3%	24
3842	A	Surface	6.3	3.6%	28	9.0	5.9%	17	3.7	0.0%	11
3842B	A	Surface	6.6	0.0%	27	9.0	0.0%	17	3.9	0.0%	10
3842D	A	Surface	12.8	2.1%	47	14.2	4.3%	23	11.6	0.0%	24
3844	A	Surface	6.1	3.4%	29	7.7	5.9%	17	4.4	0.0%	12
3844C	A	Surface	6.3	0.0%	29	8.6	0.0%	17	4.0	0.0%	12
3845E	A	Surface	24.8	10.3%	29	31.9	11.8%	17	17.4	8.3%	12
3846B	S	Surface	12.3	3.4%	29	19.9	5.9%	17	6.2	0.0%	12
3847	SR	Surface	60.5	13.3%	45	75.9	9.5%	21	49.7	16.7%	24
3847A	SR	Surface	63.7	15.2%	46	85.1	22.7%	22	48.8	8.3%	24
3847C	SR	Surface	79.8	23.4%	47	93.8	21.7%	23	68.3	25.0%	24
3847D	SR	Surface	56.3	17.0%	47	70.7	17.4%	23	45.3	16.7%	24
3847E	S	Surface	43.9	12.8%	47	44.5	8.7%	23	43.4	16.7%	24
3847F	S	Surface	15.2	2.1%	47	16.4	4.3%	23	14.2	0.0%	24
3847G	S	Surface	11.5	0.0%	47	6.9	0.0%	23	18.9	0.0%	24
3847I	S	Surface	15.0	0.0%	47	9.7	0.0%	23	22.7	0.0%	24
3848B	SR	Surface	203.1	31.0%	29	225.9	35.3%	17	174.7	25.0%	12
3848C	SR	Surface	70.2	17.2%	29	86.8	17.6%	17	52.0	16.7%	12
3850A	A	Surface	5.6	0.0%	27	5.5	0.0%	20	6.0	0.0%	7
3850B	A	Surface	10.0	3.8%	26	12.7	5.3%	19	5.3	0.0%	7
3851A	A	Surface	9.5	0.0%	27	11.1	0.0%	20	5.9	0.0%	7
3853	A	Surface	3.9	0.0%	27	4.2	0.0%	20	3.2	0.0%	7

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3853A	A	Surface	6.9	0.0%	27	8.0	0.0%	20	4.5	0.0%	7
3855A	A	Surface	8.7	0.0%	29	12.5	0.0%	17	5.2	0.0%	12
3856A	SR	Surface	6.1	3.4%	29	8.6	5.9%	17	3.7	0.0%	12
3858	A	Surface	10.3	6.9%	29	13.6	5.9%	17	7.0	8.3%	12
3858A	SR	Surface	6.0	3.4%	29	7.6	5.9%	17	4.3	0.0%	12
3859	A	Surface	6.8	0.0%	29	9.2	0.0%	17	4.4	0.0%	12
3859A	SR	Surface	6.8	0.0%	29	11.1	0.0%	17	3.3	0.0%	12
3860	S	Surface	11.3	10.3%	29	28.4	17.6%	17	3.1	0.0%	12
3860A	S	Surface	8.5	0.0%	28	8.5	0.0%	17	8.7	0.0%	11
3860B	SR	Surface	28.0	10.3%	29	41.2	11.8%	17	16.2	8.3%	12
3862A	S	Surface	14.4	10.3%	29	21.4	11.8%	17	8.2	8.3%	12
3864A	S	Surface	11.6	0.0%	29	15.9	0.0%	17	7.4	0.0%	12
3866A	A	Surface	7.6	3.4%	29	9.0	5.9%	17	6.0	0.0%	12
3867	A	Surface	4.4	0.0%	29	5.1	0.0%	17	3.4	0.0%	12
3867B	A	Surface	6.4	0.0%	28	10.4	0.0%	16	3.4	0.0%	12
3867D	A	Surface	10.1	0.0%	29	11.6	0.0%	17	8.4	0.0%	12
3867H	LA	Surface	15.2	6.9%	29	23.8	5.9%	17	8.1	8.3%	12
3867J	S	Surface	68.9	14.3%	28	86.0	17.6%	17	48.9	9.1%	11
3868F	A	Surface	9.8	3.4%	29	16.3	5.9%	17	4.8	0.0%	12
3869	A	Surface	13.3	6.9%	29	17.3	11.8%	17	9.2	0.0%	12
3869C	SR	Surface	25.0	3.4%	29	35.0	5.9%	17	15.6	0.0%	12
3870	A	Surface	6.5	0.0%	28	8.7	0.0%	17	4.1	0.0%	11
3870A	A	Surface	5.3	3.7%	27	6.6	6.3%	16	3.8	0.0%	11
3870B	A	Surface	5.5	0.0%	28	6.8	0.0%	17	3.9	0.0%	11

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
3870D	A	Surface	3.7	0.0%	29	3.8	0.0%	17	3.7	0.0%	12
3872C	A	Surface	3.4	0.0%	28	3.6	0.0%	17	3.1	0.0%	11
3872F	A	Surface	4.9	0.0%	28	5.0	0.0%	17	4.8	0.0%	11
3874	A	Surface	4.7	0.0%	27	4.5	0.0%	20	5.4	0.0%	7
3874A	A	Surface	4.6	0.0%	27	4.5	0.0%	20	5.0	0.0%	7
3874D	A	Surface	4.0	0.0%	28	4.6	0.0%	17	3.2	0.0%	11
3900D	SR	Surface	226.7	34.5%	29	300.0	47.1%	17	152.5	16.7%	12
3951	A	Surface	8.7	0.0%	15	11.3	0.0%	11	4.1	0.0%	4
3951A	A	Surface	15.0	6.7%	15	16.2	9.1%	11	12.3	0.0%	4
3952	A	Surface	13.5	0.0%	15	20.3	0.0%	11	4.3	0.0%	4
3952A	A	Surface	20.5	6.7%	15	24.6	9.1%	11	12.4	0.0%	4
3953A	A	Surface	13.2	0.0%	15	15.4	0.0%	11	8.7	0.0%	4
4100E	A	Surface	6.6	0.0%	15	8.0	0.0%	11	4.0	0.0%	4
4100G	A	Surface	4.6	0.0%	15	5.2	0.0%	11	3.3	0.0%	4
4100H	A	Surface	8.3	0.0%	15	10.7	0.0%	11	4.1	0.0%	4
4100J	SR	Surface	34.9	6.7%	15	38.9	9.1%	11	26.0	0.0%	4
4101	SR	Surface	12.9	0.0%	15	14.5	0.0%	11	9.3	0.0%	4
4101A	SR	Surface	23.5	6.7%	15	24.3	9.1%	11	21.5	0.0%	4
4101C	SR	Surface	13.8	0.0%	15	16.9	0.0%	11	8.0	0.0%	4
4101D	SR	Surface	29.4	0.0%	15	46.9	0.0%	11	8.2	0.0%	4
4101G	SR	Surface	15.6	6.7%	15	18.9	9.1%	11	9.1	0.0%	4
4101H	SR	Surface	12.0	0.0%	15	15.2	0.0%	11	6.2	0.0%	4
4102A	SR	Surface	35.5	0.0%	15	36.6	0.0%	11	32.6	0.0%	4
4102D	SR	Surface	16.3	6.7%	15	21.0	9.1%	11	8.2	0.0%	4
4102F	SR	Surface	7.0	6.7%	15	8.6	9.1%	11	4.0	0.0%	4

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
4102H	SR	Surface	14.8	0.0%	15	20.7	0.0%	11	5.9	0.0%	4
4103	A	Surface	4.5	0.0%	26	5.1	0.0%	20	3.0	0.0%	6
4103F	A	Surface	8.8	0.0%	27	10.6	0.0%	20	5.1	0.0%	7
4104A	A	Surface	8.9	3.7%	27	12.2	5.0%	20	3.7	0.0%	7
4106B	A	Surface	8.9	0.0%	27	11.1	0.0%	20	4.8	0.0%	7
4108B	A	Surface	15.5	3.7%	27	21.9	5.0%	20	5.7	0.0%	7
4110A	A	Surface	10.0	0.0%	26	12.8	0.0%	20	4.3	0.0%	6
4111A	A	Surface	14.6	0.0%	27	20.6	0.0%	20	5.5	0.0%	7
4112	SR	Surface	4.4	0.0%	26	4.3	0.0%	20	4.8	0.0%	6
4112E	A	Surface	10.5	3.7%	27	12.9	5.0%	20	5.8	0.0%	7
4113	A	Surface	9.0	0.0%	27	11.8	0.0%	20	4.1	0.0%	7
4114	A	Surface	15.5	3.7%	27	23.0	5.0%	20	5.0	0.0%	7
4115	A	Surface	9.5	3.8%	26	12.7	5.3%	19	4.4	0.0%	7
4116	SR	Surface	6.5	0.0%	27	7.9	0.0%	20	3.8	0.0%	7
4116E	SR	Surface	7.5	0.0%	27	9.2	0.0%	20	4.2	0.0%	7
4201	SR	Surface	8.3	0.0%	27	10.5	0.0%	20	4.3	0.0%	7
4201A	SR	Surface	10.9	0.0%	27	14.4	0.0%	20	5.0	0.0%	7
4202	SR	Surface	8.0	0.0%	27	9.3	0.0%	20	5.4	0.0%	7
4203	SR	Surface	7.8	0.0%	26	9.5	0.0%	20	4.1	0.0%	6
4204	SR	Surface	6.3	3.7%	27	6.9	5.0%	20	4.8	0.0%	7
4204D	SR	Surface	8.5	3.7%	27	11.3	5.0%	20	3.7	0.0%	7
4300	SR	Surface	23.3	13.3%	15	32.0	18.2%	11	9.7	0.0%	4
4300A	SR	Surface	38.9	6.7%	15	47.5	9.1%	11	22.3	0.0%	4
4300B	P	Surface	58.2	6.7%	15	78.2	9.1%	11	25.8	0.0%	4
4300C	P	Surface	40.4	0.0%	15	49.3	0.0%	11	23.4	0.0%	4

Station	Status	Depth	Year Round			Summer			Winter		
			Geo. Mean	%>330	N	Geo. Mean	%>330	N	Geo. Mean	%>330	N
4300D	P	Surface	89.3	6.7%	15	120.6	9.1%	11	39.0	0.0%	4
4300E	P	Surface	75.3	13.3%	15	112.7	18.2%	11	24.8	0.0%	4
4300F	P	Surface	98.6	13.3%	15	100.8	9.1%	11	92.7	25.0%	4
4300G	P	Surface	140.2	33.3%	15	160.9	36.4%	11	96.0	25.0%	4
4300H	P	Surface	227.9	60.0%	15	287.5	63.6%	11	120.3	50.0%	4
4300I	P	Surface	188.3	40.0%	15	165.4	36.4%	11	268.8	50.0%	4

TIDAL EFFECTS

The tidal effects or preferences can be either ebb currents, flood currents, or neither of these two types of currents. Ebb and flood currents describe the horizontal motions associated with the fall and rise of the tide in restricted regions along the coast. Tidal currents can affect the water quality of a shellfish growing area because hydrographic and meteorological characteristics, such as tidal amplitude and type, water circulation patterns, depth, salinity, stratification characteristics, rainfall patterns and intensity, and prevailing winds may affect the distribution of pollutants in a specific area. This is why an evaluation of pollution sources and hydrographic characteristics are used to evaluate the water quality in a shellfish growing area.

Tidal impacts were evaluated by performing a t-test on log- transformed total coliform MPN values. Table 11 lists the sampling stations in this shellfish growing area that show a relationship between tidal effects and water quality. Figures 38 and 39 show the locations of these sampling stations.

TABLE 11: TIDAL EFFECTS

Station	Geometric Mean Total Coliform MPN		Probability>[T]	Location	Classification
	Ebb	Flood			
3841H	11.9	28.7	0.009	Oranoaken Creek	Seasonal (Nov-Apr)
3847F	19.7	5.1	0.011	Maurice River Cove	Seasonal (Nov-Apr)
3872F	7.2	3.3	0.026	Beadons Cove	Approved
4102F	14.8	3.6	0.037	Cohansey Cove	Special Restricted
4201	10.6	4.7	0.039	Alder Cove	Special Restricted
4204	8.5	3.1	0.041	Hope Creek	Special Restricted
4300G	65.4	335.0	0.043	Cohansey River	Prohibited

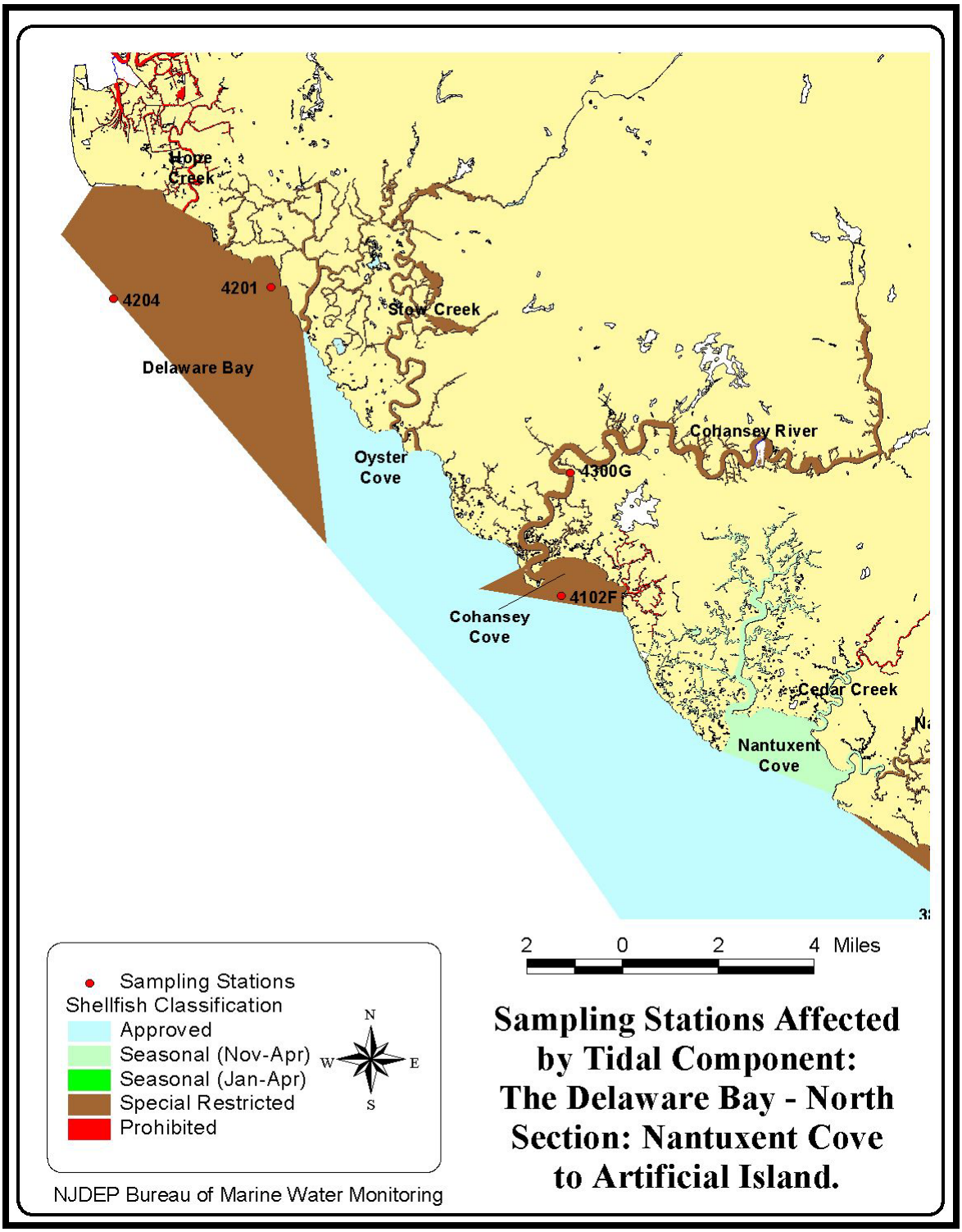

FIGURE 38: SAMPLING STATIONS AFFECTED BY TIDE: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

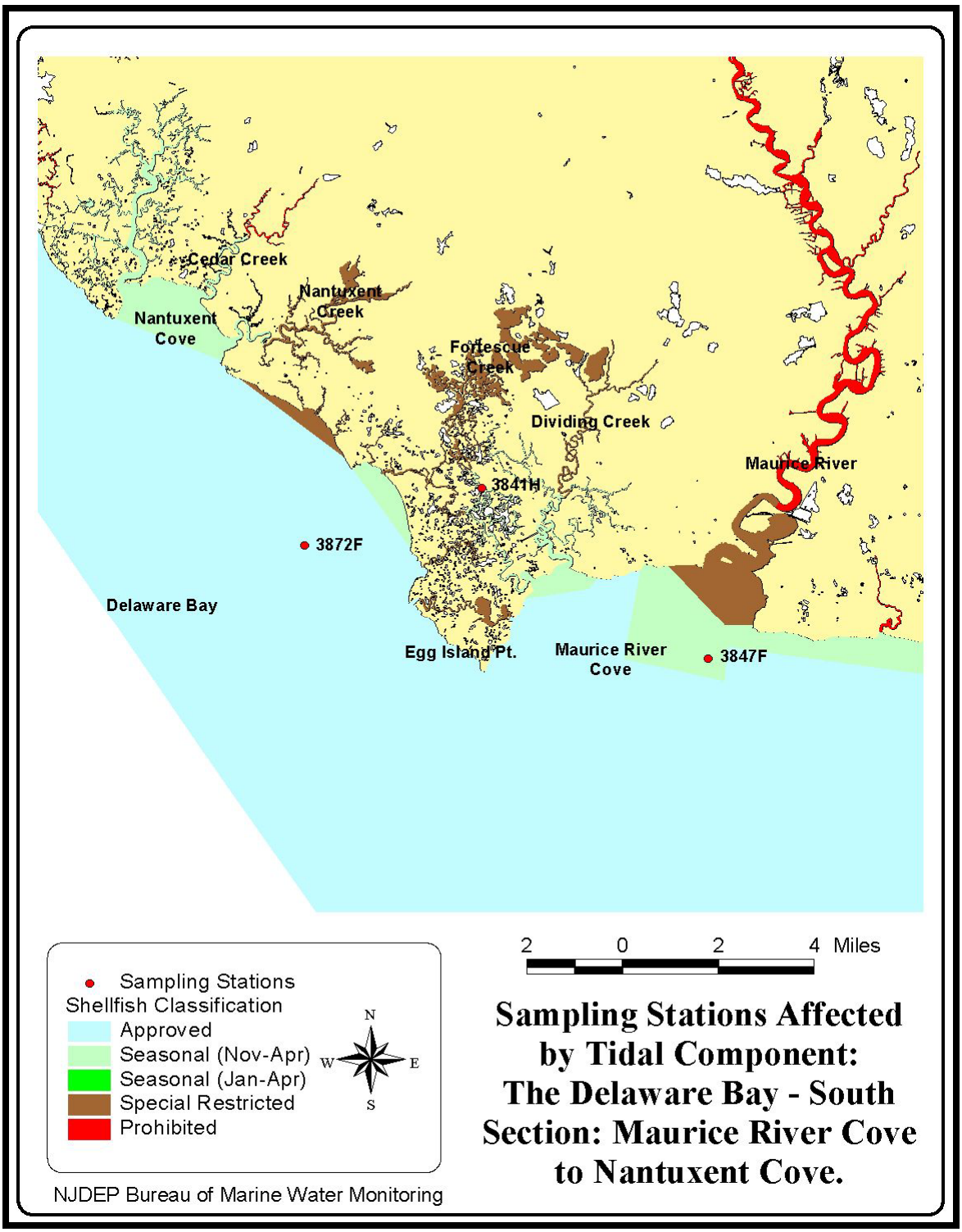

FIGURE 39: SAMPLING STATIONS AFFECTED BY TIDE: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

RAINFALL EFFECTS

Non-point source pressures on shellfish beds in New Jersey originate in materials that enter the water via stormwater. These materials include bacteria, as well as other waste that enters the stormwater collection system.

Data comparing the difference between coliform levels measured after rainfall with those during dry periods from 2000 to 2003 for this shellfish growing area were compared to generate the table and map below (see Table 12 and Figures 40 and 41). Rainfall impacts were assessed by correlating total coliform MPN values with cumulative rainfall on the day of sampling, 24 hours prior to the day of sampling, and 48 hours prior to the day of sampling. A relationship between rainfall amounts and total coliform levels is suggested if the rainfall correlation coefficient is greater than 0.6.

The Bureau of Marine Water Monitoring has begun to identify particular stormwater outfalls that discharge excessive bacteriological loads during storm events. In some cases, specific discharge points can be identified. When specific outfalls are identified as significant sources, the Department works with the county and municipality to further refine the source(s) of the contamination and implement remediation activities.

TABLE 12: CORRELATION OF TOTAL COLIFORM VALUES WITH CUMULATIVE RAINFALL

Station	Correlation of Total Coliform with Rainfall			Number of Observations	Location	Classification
	Day of Sampling	24 hours prior	48 hours prior			
3800B	-0.177	0.616	0.509	15	Nantuxent Cove	*Approved*
3867B	0.716	0.760	0.692	28	False Egg Island Point	*Approved*
4102F	0.860	0.433	0.424	15	Cohansey Cove	*Special Restricted*
4300A	0.666	0.186	0.133	15	Cohansey Cove	*Special Restricted*

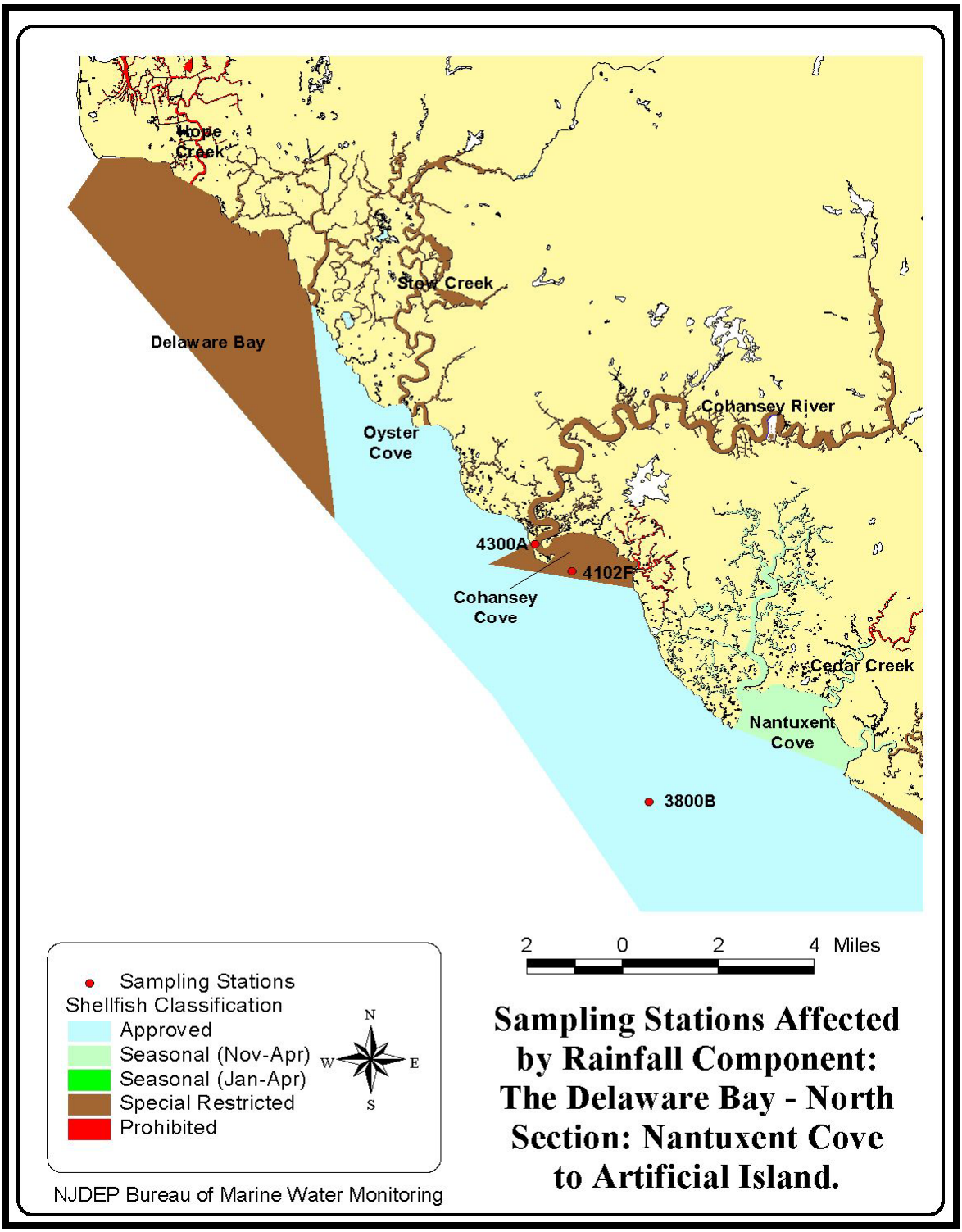

FIGURE 40: SAMPLING STATIONS AFFECTED BY RAINFALL: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

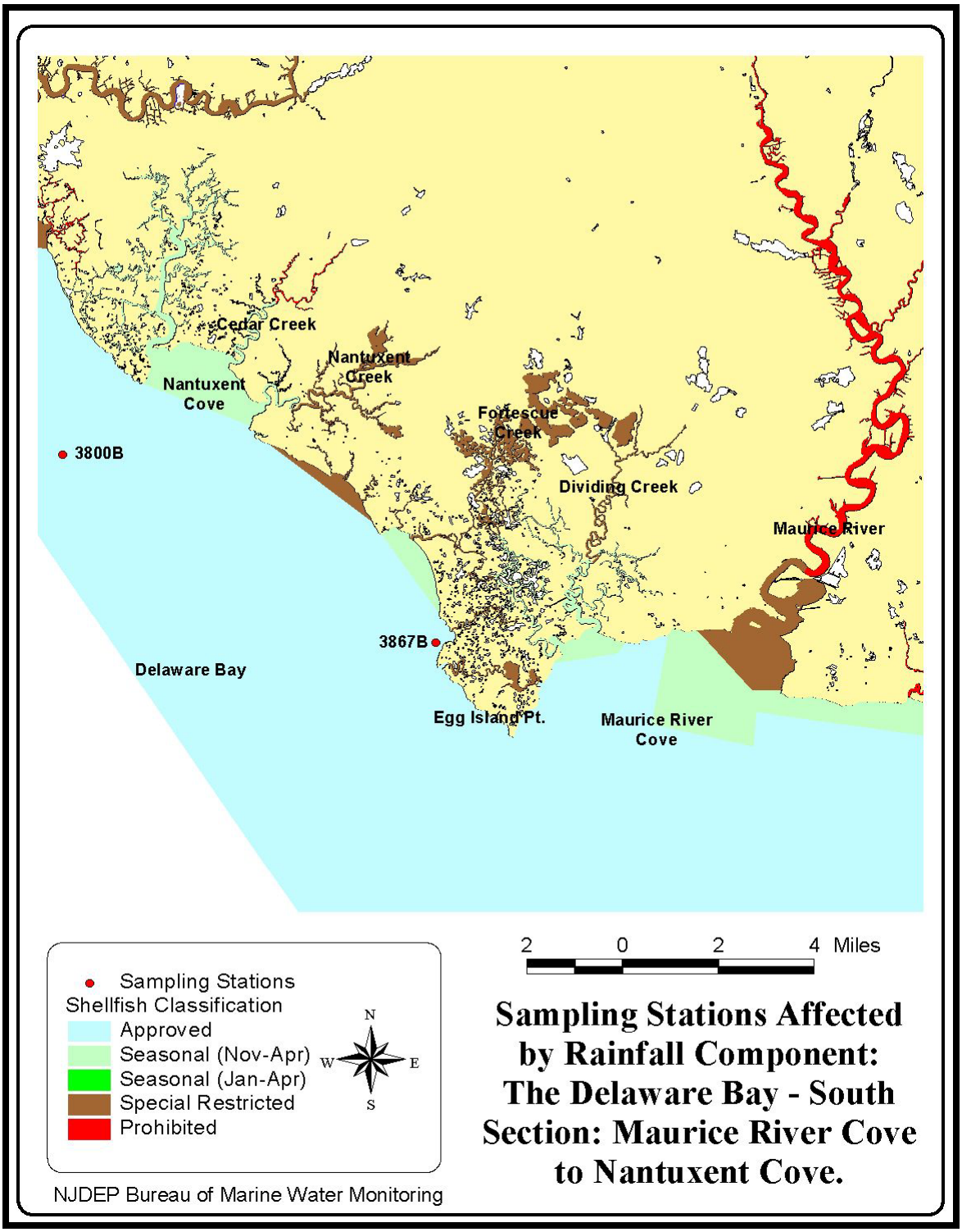

FIGURE 41: SAMPLING STATIONS AFFECTED BY RAINFALL: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

SEASONAL EFFECTS

Temperature, precipitation, wind, and the general circulation of the atmosphere have seasonal variations that also affect the marine environment.

Shellfish are filter-feeding organisms that live in the sand, silt, and mud on the bottom of oceans and bays. They have a range of tolerance to specific environmental conditions, such as temperatures, salinity levels, oxygen levels, quantity and availability of food, and water quality. Seasonal effects on these variables will have an effect on shellfish populations. For example, different species of shellfish require very specific salinity levels for survival. Since salinity levels can have an effect on the species found in certain waters of an area, the salinity level is important for a complete understanding of the complex ecological balance in the marine environment. At a time of the year when rainfall is low, where evaporation exceeds precipitation, the salinity of the marine environment in certain areas is higher than it is in regions where precipitation exceeds evaporation. This can affect the quantity and type of shellfish found in a specific area.

Seasonal variations also affect human activities, with generally more human activity in the warmer months of the year. An increase in human activities in or near the marine environment can have an impact on shellfish populations. Increased pressure from human activities on already stressed failing septic systems and overloaded wastewater treatment facilities can cause sewage to spill into the marine environment, which can negatively impact the water quality of a shellfish growing area by increasing the coliform levels in the water.

Seasonal effects were assessed using a t-test to compare log-transformed total coliform values for summer versus winter data. Table 13 lists the sampling stations in this shellfish growing area that showed a correlation between seasonal effects and water quality. Figures 42 and 43 show the locations of these sampling stations.

TABLE 13: SEASONAL EFFECTS

Station	Total Coliform Geometric Mean		Probability > [T]
	Summer	Winter	
3801E	27.6	8.4	0.001
3801G	43.9	14.3	0.009
3802D	13.6	5.4	0.006
3804E	17.4	7.5	0.038
3804F	51.7	11.1	0.001
3805	14.7	6.3	0.017
3805B	21.5	5.9	0.002
3805M	30.9	12.2	0.040
3840G	35.0	12.7	0.013
3841G	24.2	10.1	0.015
3842B	9.0	3.9	0.036
3847G	6.9	18.9	0.004
3847I	9.7	22.7	0.041
3859A	11.1	3.3	0.003
3860	28.4	3.1	0.001
3867B	10.4	3.4	0.010
3868F	16.3	4.8	0.019
4101D	46.9	8.2	0.020
4106B	11.1	4.8	0.036
4111A	20.6	5.5	0.043
4114	23.0	5.0	0.032
4201	10.5	4.3	0.029

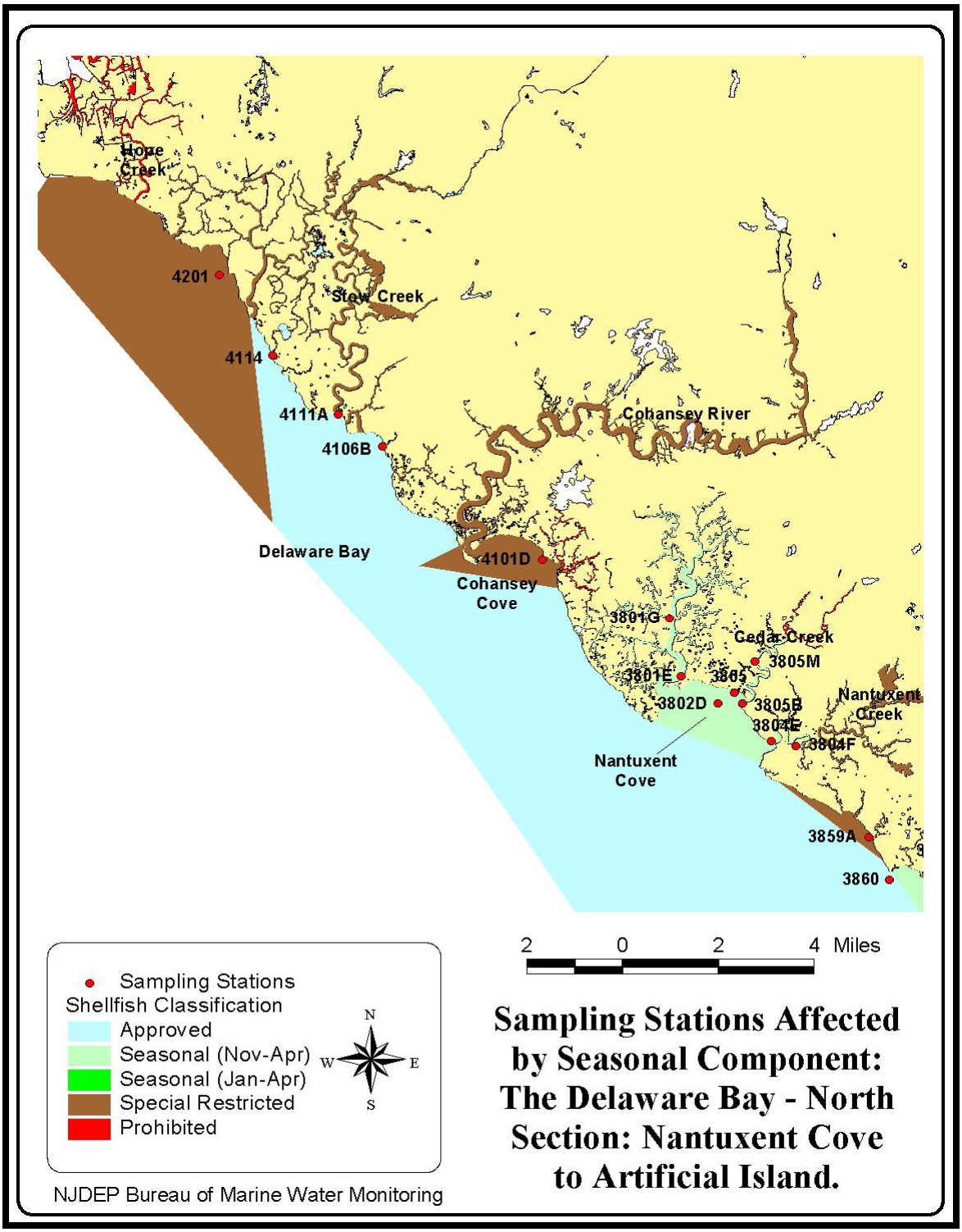

FIGURE 42: SAMPLING STATIONS AFFECTED BY SEASON: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

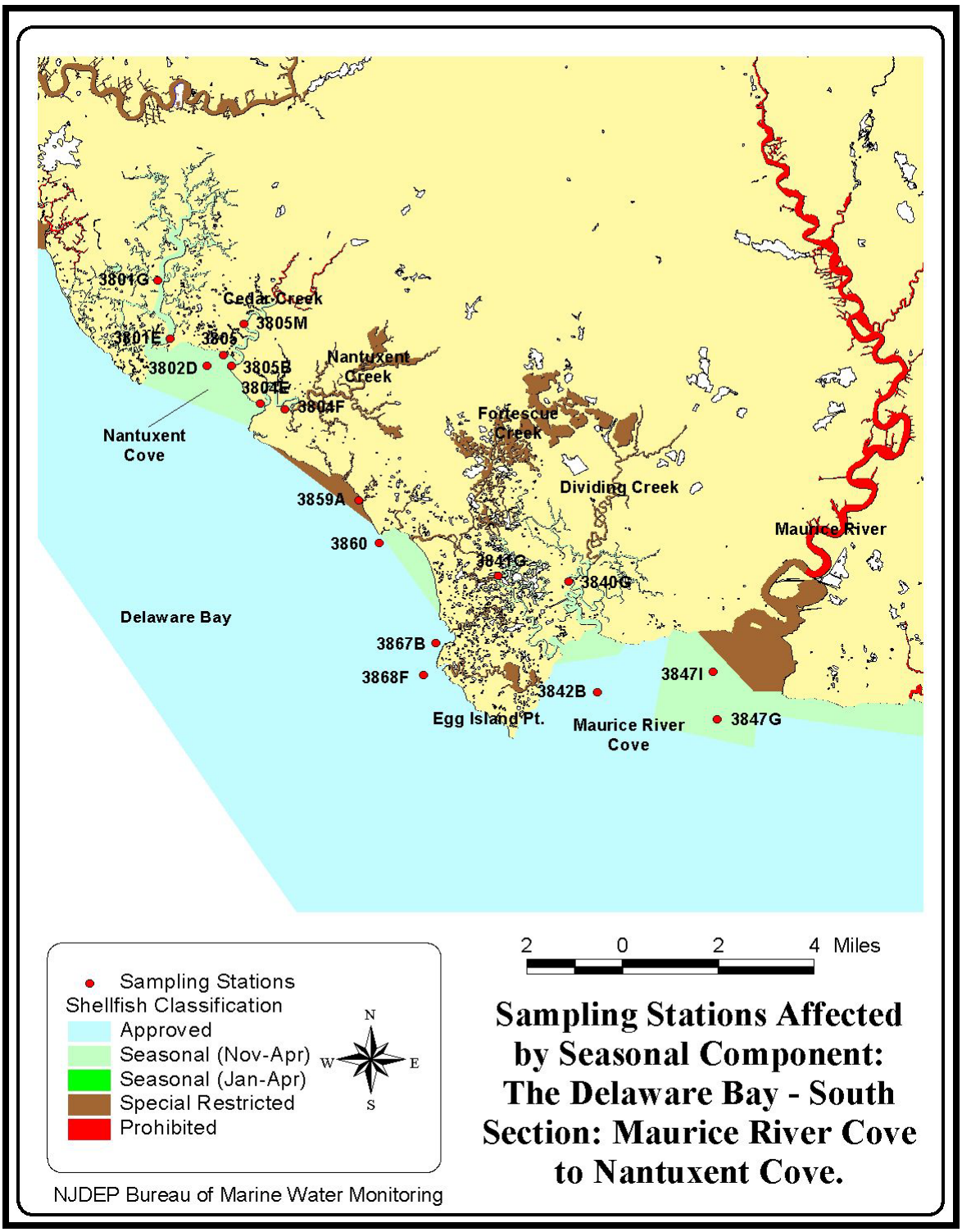

FIGURE 43: SAMPLING STATIONS AFFECTED BY SEASON: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

INTERPRETATION AND DISCUSSION OF DATA

BACTERIOLOGICAL

Criteria for bacterial acceptability of shellfish growing waters are provided in the National Shellfish Sanitation Program *Guide for the Control of Molluscan Shellfish* (USPHS, 1999 Revision). Each state must adopt either the total coliform criteria or fecal coliform criteria for growing water classifications. New Jersey has and continues to base growing water classifications on the total coliform criteria.

While New Jersey does make corresponding fecal determinations for each total coliform determination, these data are viewed as adjunct information and are not directly used for classification. Therefore, the data analysis is based on the total coliform results.

For the Adverse Pollution Condition (APC) strategy, the data analysis is based on the total coliform results in which the total coliform median or geometric mean MPN (most probable number) for the *Approved* shellfish water classification shall not exceed 70/100 mL and not more than 10 percent of the sample shall exceed an MPN of 330/100 mL for the three tube decimal dilution test (see Table 2) (USPHS, 1999 Revision). Also, the total coliform median or geometric mean MPN (most probable number) for the *Special Restricted* shellfish water classification shall not exceed 700/100 mL and not more than 10 percent of the sample shall exceed an MPN of 3,300/100 mL, where the three tube decimal dilution test is used for the Adverse Pollution Condition (APC) strategy (see Table 2) (USPHS, 1999 Revision).

Figures 44 and 45 show the 21 sampling stations that exceeded the *Approved* total coliform year-round criteria for water quality after being sampled with the Adverse Pollution Condition (APC) strategy. All 21 of these sampling stations met the APC *Special Restricted* year-round shellfish classification criteria.

One of these sampling stations (**3847E**) was out of compliance with the existing shellfish growing water classification criteria. Sampling Station **3847E** is located in the Maurice River Cove in *Seasonally Approved (November to April)* shellfish waters. The rest of these sampling stations are located in the Cohansey River in *Prohibited* shellfish waters, in Beadons Cove in *Seasonally Approved (November to April)* shellfish waters, in Beadons Creek in *Special Restricted* shellfish waters, in the Delaware Bay off of Fortescue Beach in *Seasonally Approved (November to April)* shellfish waters, in Fishing Creek in *Seasonally Approved (November to April)* shellfish waters, in the Maurice River in *Special Restricted* shellfish waters and in the Maurice River Cove in

Seasonally Approved (November to April) shellfish waters. Sampling Station **3847E** exceeded the total coliform criteria year-round and in the winter for shellfish waters that are classified as *Seasonally Approved (November to April)*. Since this sampling station exceeded the criteria during the winter when shellfish are harvested in this area, approximately 224 acres of shellfish waters around this station in the Maurice River Cove will need to be downgraded to the *Special Restricted* shellfish classification.

Based on the water data collected, seven sampling stations (**3841H, 3847F, 3872F, 4102F, 4201, 4204, and 4300G**) showed a significant tidal component for water quality in the Delaware Bay from Maurice River Cove to Artificial Island (see Figures 38 and 39, and Table 11). The sampling stations in the Dividing Creek and Maurice River Cove area (Assignment 332) are sampled under an ebb tide preference. The rest of the areas in Shellfish Growing Area DB1 are not sampled with any tidal preference. Five of these seven tidally affected sampling stations showed a higher total coliform geometric mean during the ebb tide, while two of these sampling stations (Sampling Stations **3841H** and **4300G)** showed a higher total coliform geometric mean during the flood tide. The total coliform levels still meet the existing *Approved, Seasonally Approved (November-April),* and *Special Restricted* shellfish classification criteria for these shellfish waters. Since the water quality in this shellfish growing area is slightly impacted by tidal effects but not enough to affect the shellfish classification of this area, this shellfish growing area will continue to be sampled using the Adverse Pollution Condition (APC) strategy with no tidal preference.

A significant correlation between total coliform MPN and rainfall was found to occur at four sampling stations (Sampling Stations **3800B**, **3867B**, **4102F**, and **4300A**) in this shellfish growing area (see Figures 40 and 41, and Table 12). However, the total coliform levels still meet the existing *Approved* and *Special Restricted* shellfish classification criteria for these shellfish waters. Since the water quality in this shellfish growing area is slightly impacted by rainfall but not enough to affect the shellfish classification of this area, this shellfish growing area will continue to be sampled using the Adverse Pollution Condition (APC) strategy without a wet weather preference.

There were 22 sampling stations that showed a seasonal component for water quality in the Delaware Bay from the Maurice River Cove to Artificial Island (see Figures 42 and 43, and Table 13). All of these sampling stations were located throughout this shellfish growing area. 20 of these sampling stations showed a higher total coliform geometric mean during the summer than during the winter. Two of these sampling stations (Sampling Station **3847G** and **3847I**) showed a higher total coliform geometric mean during the winter than during the summer. Sampling Stations **3847G** and **3847I** are located in the Maurice River Cove in *Seasonally Approved (November to April)* shellfish waters. The higher total coliform geometric mean during the summer is most likely due to population pressures resulting from increased summer activities in these shellfish waters. The higher total coliform geometric mean during the winter could be from the impact of wild bird

populations to this area. However, the total coliform levels still meet the existing *Approved, Seasonally Approved (November-April),* and *Special Restricted* shellfish classification criteria for these shellfish waters. Since the water quality in this shellfish growing area is slightly impacted by seasonal effects but not enough to affect the shellfish classification of this area, this shellfish growing area will continue to be sampled using the Adverse Pollution Condition (APC) strategy without a seasonal preference.

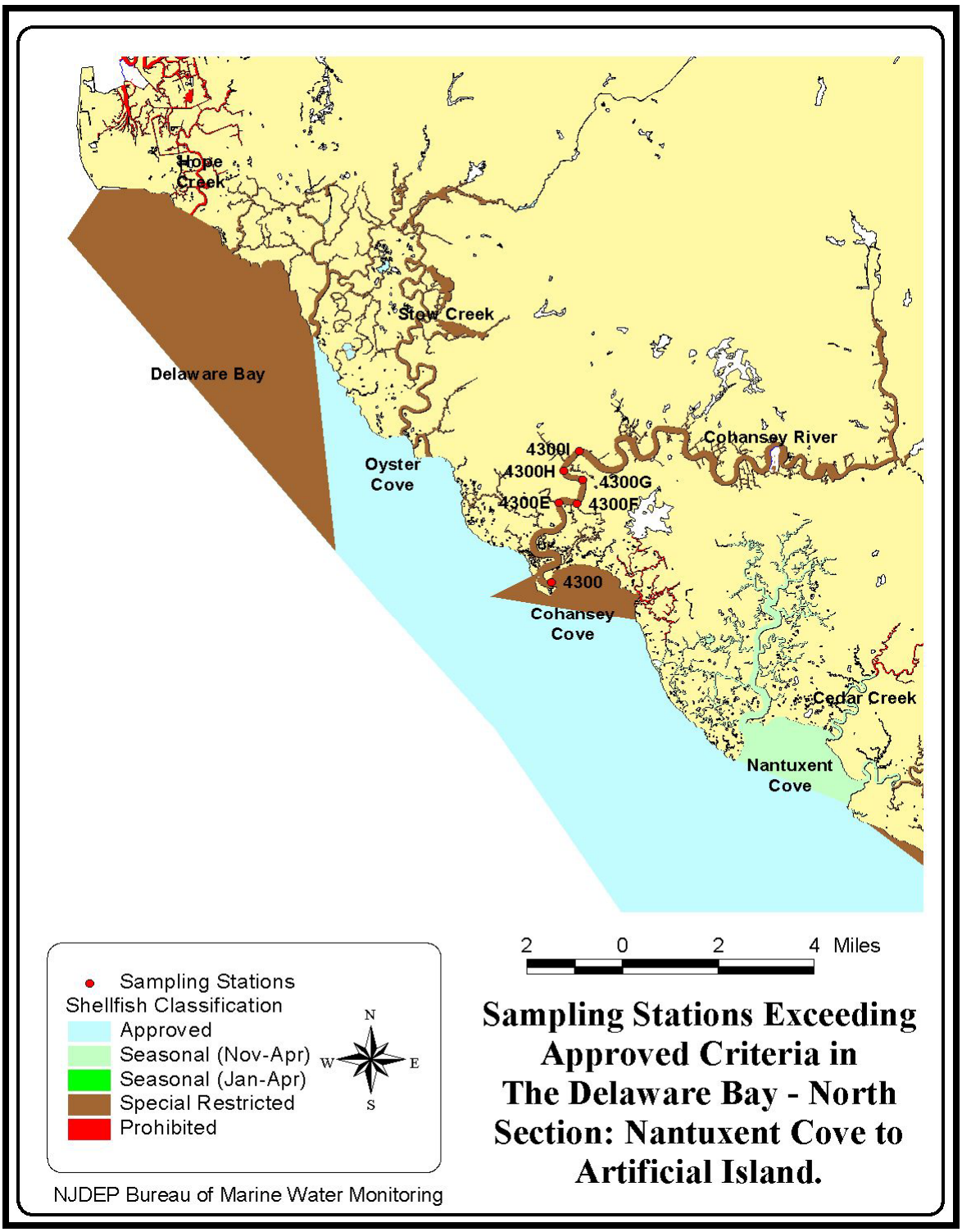

FIGURE 44: SAMPLING STATIONS EXCEEDING APPROVED CRITERIA: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

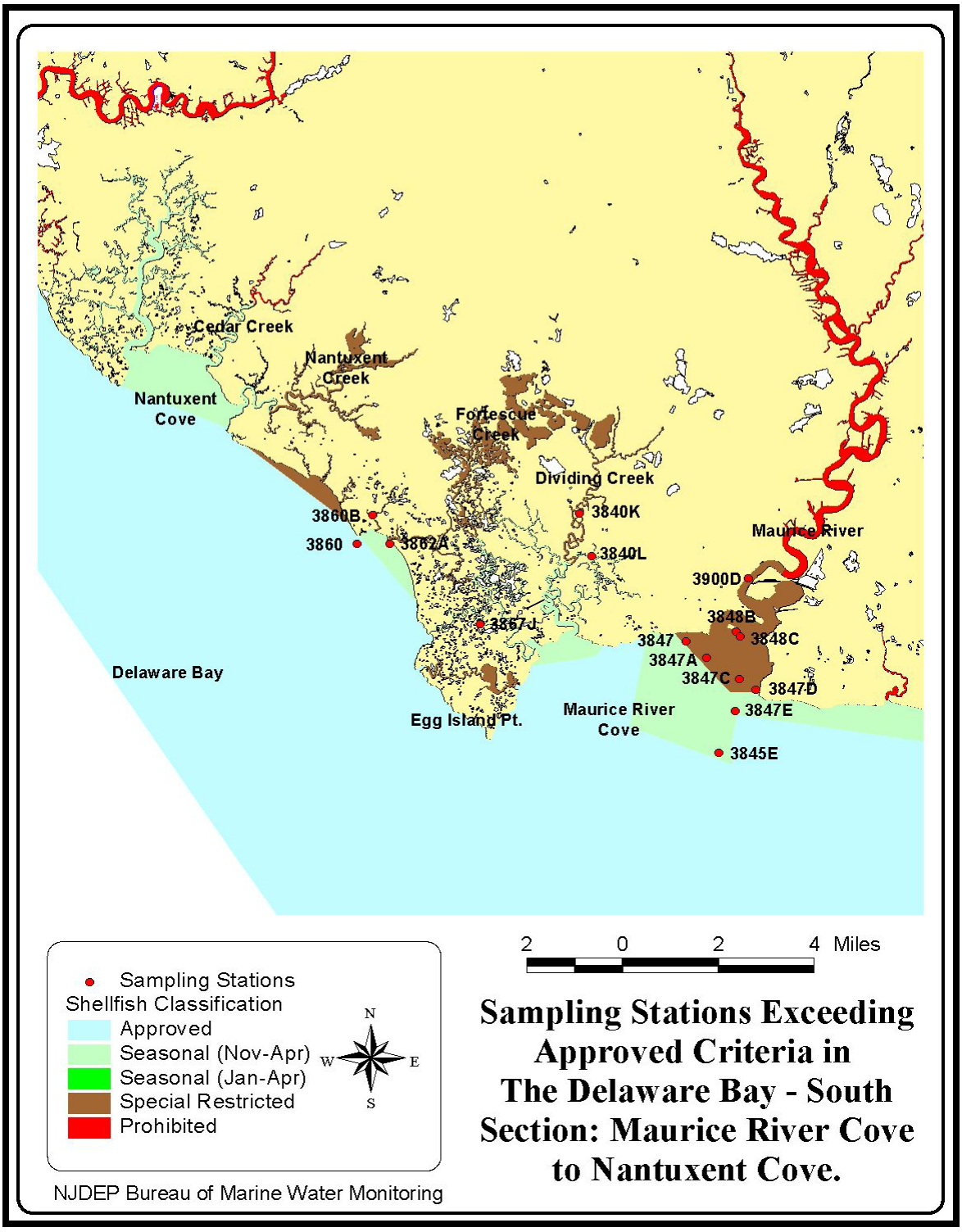

FIGURE 45: SAMPLING STATIONS EXCEEDING APPROVED CRITERIA: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

RELATED STUDIES

NUTRIENTS

According to the 2002-2003 Marine Water Sampling Assignments Schedule for Assignment 315, Assignment 327, Assignment 332, Assignment 357, and Assignment 362, there are 11 stations in Shellfish Growing Area DB1 that are sampled under the estuarine monitoring program for chemical parameters including nutrients. These nutrient stations include sampling stations **3800**, **3801B**, **3803A**, **3840A**, **3847B**, **3848B**, **3874B**, **3900A**, **3900M**, **4100**, and **4101B**. They are located throughout this shellfish growing area (see Figures 46 and 47).

At these nutrient stations, the various parameters measured include water temperature (in Celsius), salinity levels, Secchi Depth, total suspended solids, dissolved oxygen levels, ammonia levels, nitrate and nitrite levels, orthophosphate levels, total nitrogen levels, and the inorganic nitrogen to phosphorus ratios (Zimmer, 2000, Zimmer, 2001).

For more detailed information concerning dissolved oxygen and nutrient levels, see the Estuarine Monitoring Report published by the NJDEP. The report, New Jersey Ambient Monitoring Program: Report on Marine and Coastal Water Quality – 1993 – 1997, is available electronically at: www.state.nj.us/dep/wmm/bmw.

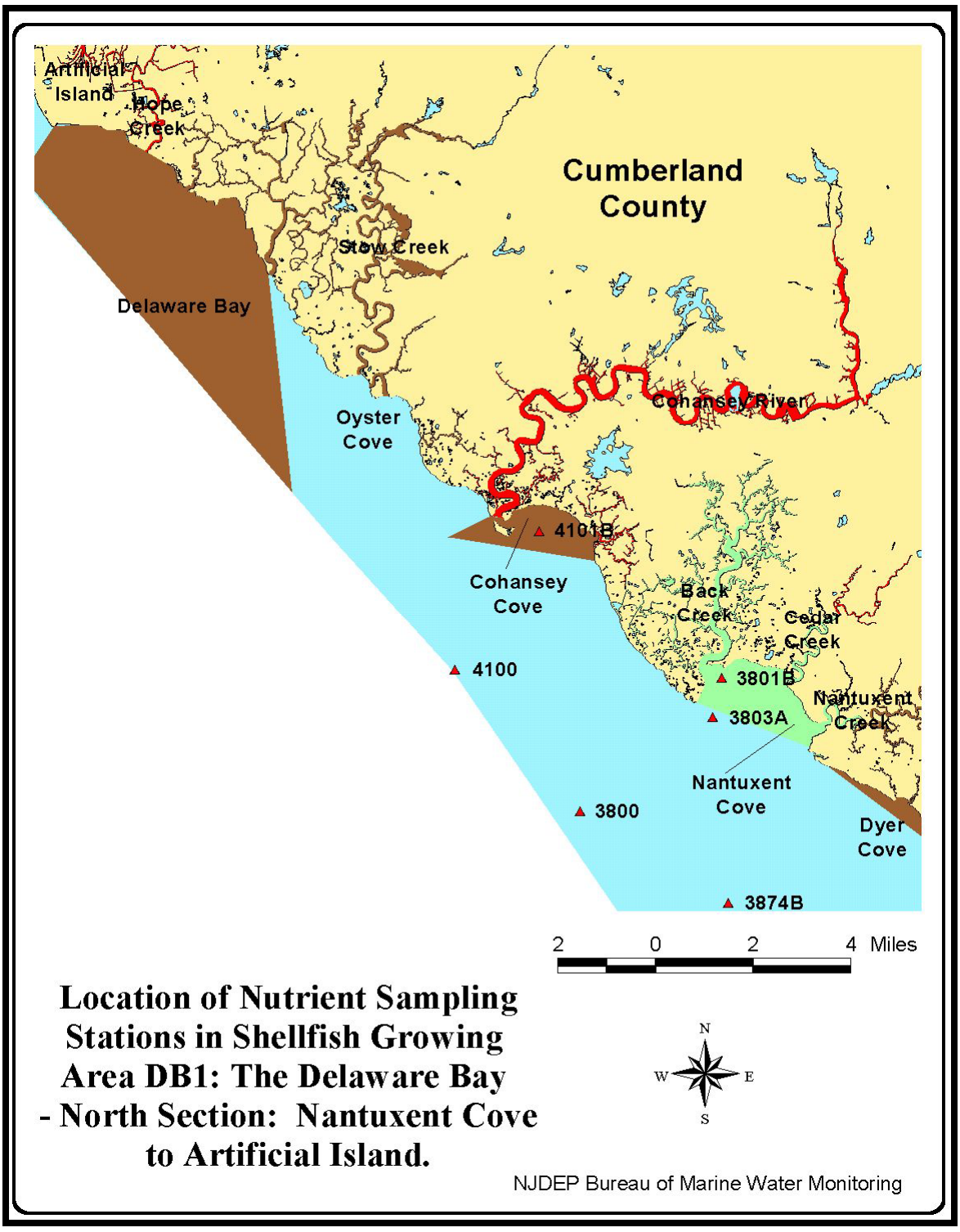

FIGURE 46: SAMPLING SITES WHERE ADDITIONAL DATA HAVE BEEN COLLECTED FOR NUTRIENTS IN AREA DB1: THE DELAWARE BAY – NORTH SECTION: NANTUXENT COVE TO ARTIFICIAL ISLAND.

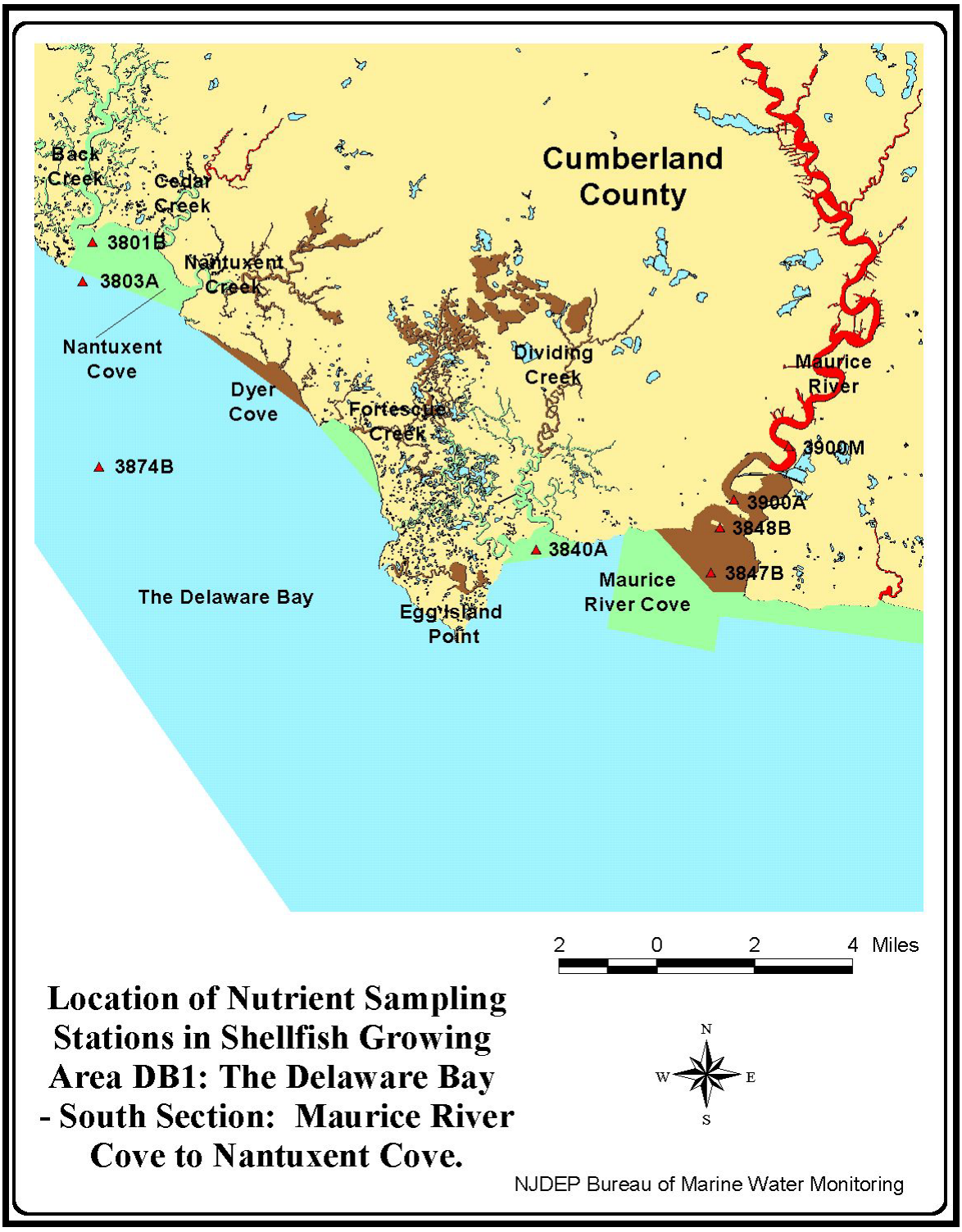

FIGURE 47: SAMPLING SITES WHERE ADDITIONAL DATA HAVE BEEN COLLECTED FOR NUTRIENTS IN AREA DB1: THE DELAWARE BAY – SOUTH SECTION: MAURICE RIVER COVE TO NANTUXENT COVE.

MUSSEL WATCH SAMPLING STATIONS

The NOAA Mussel Watch Program is a program that monitors the levels of toxins and metals in coastal waters. The blue mussel, *Mytilus edulis*, occurs worldwide and effectively takes up toxins and metals from seawater and sediment, and concentrates the toxins and metals in their living tissues. Assays from the living tissues of this shellfish can be made easily and cheaply. The Mussel Watch Program monitors metals such as mercury, lead, zinc, nickel, cadmium, copper, chromium, aluminum, silicon, manganese, iron, arsenic, selenium, tin, antimony, thallium, and silver. The program also monitors toxins such as the synthetic organic compounds that are widely used in pesticides, solvents, flame-retardants, and other products. There are four NOAA Mussel Watch Sampling Stations located in this shellfish growing area, and they are DBHC (Delaware Bay - Hope Creek), DBAP (Delaware Bay - Arnolds Point Shoal), DBBD (Delaware Bay - Ben Davis Point Shoal), and DBFE (Delaware Bay - False Egg Island Point) (see Figure 48). Due to the small amount of mussels in the Delaware Bay and the abundance of oysters (*Crassostrea virginica*), oysters and mussels are monitored in the Delaware Bay.

For 1999 to 2003, an evaluation of the Mussel Watch data for the Mussel Watch Sampling Stations in this shellfish growing area showed that the levels of the contaminants and pesticides in the assays of the living tissues of the mussels and oysters sampled did not exceed the FDA Environmental Chemical Contaminant and Pesticide Tolerances, Action Levels, and Guidance Levels. On the list of the FDA environmental chemical contaminants and pesticides, the deleterious substances measured in this shellfish growing area include aldrin, dieldrin, benzene hexachloride, chlordane, DDT, TDE, DDE, arsenic, cadmium, chromium, lead, nickel, methyl mercury, heptachlor, heptachlor epoxide, and mirex.

Additional information on the NOAA Mussel Watch Program is available electronically at: http://nsandt.noaa.gov.

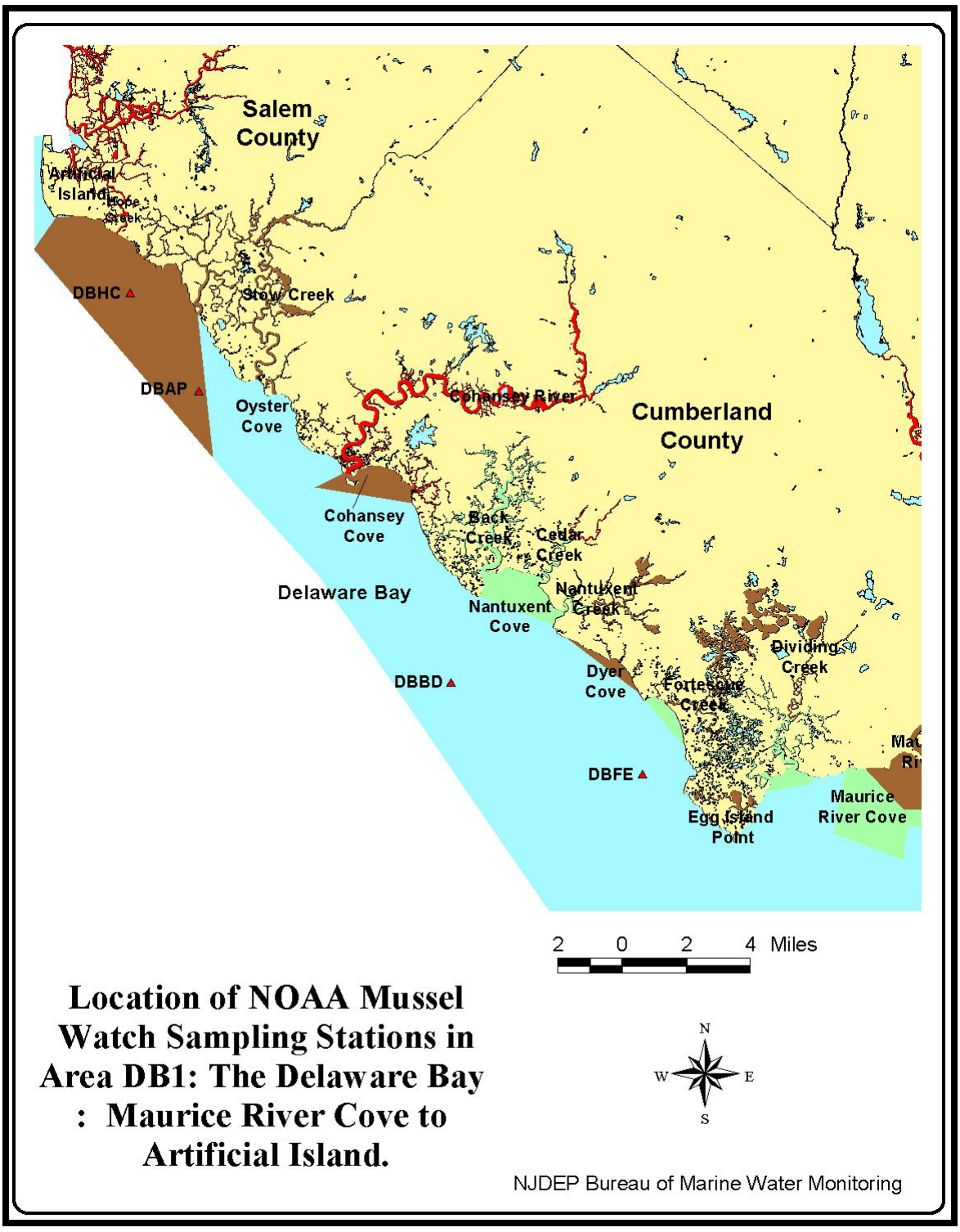

FIGURE 48: SAMPLING STATIONS WHERE NOAA MUSSEL WATCH DATA HAVE BEEN COLLECTED IN AREA DB1: THE DELAWARE BAY: MAURICE RIVER COVE TO ARTIFICIAL ISLAND.

MARINE BIOTOXINS

The Department collects samples at regular intervals throughout the summer to determine the occurrence of marine algae that produce biotoxins.There are no phytoplankton sampling stations located in this shellfish growing area. Certain planktonic species have the potential to adversely affect the suitability of shellfish for human consumption. These planktonic species cause algal blooms that deplete the dissolved oxygen levels in the water. Algal blooms were reported each year for the period 1993 – 1997 and the areas most severely impacted include the Raritan / Sandy Hook Bay, the Barnegat Bay, and sporadic offshore areas (NJDEP, 2001, Zimmer, 2000, Zimmer, 2001). No algal blooms capable of producing biotoxins were identified for this growing area during 1998, 1999, 2000, or 2001 (NJDEP, 2001). These data are evaluated weekly during the summer by the Bureau of Marine Water Monitoring in accordance with the NSSP requirements. An annual report is compiled and is available electronically at:

www.state.nj.us/dep/wmm/bmw.

CONCLUSIONS

BACTERIOLOGICAL EVALUATION

Water quality in Shellfish Growing Area DB1 - The Delaware Bay from Maurice River Cove to Artificial Island continues to be mostly good, with most of the sampling stations in compliance with the shellfish classification for this area, based on NSSP total coliform criteria. However, Sampling Station **3847E** was out of compliance with the existing shellfish growing water classification criteria and exceeded the *Approved* total coliform classification criteria year-round and during the winter. This sampling station is located in the Maurice River Cove in *Seasonally Approved (November to April)* shellfish waters and exceeded the existing shellfish classification criteria during the winter when shellfish are harvested from these waters. Therefore, 224 acres of shellfish growing waters in the Maurice River Cove will need to be downgraded to the *Special Restricted* shellfish classification

RECOMMENDATIONS

BACTERIOLOGICAL EVALUATION

RECOMMENDED CLASSIFICATION CHANGES

It is recommended that 224 acres of shellfish waters, which are currently classified as *Seasonally Approved (November to April)* and located in the Maurice River Cove, will be downgraded to the *Special Restricted* shellfish classification. This area will be added to the 1,927 acres of *Special Restricted* shellfish growing waters north of this area. The area to be reclassified is shown in Figures 49 and 50.

The New Jersey Administrative Code (N.J.A.C. 7:12) Shellfish Water Classification & Special Permit Rules needs to be revised to show the change in this shellfish water classification.

LEGAL DESCRIPTION FOR RECOMMENDED CHANGES:

In New Jersey Administrative Code 7:12-3.2 Shellfish growing waters that are classified as Special Restricted

(a) The following shellfish growing waters are classified as Special Restricted:

32. Delaware Bay area (Note: A portion is also designated as Seasonal. See N.J.A.C. 7:12-4):

i. Maurice River and Maurice River Cove: Maurice River and tributaries thereof and that portion of Maurice River Cove between the following two lines:

(1) All of the water upstream of a line beginning at the East Point Lighthouse and bearing approximately **[**270**]** **226** degrees T to **[**Can Buoy C7**]** **Flashing Green 2.5 second "5" (Fl G 2.5 sec "5") in the Maurice River Approach Channel** then bearing approximately **[**317**]** **323** degrees T to a Department maintained marker on the western bank of the Maurice River Cove and terminating;

(2) (No Change)

ii. (No Change)

iii. (No Change)

iv. (No Change)

v. (No Change)

vi. (No Change)

vii. (No Change)

viii. (No Change)

ix. (No Change)

x. (No Change)

In New Jersey Administrative Code 7:12-4.1 Seasonally Approved growing waters (Approved November 1 through April 30 yearly, Special Restricted May 1 through October 31, yearly)

(a) The following shellfish growing waters designated on the charts referred to in N.J.A.C. 7:12-1.1 shall be Special Restricted for the harvest of shellfish from May 1 through October 31 yearly and Approved for the harvest of shellfish from November 1 through April 30 yearly:

13. Delaware Bay:

i. (No Change)

ii. East Point area: Seasonal-Special Restricted May 1 through October 31 yearly. Approved November 1 through April 30 yearly:

(1) All that portion of Delaware Bay contained within a line beginning at the East Point Lighthouse and bearing approximately **[**270**]** **226** degrees T to **[**Can Buoy C7 then bearing approximately 165 degrees T to**]** Flashing Green 2.5 second "5" (Fl G 2.5 sec "5") in the Maurice River Approach Channel, then bearing approximately 098 degrees T to the marker (Department maintained) on the point of land on the west shore at the mouth of West Creek and terminating.

iii. Maurice River Cove: Seasonal-Special Restricted May 1 through October 31 yearly, Approved November 1 through April 30 yearly.

(1) All those waters inside of a line beginning at **[**the East Point Lighthouse and bearing approximately 270 degrees T to Can Buoy C7 then bearing approximately 165 degrees T to**]** Flashing Green 2.5 second "5" (FL G 2.5 sec. "5"), then bearing approximately 188 degrees T to Flashing Green 4 second "3" (FL G 4 sec "3"), then bearing approximately **[**282 degrees T**]** **171 degrees T to a point at Latitude 39 degrees 10 minutes 23.32 seconds N., Longitude 75 degrees 2 minutes 19.99 seconds W., then bearing approximately 290.5 degrees T** to a Department maintained marker at latitude 39 degrees 11 minutes 6 seconds N., Longitude 75 degrees 04 minutes 50 seconds W., then bearing approximately 013 degrees T to a Department maintained marker on the shoreline west of the mouth of the Maurice River, then along the shoreline in a northeasterly direction to another Department maintained marker, then bearing approximately **[**137**]** **143** degrees T to **[**Can Buoy C7**]** **Flashing Green 2.5 second "5" (FL G 2.5 sec. "5"), [**then bearing approximately 090 degrees T to the East Point Lighthouse**]** and terminating; and

(2) (No Change)

iv. (No Change)

v. (No Change)

vi. (No Change)

vii. (No Change)

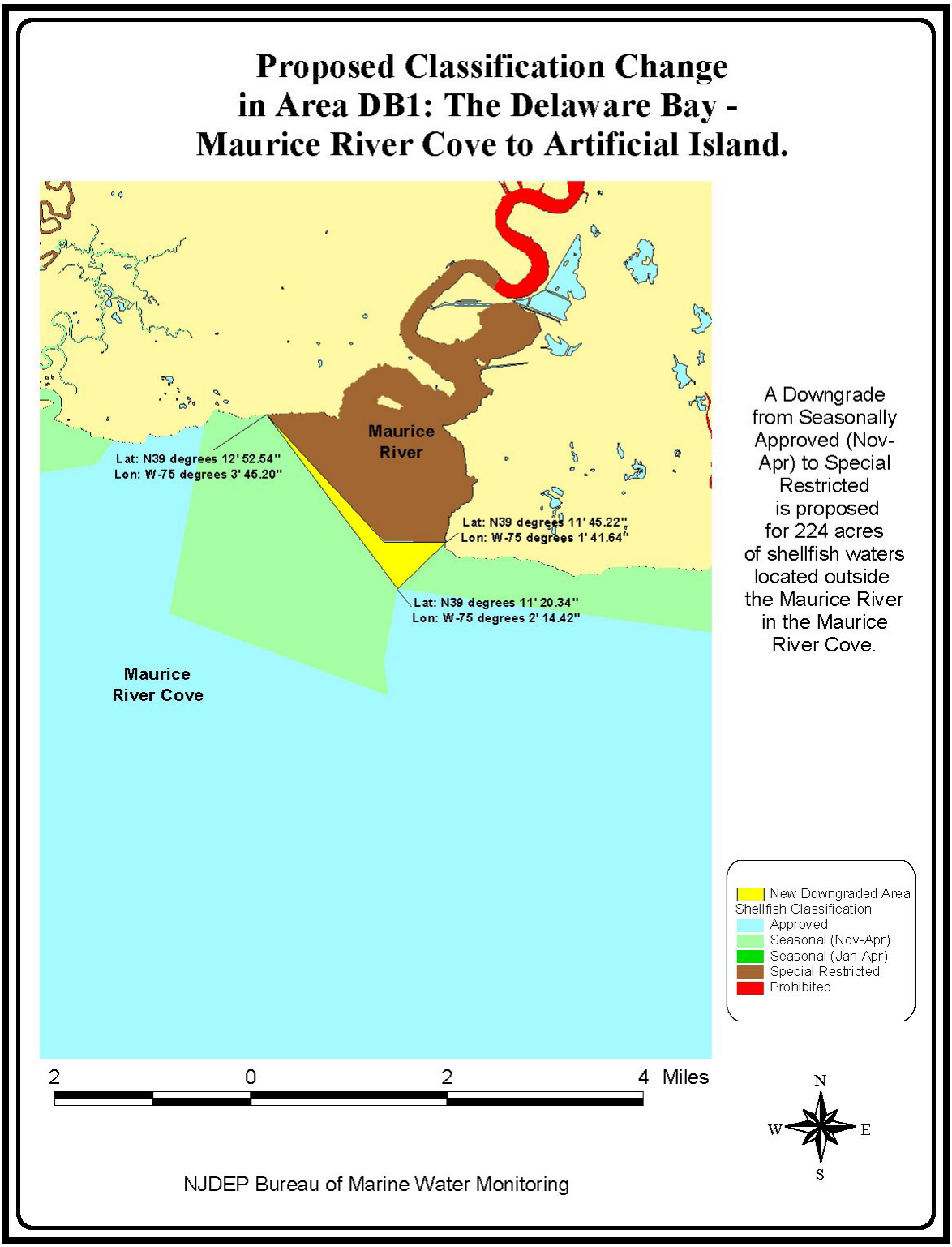

FIGURE 49: RECOMMENDED CHANGES IN CLASSIFICATION FOR THE MAURICE RIVER COVE.

FIGURE 50: LOCATION OF MAURICE RIVER COVE FROM EAST POINT. PHOTOGRAPH WAS TAKEN ON MAY 6, 2004 AT 9:57 A.M.

RECOMMENDED CHANGES IN MONITORING SCHEDULE

Continue sampling using the existing APC year-round strategy for Assignment 315, 327, 332, 357, and 362.

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ACKNOWLEDGMENTS

This report was written under the direction of Robert Connell, Bureau Chief, and Leslie McGeorge, Administrator. Mike Kusmiez assisted in statistical and GIS data analysis. Special acknowledgment is given to Captain Joseph Buzby for his perseverance in collecting shellfish water quality samples in the DB1, the Delaware Bay from Maurice River Cove to Artificial Island. This study would not have been completed without the aid of Robert Schuster (Special Projects and Field Operations Supervisor) and the analytical capabilities of our microbiology laboratory staff, including Eric Feerst (Section Chief), Bruce Hovendon (Bacteriological Laboratory Supervisor), Elena Heller, Robert Seabrook, and Lisa DiElmo; and our chemistry laboratory staff, including Mike DiLeo (Chemistry Laboratory Supervisor), Stephanie Swanke, and Dawn Thompson.

APPENDICES

A. Statistical Summaries

   Yearround

   Winter Only

   Summer Only

B. Seasonal Evaluation

C. Precipitation

   Rainfall Correlation

   Cumulative Rainfall

   Wet Weather Statistical Summary

   Dry Weather Statistical Summary

D. Tidal Evaluation

E. Data Listing - 1999 through 2003