NJ Department of Environmental Protection
Water Monitoring and Standards

NJ WATER QUALITY MONITORING NETWORKS 2006

State of New Jersey

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April 2006

WATER QUALITY MONITORING NETWORKS 2006

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April 2006

Cover Photos Provided by: NJDEP Water Monitoring & Standards staff & Paul Leakan (Pinelands Commission)

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Introduction

Water Monitoring and Standards (WM&S) is the program, in the NJ Department of Environmental Protection (NJDEP), which is responsible for ambient monitoring of the state's fresh, ground and marine waters. This monitoring is performed in accordance with the objectives of the Federal Clean Water Act which are to "restore and maintain the chemical, physical and biological integrity of the Nation's waters". In order to accomplish this, states are expected to develop, adopt and maintain water quality standards which are used in assessments of the quality of the state's waters. These standards and assessments must be based on sound, up-to-date scientific information, including monitoring data. WM&S oversees the operation of the primary water quality monitoring networks for the State of New Jersey.

The mission of WM&S is the continued development and implementation of appropriate water monitoring programs using innovative approaches for the design, collection, measurement, storage, retrieval, assessment and dissemination of water quality data. The information generated from these water quality monitoring networks is used for multiple purposes including:

- evaluating water quality status and trends
- classifying waters, including shellfish water quality
- assessing and ranking chemical and biological waterbody impairments
- development of Total Maximum Daily Loads (TMDLs)
- informing water quality-sensitive land use
- identifying pollution sources (both point and non-point) and relative impacts
- designing and implementing watershed management initiatives
- determining the effectiveness of pollution control programs
- responding to environmental emergencies and spills

Monitoring strategies employed by WM&S are comprised of multiple water quality assessment techniques including: habitat assessments, in-stream biological monitoring such as fish population surveys, collection of physical/chemical data on a variety of matrices (surface water, ground water, sediment), identifying pollution sources in the coastal and freshwater environment (discharges, stormwater, marinas), and sediment toxicity testing.

WM&S locates all monitoring stations via the Global Positioning System (GPS), with all locational information being downloaded into NJDEP's Geographic Information System (GIS). All physical/chemical and biological monitoring data collected are stored in the US Environmental Protection Agency's STORET water quality database or the U.S. Geological Survey's NWIS database

The following pages contain information on each of the networks that are maintained by WM&S. Included for each network is a brief description of the network (including, for appropriate networks, the parameters monitored), a map of the sampling site locations, as well as references for the locations of the monitoring results. Additionally, at the end of the report, information is included regarding additional specialized WM&S monitoring capabilities.

FRESHWATER & BIOLOGICAL MONITORING

Ambient Biological Monitoring Network (AMNET)

In 1992, a network of over 800 stream sites was initiated in New Jersey to provide long-term biological data reflecting the quality of surface waters throughout the State. Designed and conducted by the Bureau of Freshwater and Biological Monitoring, the Ambient Biomonitoring Network (AMNET) program routinely samples and analyzes aquatic macroinvertebrate populations at each site, employing USEPA-developed Rapid Bioassessment (RBP) methods to provide an index of stream water and habitat quality.

Biomonitoring programs, including both ambient and intensive surveys, were initiated by the NJDEP because the micro and macro flora and fauna of various trophic levels can integrate the effects of water quality changes over time, thus making them efficient pollution indicators. Macroinvertebrates, largely benthic (bottom-dwelling) organisms, provide a primary, cost-effective biomonitoring tool. These organisms are ubiquitous in distribution, more stationary than fish but less transient than algae and other microscopic communities, and they are easily collected and quantified.

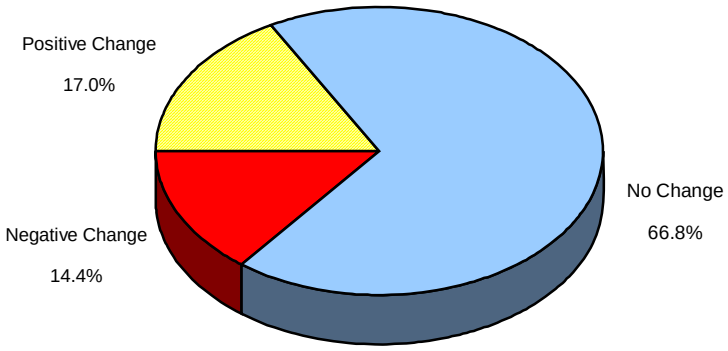
Establishment of the AMNET system in 1992 was facilitated by USEPA's introduction of the RBP protocols; protocols which decreased the per station level of effort so that biological surveys with large number of sites could be completed with less resources. Sites in each Water Region (Upper Delaware, Northeast, Raritan, Atlantic, and Lower Delaware) are sampled on a five-year rotational basis to allow time for recovery from possible transient environmental impacts, and to establish trends in water and habitat quality. As of March 2006, all of the network stations have been sampled at least twice, with 4/5 of the stations having been sampled three times. The data generated by AMNET contribute substantially to NJDEP's preparation of the Integrated Water Quality Monitoring and Assessment Report (305b water quality report and 303d impaired waterbodies list). The information is also key in selecting additional waterbodies appropriate for increased Category 1 (C1) antidegradation protections.

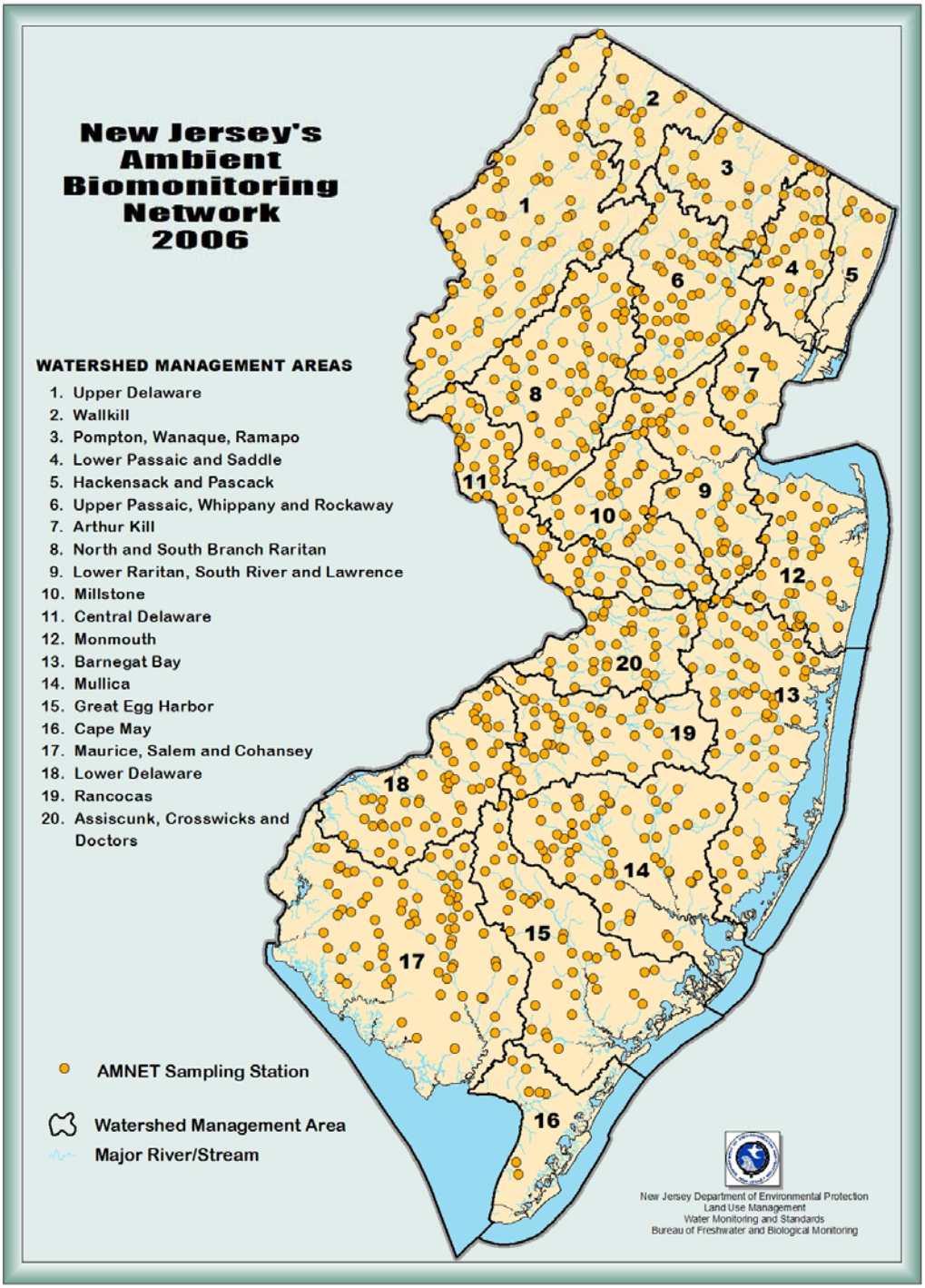
A summary of results from the most recently completed round of AMNET sampling is shown below. Detailed results may be found on the Bureau of Freshwater & Biological Monitoring's webpage: www.state.nj.us/dep/wmm/bfbm/publications.html

AMNET Round 2 Statewide Data Summary

Year	Water region	Non-impaired	Moderately impaired	Severely Impaired	Total # sites
1997-1998	Upper Delaware	80 (58.0%)	57 (41.3%)	1 (0.7%)	138
1998–1999	Northeast	38 (36.9%)	59 (57.3%)	6 (5.8%)	103
1998-1999	Raritan	57 (35.2%)	90 (55.6%)	15 (9.2%)	162
1999-2000	Atlantic Coastal	75 (35.2%)	115 (54.0%)	23 (10.8%)	213
2000- 2001	Lower Delaware	31 (15.7%)	139 (70.6%)	27 (13.7%)	197
	Totals:	281 (34.6%)	460 (56.6%)	72 (8.8%)	813

Percent Change in Rating Between Round 1 (1992-1996) and Round 2 (1997-2001) sampling



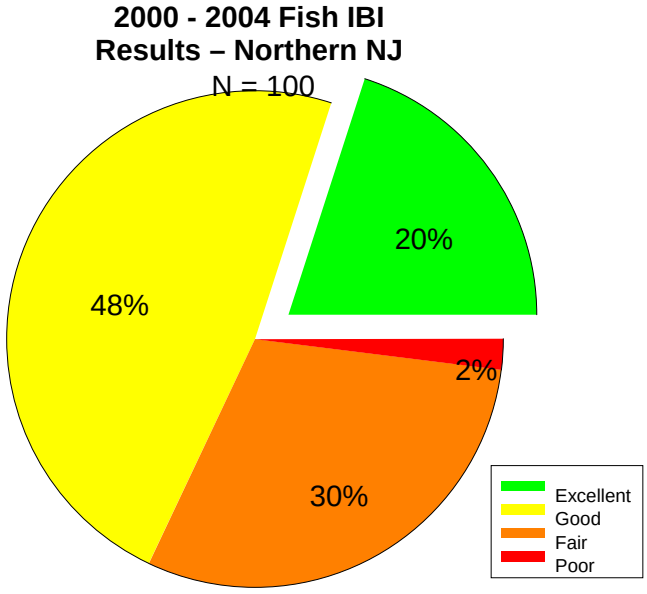

New Jersey's Ambient Biomonitoring Network 2006
WATERSHED MANAGEMENT AREAS
1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors
AMNET Sampling Station
Watershed Management Area
Major River/Stream
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

Fish Index of Biotic Integrity (IBI)

The Bureau of Freshwater and Biological Monitoring began implementing a Fish Index of Biotic Integrity (IBI) sampling program in 2000. The objective is to assess stream quality using the IBI. The IBI evaluates environmental conditions based on assessments of fish populations.

Once fish from sample collections have been identified, counted, examined for disease and anomalies, and recorded, several biometrics are applied to evaluate biotic integrity. Fish community analysis is accomplished using a regional modification of the original IBI (Karr *et. al.* 1986)[1]. The modified IBI uses the following ten biometrics: 1) total number of fish species, 2) number and identity of benthic insectivorous species, 3) number and identity of trout (non-stocked) and/or sunfish species, 4) number and identity of intolerant species, 5) proportion of individuals as white suckers, 6) proportion of individuals as generalists, 7) proportion of individuals as insectivorous cyprinids, 8) proportion of individuals as non-stocked trout or proportion of individuals as piscivores (excluding American eel), 9) number of individuals in the sample and , 10) proportion of individuals with disease or anomalies. Water Monitoring & Standards is collecting samples in the northern part of the State, north of the fall line for this ongoing monitoring program. The Division of Fish and Wildlife is collecting fish assemblage samples in the southern portion of the state to calibrate the IBI protocol for these waters of the state.

Fish IBI results from annual sampling seasons may be obtained by visiting the Bureau's webpage (www.state.nj.us/dep/wmm/bfbm/publications.html) or by calling the Bureau at (609) 292-0427.



[1] Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.S. Schlosser. 1986. *"Assessing biological integrity in running waters: a method and its rationale"* Illinois Natural History Survey, Champaigne, IL, Special Publication 5.


New Jersey's Fish IBI Sampling Stations 2000 - 2005
WATERSHED MANAGEMENT AREAS
1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors
Fish IBI Sampling Station
Watershed Management Area
Major River/Stream
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

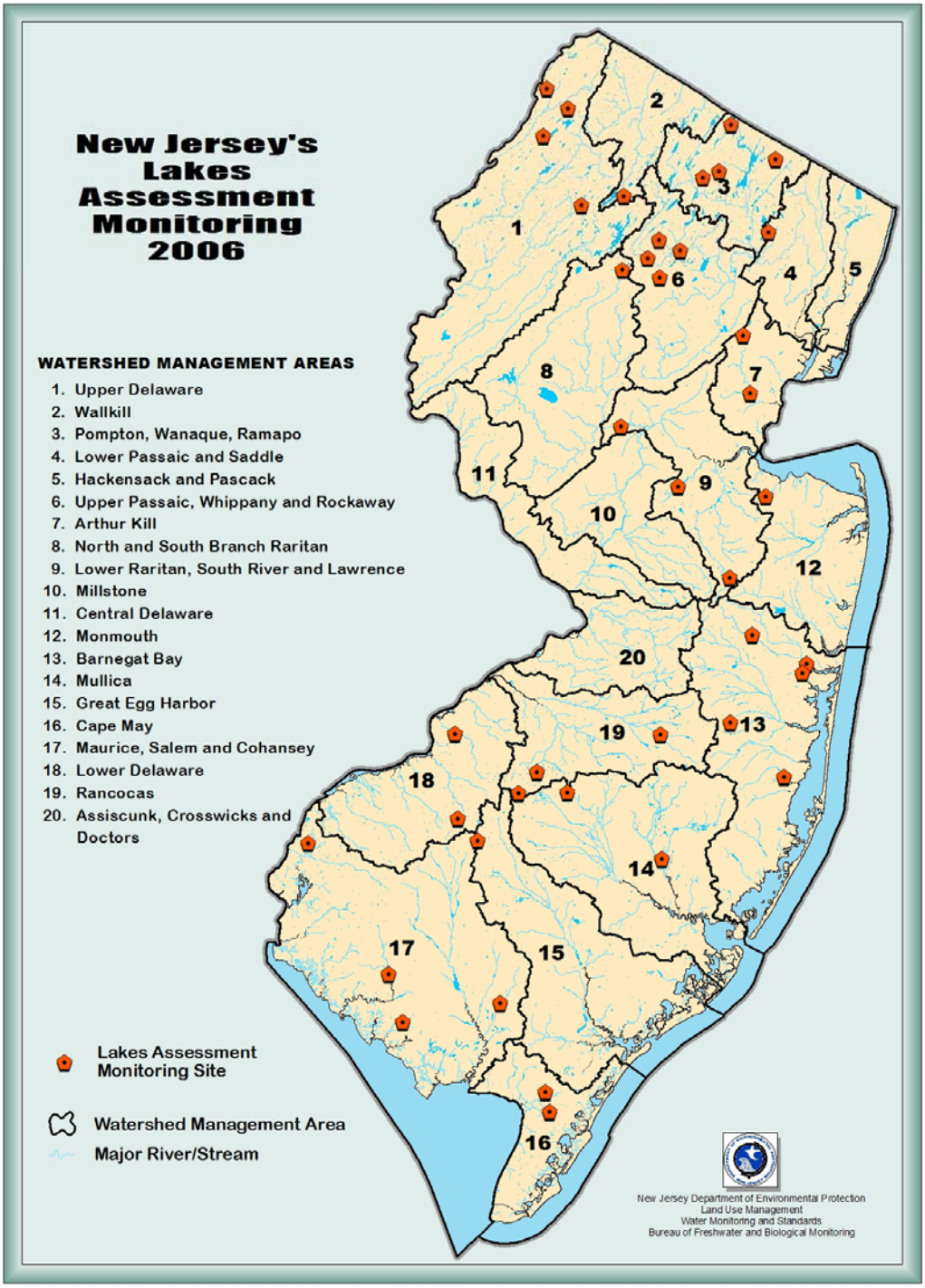
Ambient Lakes Monitoring Network

NJDEP's renewed ambient lake monitoring network is designed to provide the water quality data necessary to assess the ecological health of the State's lentic water resource. Reinitiated in 2004, this program involves the testing of randomly selected lakes from the state's approximately 1100 named lakes. The water quality measurements conducted at each lake include parameters such as dissolved oxygen, pH, nutrients, and chlorophyll a. Such testing will assist New Jersey in determining the status and trends in lake water quality, as needed to meet the state's Clean Water Act requirements and the Total Maximum Daily Load (TMDL)-related water quality assessment obligations.

WM&S has developed a monitoring program that will address both the NJ water program deficiencies cited in the 1999 USEPA's Office of Inspector General's Audit Report, and the needs of the watershed management and water quality assessment (305(b)/303(d)) programs. This approach comports with the guidance provided in USEPA's publication, "Elements of a State Water Monitoring and Assessment Program," March 2003, which requires that states develop and implement long-term strategies which include monitoring of all state waterbody types, including lakes. The lake monitoring network design is as follows:

1. **Target Population**: All lakes, man-made or natural, excepting water supply reservoirs, wholly or partially within the State of NJ political boundaries. A lake is defined as a permanent body of water of at least two hectares in surface, and a minimum depth of one meter. Lakes will be selected randomly, using the USEPA - Generalized Random Tessellation Stratified (GRTS) survey design, but in a manner that equalizes selections over all Omernik level III ecoregions (6 within state). The NJ GIS coverage containing approximately 1,100 polygons of named lakes will be used for the selection process.
2. **Network Stations**: The network will consist of 200 lakes, each sampled once every five years, with forty lakes sampled per year. Depending on the lake size and characteristics, up to four sampling locations are monitored in each lake. Lakes not exhibiting temperature stratification will be sampled at one meter below the surface, unless the lake is too shallow, in which case the sample will be taken at a depth of one-foot below the surface. Lakes exhibiting stratification will be sampled above and below the thermocline. Depth to bottom will be measured at each station. Sampling Frequency: All lakes in the network will be sampled once every five years, with each lake being sampled at least three times during the year (Spring, Summer, and Fall). A fourth winter sampling period will be added if weather conditions and resources permit.
3. **Monitoring Parameters**: Total Phosphorus, Total Kjeldahl Nitrogen, Total Nitrite+Nitrate Nitrogen, Ammonia Nitrogen, Dissolved Oxygen, Temperature, Specific Conductance, Alkalinity, Hardness, Secchi depths, and Chlorophyll a will be collected and analyzed at each station. Qualitative evaluations of algal blooms and aquatic vegetation will be performed at each lake.

Lakes monitoring network results will be available via the Bureau's webpage (www.state.nj.us/dep/wmm/bfbm/publications.html) or by calling the Bureau at (609) 292-0427.


New Jersey's Lakes Assessment Monitoring 2006
WATERSHED MANAGEMENT AREAS
1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
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9. Lower Raritan, South River and Lawrence
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12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors
Lakes Assessment Monitoring Site
Watershed Management Area
Major River/Stream
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

Ambient Surface Water Quality Monitoring Network (ASWMN)

The Ambient Surface Water Quality Monitoring Network is a cooperative DEP/USGS program, established in the mid-1970's. A major redesign of the network occurred in 1997. The revised network was specifically designed to address surface water quality issues in each of the state's 20 watershed management areas addressing the following objectives: (1) track status and trends in ambient water quality; (2) establish background water quality; (3) obtain water quality data that can be correlated with specific land uses (urban/suburban, agricultural and undeveloped); and (4) coordinate water chemistry and biological monitoring networks. A second major revision occurred in 2005 with the addition of 100 additional monitoring stations to improve statewide spatial coverage for the network. These 100 additional stations are sampled for water quality by DEP and for flow by USGS.

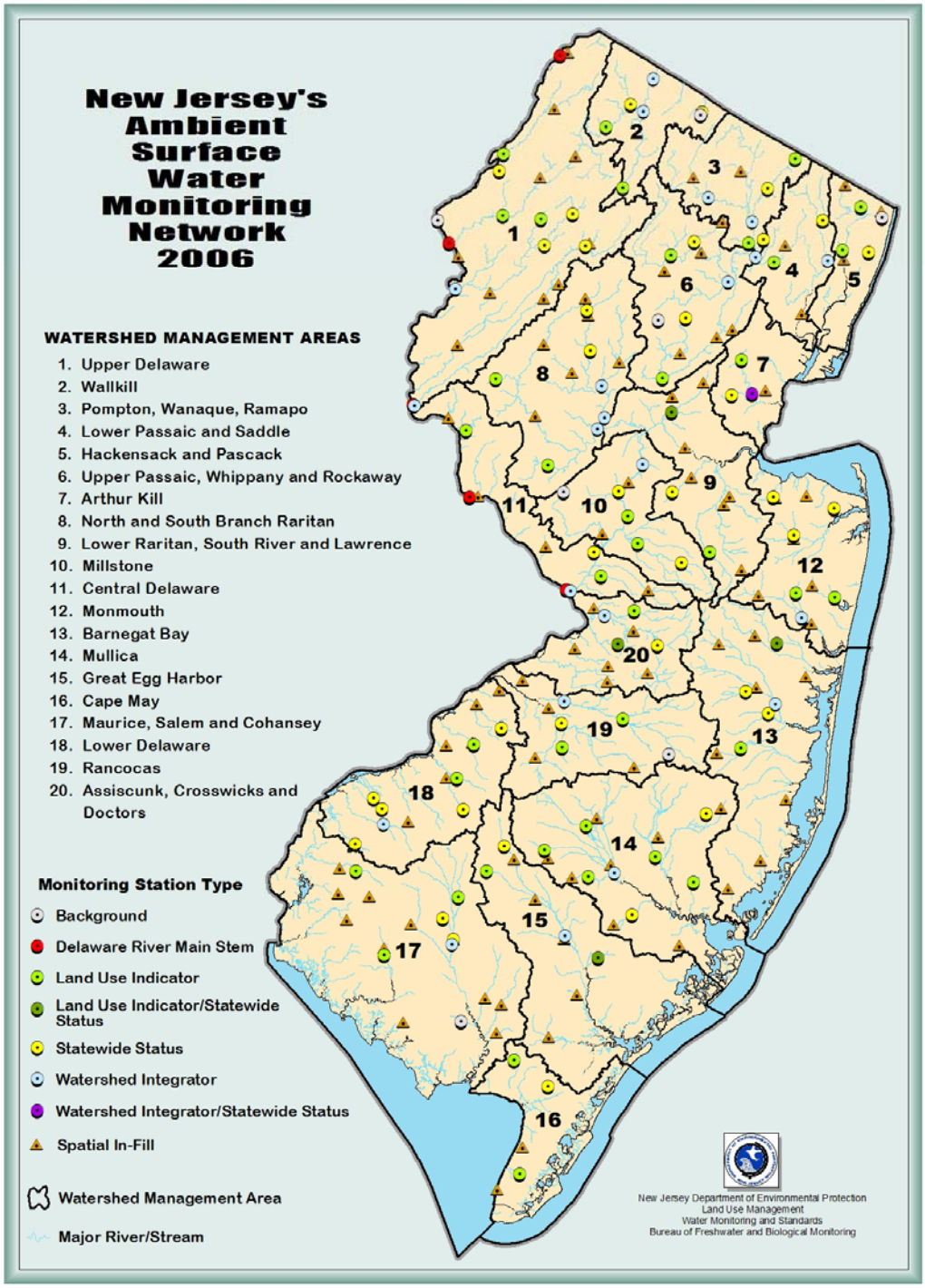
The network is comprised of 5 station types: (1) *background / reference sites* – waterways located in undeveloped watersheds (generally county, state or federal parks and forests), (2) *land use indicator sites* – waterways which reflect a dominate land use (urban / suburban, agricultural or undeveloped) within a watershed management area, (3) *watershed integrator sites* – waterways which reflect large drainage areas and multiple pollution sources, (4) *statewide status sites* – sites randomly reselected every two years from DEP's 829 station biological (macroinvertebrate – AMNET) network and (5) *spatial infill sites* - sites added in 2005 to provide a minimum of one site in each HUC (Hydrologic Unit Code) 11. These sites were selected from a group of stations formerly referred to as the "Supplemental Network". The overall ASWMN consists of 215 stations that are sampled quarterly.

Parameters monitored:
Monitored quarterly – discharge (except at statewide status sites), field parameters, filtered common ions, total and filtered nutrients, suspended solids and BOD

Monitored biannually – metals (spring – high flow and summer – low flow)

Monitored annually at selected sites – bacterial parameters (5 times in 30 days), diurnal DO, pesticides, sediment metals, sediment nutrients and sediment polyaromatic hydrocarbons.

The data collected via this Network are used in assessments for the New Jersey Integrated Water Quality Monitoring and Assessment Report (formerly referred to as the 305(b) Water Quality Inventory Report and the 305 (d) Impaired Waterbodies List). Network data are available from the following: (1) the USGS computerized data system, NWIS (http://nj.usgs.gov), (2) EPA's computerized data system, STORET (http://www.epa.gov/storet/dbtop.html) and (3) USGS annual reports " Water Resources data – New Jersey". Additional information on this monitoring network is available from the Bureau of Freshwater & Biological Monitoring's webpage (www.state.nj.us/dep/wmm/bfbm).


New Jersey's Ambient Surface Water Monitoring Network 2006
WATERSHED MANAGEMENT AREAS
1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors
Monitoring Station Type
Background
Delaware River Main Stem
Land Use Indicator
Land Use Indicator/Statewide Status
Statewide Status
Watershed Integrator
Watershed Integrator/Statewide Status
Spatial In-Fill
Watershed Management Area
Major River/Stream
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

Ambient Ground Water Network - DEP/USGS

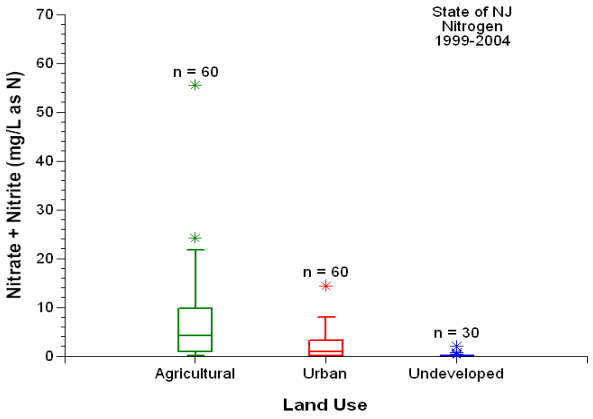
The first Ambient Ground Water Monitoring Network was established by NJDEP and USGS in 1983. The original network was designed to determine the concentration range of chemical constituents as a function of rock type. Having addressed that goal, the network was redesigned in 1998 to address the following objectives: (1) assess status and trends in newly recharged ground water; (2) define ground water quality by land use type (urban/suburban, agricultural and undeveloped); (3) determine potential ground water impacts on surface water quality; and (4) identify emerging ground water quality issues.

The redesigned network is comprised of 150 shallow wells. Network installation and the first round of sampling was completed in 2004. Well locations were identified using a stratified random approach, based on land use type. Sixty wells are located in urban/suburban settings, sixty wells are located in agricultural settings and thirty wells are located in undeveloped settings. With a sampling rate of 30 wells per year, sampling frequency for network wells is once every 5 years.

Parameters monitored:

- Field Parameters : Specific conductance, pH, alkalinity, D.O., water temperature and turbidity.

- Laboratory Parameters : Dissolved major ions and trace elements (metals), dissolved nutrients, volatile organic compounds, pesticides and gross alpha / beta.



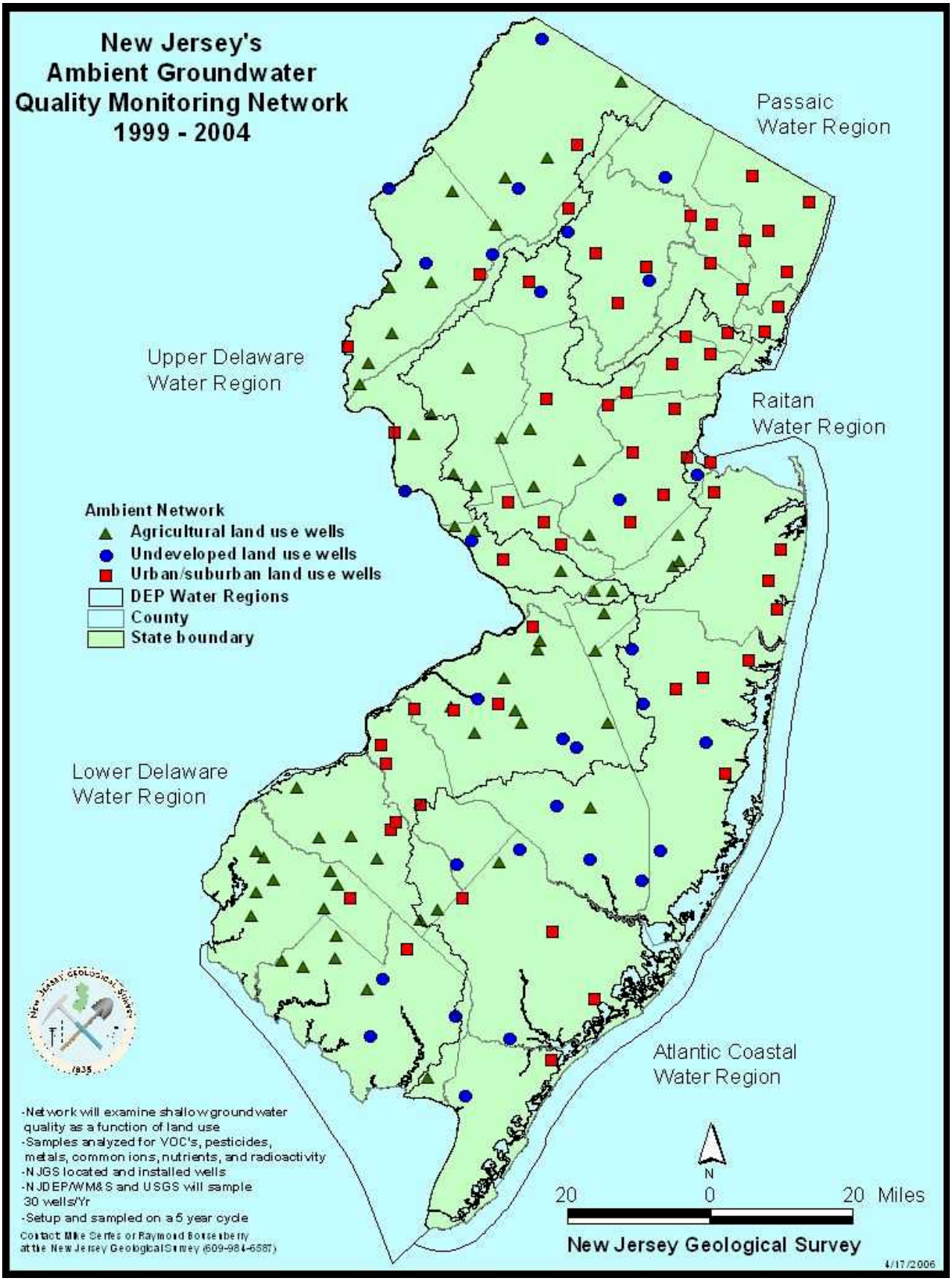
Nitrate + nitrite concentration data for 150 well

The ground-water quality data are currently available in an NJDEP I-MAP format at: http://www.state.nj.us/dep/gis/depsplash.htm, in annual USGS Water Resources Reports for New Jersey and online at the USGS NWIS database at, http://waterdata.usgs.gov/nwis/. Data summaries are available in: (1) The Integrated Water Quality Monitoring and Assessment Report, http://www.state.nj.us/dep/wmm/sgwqt/wat/integratedlist/integratedlist2004.html (2) the references listed below, (3) In subsequent NJDEP/USGS Informational Circulars, (4) the USGS annual reports " Water Resources Data – New Jersey", and (5) on the NJGS web site (Piedmont data only) (www.nj.gov/dep/njgs). Applicable data updates are ongoing.

References:

Serfes, M.E., 2004, Ground Water Quality in the Bedrock Aquifers of the Highlands and Valley and Ridge Physiographic Provinces of New Jersey: New Jersey Geological Survey Report no. 39, 29p.

Serfes, M.E., 1994, Natural ground-water quality in bedrock of the Newark Basin, New Jersey: New Jersey Geological Survey Report no. 35, 29p.


New Jersey's
Ambient Groundwater
Quality Monitoring Network
1999 - 2004
Passaic
Water Region
Upper Delaware
Water Region
Raitan
Water Region
Ambient Network
Agricultural land use wells
Undeveloped land use wells
Urban/suburban land use wells
DEP Water Regions
County
State boundary
Lower Delaware
Water Region
Atlantic Coastal
Water Region
-Network will examine shallow groundwater quality as a function of land use
-Samples analyzed for VOC's, pesticides, metals, common ions, nutrients, and radioactivity
-NJGS located and installed wells
-NJDEP/WM&S and USGS will sample 30 wells/Yr
-Setup and sampled on a 5 year cycle
Contact: Mike Serfes or Raymond Bonsteberry at the New Jersey Geological Survey (609-984-6587)
N
20 0 20 Miles
New Jersey Geological Survey
4/17/2006

MARINE WATER MONITORING

National Shellfish Sanitation Program

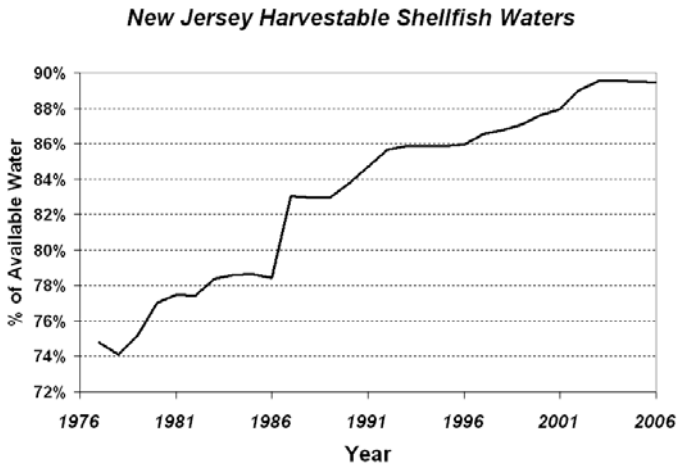
The National Shellfish Sanitation Program (NSSP) was established by the Surgeon General in 1925 and is active in all coastal states involved in interstate shellfish harvest and sale. Its purpose is to regulate the harvest and sale of shellfish to safeguard the public health from the consumption of contaminated shellfish. The shellfish industry represents a significant portion of New Jersey's coastal economy with an estimated dockside value of about $80,000,000 per year. The data from the NSSP also supports a significant indicator of coastal water quality over time.

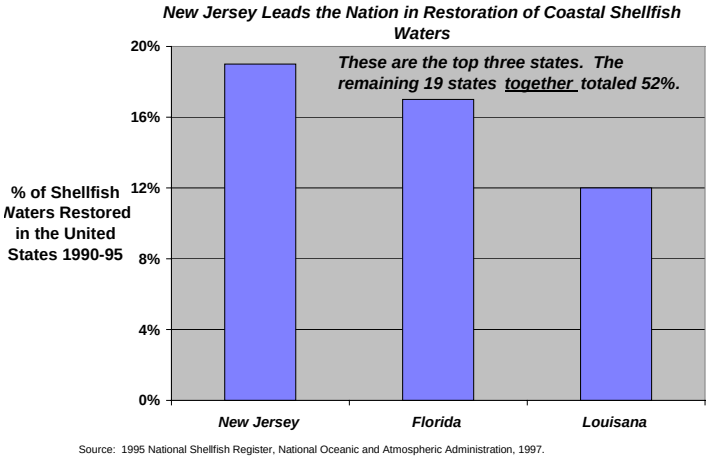
One portion of the program requires shellfish producing states to classify their coastal waters according to suitability for safe shellfish harvest. Part of the assessment of these waters for safe shellfish harvest involves the monitoring of pollutant levels in those waters. Of principal concern are indicators of human pathogens in the water that may be transmitted to consumers through the harvest of tainted shellfish. Each year the Bureau of Marine Water Monitoring assesses the most recent water quality data and shoreline survey information for compliance with the National Shellfish Sanitation Program guidelines. Waters not in compliance are closed to shellfish harvest.

The Bureau of Marine Water Monitoring maintains a network of more than 1,600 active monitoring stations throughout the state's coastal waters. These stations are sampled between five and twelve times each year for total coliform and fecal coliform bacteria (indicators of human pathogens). The Bureau's staff at the Leeds Point, NJ laboratory facility analyzes the samples.

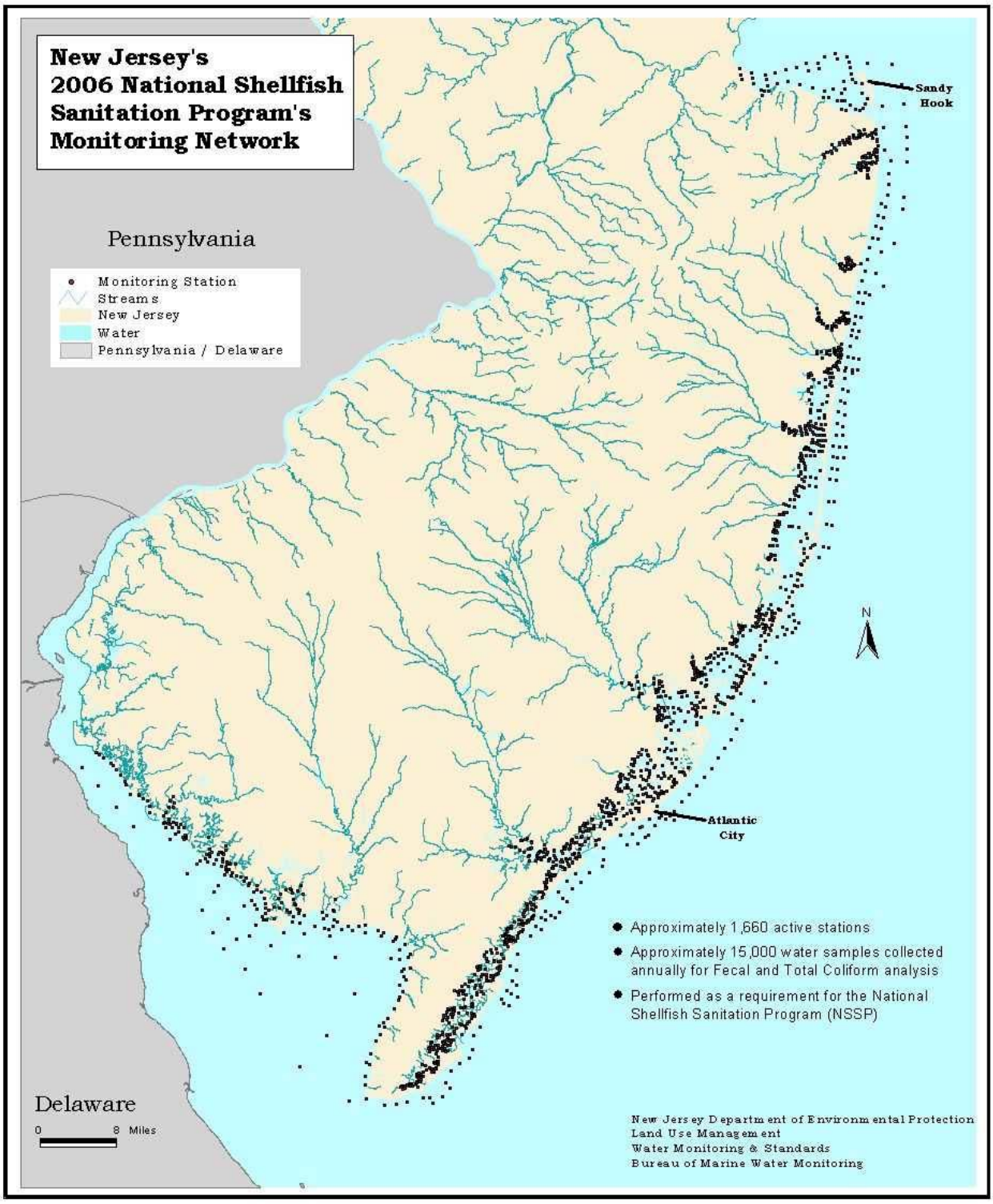
New Jersey has been very successful in improving water quality for shellfish harvesting. For 15 consecutive years, New Jersey has upgraded more waters that it has downgraded for shellfish harvesting. Currently, 90% of the State's shellfish waters are harvestable. As of the last national survey of shellfish waters in the United States, New Jersey was the leading state in the restoration of coastal shellfish waters.

Further information on this program and water quality results can be found on the Bureau's web page (www.nj.gov/dep/wmm/bmw).



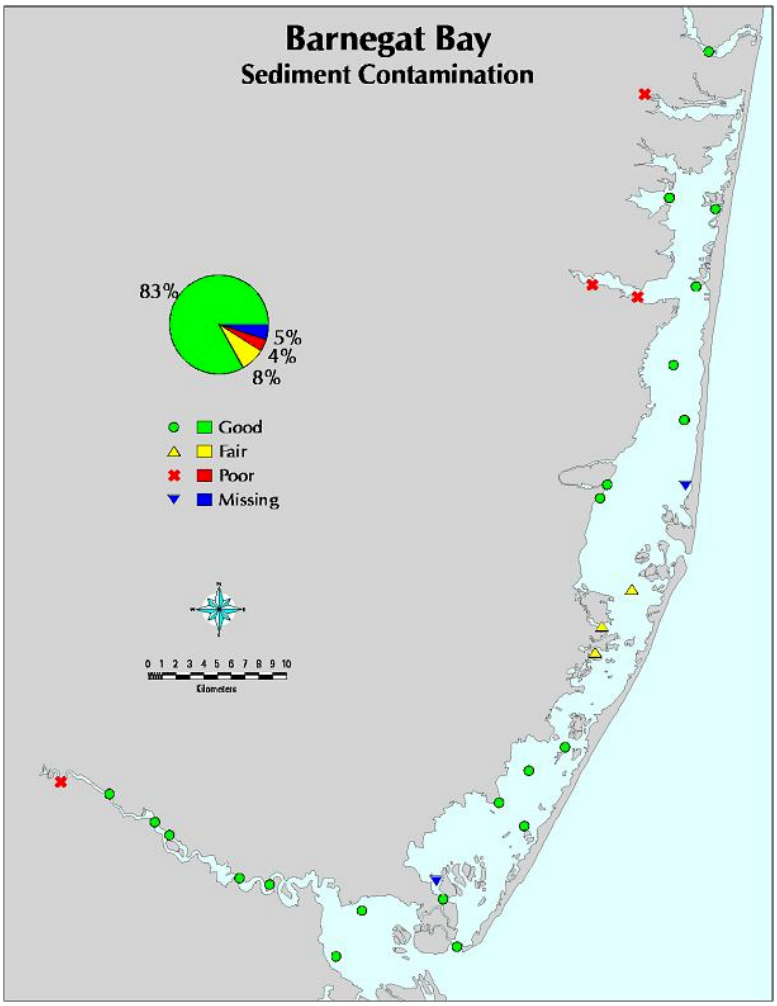


Source: 1995 National Shellfish Register, National Oceanic and Atmospheric Administration, 1997.


New Jersey's
2006 National Shellfish
Sanitation Program's
Monitoring Network
Pennsylvania
Monitoring Station
Streams
New Jersey
Water
Pennsylvania / Delaware
Sandy
Hook
N
Atlantic
City
Approximately 1,660 active stations
Approximately 15,000 water samples collected annually for Fecal and Total Coliform analysis
Performed as a requirement for the National Shellfish Sanitation Program (NSSP)
Delaware
0
8 Miles
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring & Standards
Bureau of Marine Water Monitoring

National Coastal Assessment Network

National Coastal Assessment (NCA) is a federally funded program to assess the ecological condition of the nation's estuarine resources. Starting in 2000, NCA's annual summer sampling involves collection of water, sediment, and benthic invertebrate samples at 35 locations in NJ's coastal bays. Samples are analyzed for water chemistry (e.g., nutrients, dissolved oxygen), sediment chemistry/toxics, sediment toxicity and benthic diversity. Results from this program are used in EPA's National Coastal Condition Reports. Results from NCA sampling are also now being used by NJDEP to assess ecosystem impairment of the NY/NJ Harbor in NJ's Integrated Assessment Report. Through a collaborative effort between EPA, NJDEP and Rutgers University, research is currently underway in New Jersey to expand NCA's assessment to the state's (and subsequently the nation's) near-shore ocean waters.



The design of the NCA program is probabilistic, which means that it can be used to estimate what percentage of the state's or nation's waters are in good, fair or poor condition. The pie chart to the right shows an example of that type of assessment of sediment contamination in the Barnegat Estuary. Red, yellow and green marks on the map show conditions measured at specific locations within the estuary.

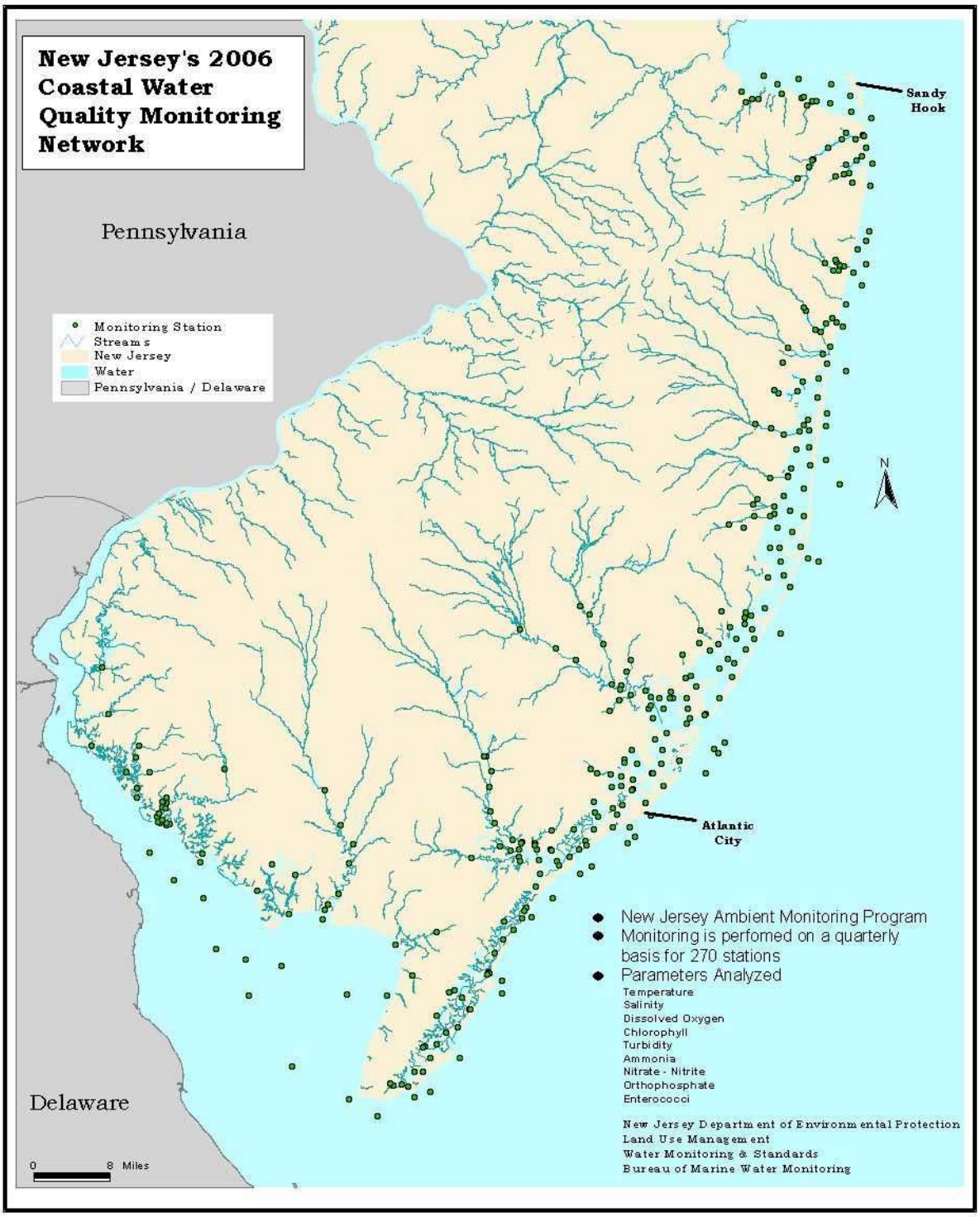
NCA data are available from EPA's NCA website (www.epa.gov/emap/nca/index.html).

Coastal Water Quality Network

The purpose of this Network is to provide basic measures of the ecological health of New Jersey's coastal waters (includes ocean, estuarine and tidal river waters). Temperature, salinity, suspended solids and oxygen measurements can provide information on the degree of environmental stress that organisms are exposed to. Nutrients (nitrogen and phosphorus) and chlorophyll relate to the amount of plant material in the water. Too much or too little plant material in the water can be detrimental to other organisms in the bay and ocean.

The Network monitors parameters such as dissolved oxygen, salinity, nitrogen, phosphorus, secchi depth, temperature, chlorophyll and suspended solids. Samples are collected four times per year (once each quarter) at approximately 270 locations.

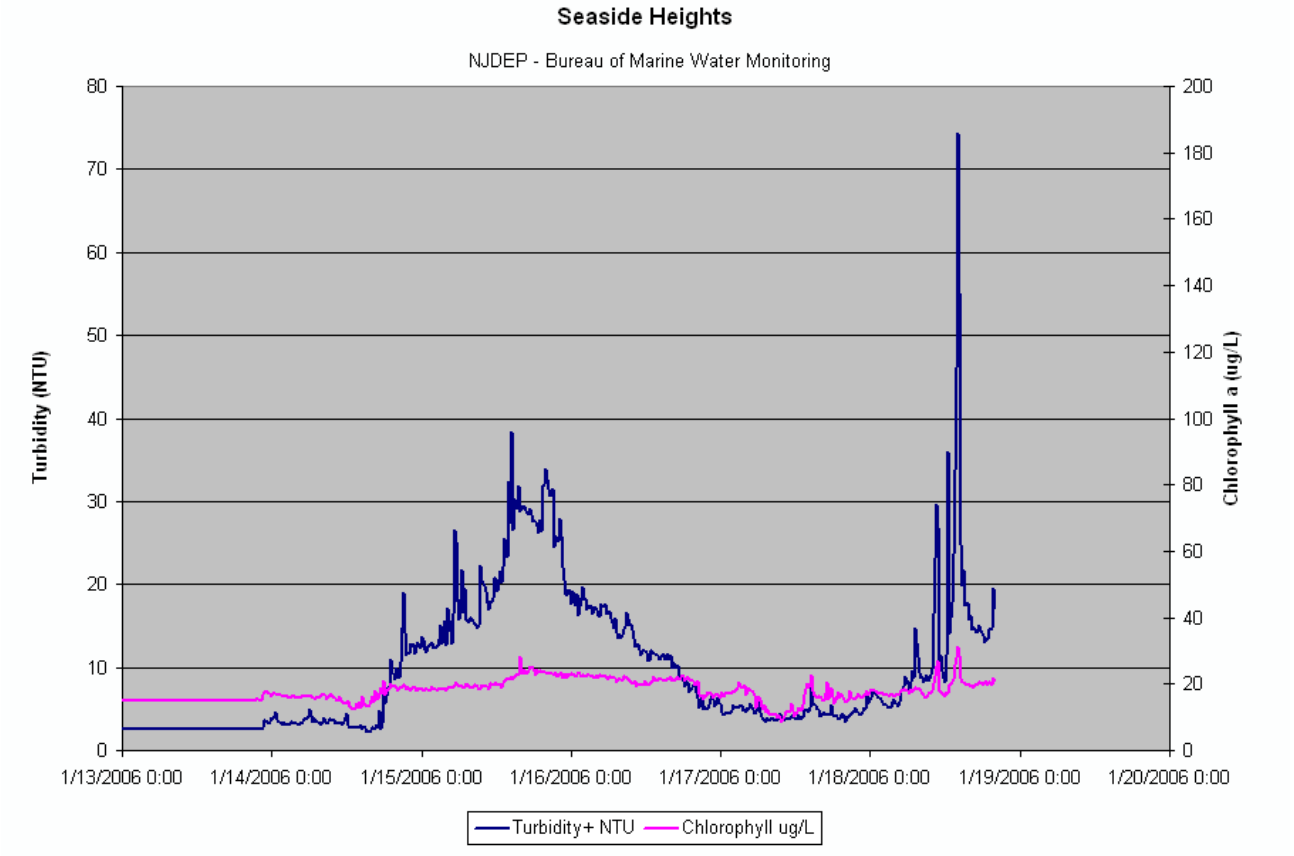
Data and results from this Network may be obtained from the Bureau's webpage (www.nj.gov/dep/wmm/bmw) or by calling the Bureau at (609) 748-2000.

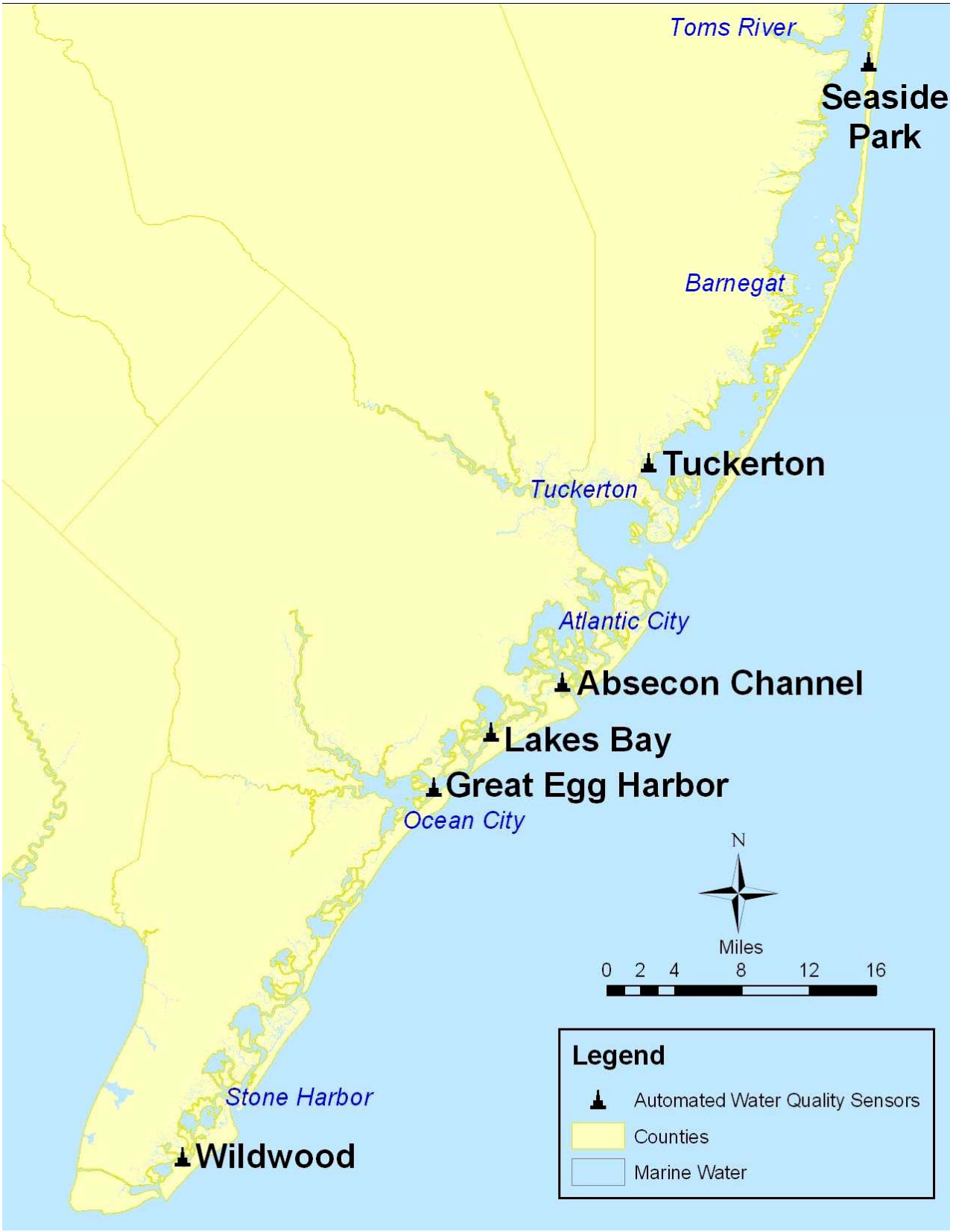

New Jersey's 2006 Coastal Water Quality Monitoring Network
Pennsylvania
Monitoring Station
Streams
New Jersey
Water
Pennsylvania / Delaware
Sandy Hook
Atlantic City
N
New Jersey Ambient Monitoring Program
Monitoring is perfomed on a quarterly basis for 270 stations
Parameters Analyzed
Temperature
Salinity
Dissolved Oxygen
Chlorophyll
Turbidity
Ammonia
Nitrate - Nitrite
Orthophosphate
Enterococci
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring & Standards
Bureau of Marine Water Monitoring
Delaware
0
8 Miles

Cooperative Real-time Monitoring Network

In 2003, NJDEP began operation of four automated water quality monitoring buoys. The sensors measure conditions such as dissolved oxygen, salinity, temperature, pH and turbidity. They continually measure these parameters every 15 minutes and send this information to computers at the Bureau of Marine Water Monitoring. Those computers process the data, graph the results, and post the information on the Bureau's web page (http://www.nj.gov/dep/wmm/bmw/sensorhome.htm) - see example below. The buoys are operational from March through December. The buoy mounted sensors are removed during the winter to avoid possible ice damage.

Updates to the data occur once every two hours. Through a cooperative agreement with the Barnegat Bay National Estuary Program and Rutgers University, two new real-time sensors became part of this network in 2005. The location of these two sensors, along with NJDEP's four sensors, is shown in the figure on the next page. Through a similar agreement with Monmouth University, two additional sensors are being planned for startup in 2006 in northern Barnegat Bay.

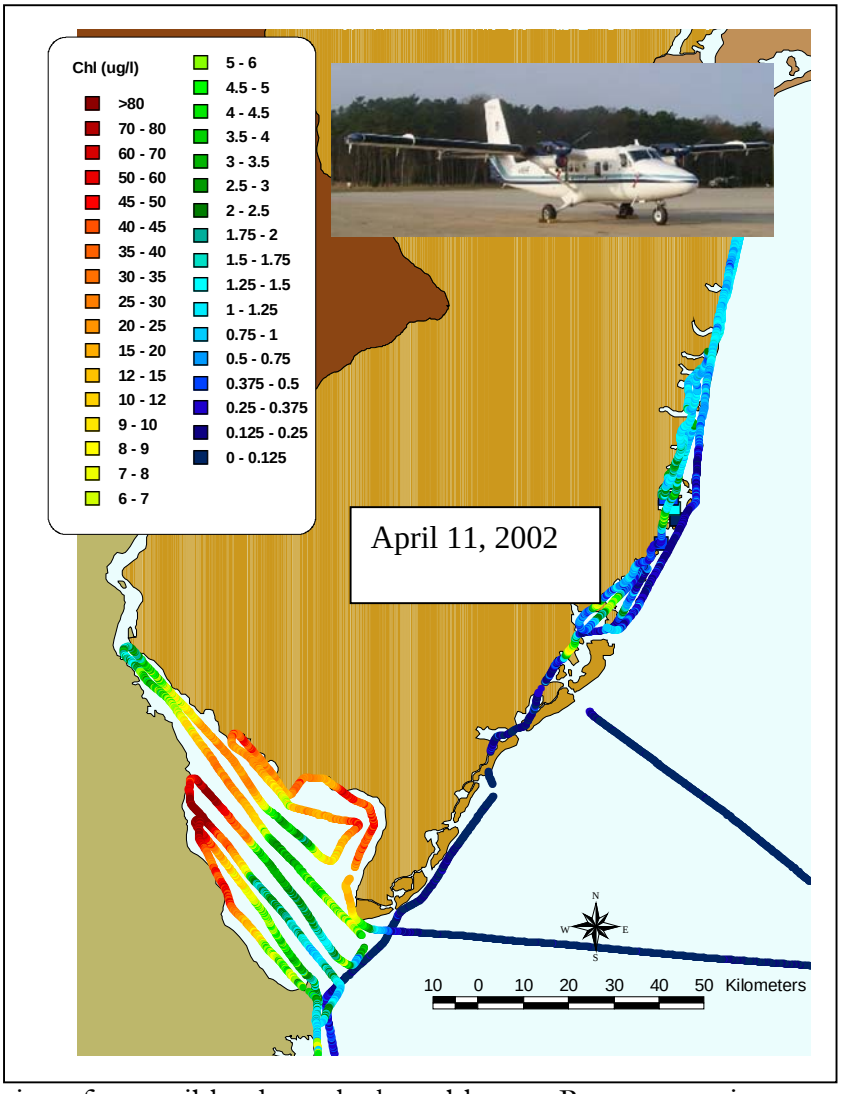



Toms River
Seaside Park
Barnegat
Tuckerton
Tuckerton
Atlantic City
Absecon Channel
Lakes Bay
Great Egg Harbor
Ocean City
Stone Harbor
Wildwood
N
Miles
0 2 4 8 12 16
Legend
Automated Water Quality Sensors
Counties
Marine Water

Coastal Phytoplankton Monitoring Network

Every summer, the Bureau of Marine Water Monitoring in collaboration with Region 2 of the U.S. Environmental Protection Agency (EPA) monitors phytoplankton populations in the waters along the 127 miles of New Jersey's coastline and major estuaries. Large-scale blooms of these organisms can produce unsightly and unhealthy water quality conditions, often referred to as red, green or brown tides, depending on the dominant varieties. When these algae die, the decay process uses significant amounts of dissolved oxygen in the water, sometimes reducing the bottom oxygen levels below tolerable levels to larger organisms, such as fish and shellfish. Some of the algal species that create red tides are known to have potentially harmful effects on human health, either through direct contact or through ingestion of shellfish that have become contaminated with the microorganisms. Fortunately, to date, New Jersey's red tides have not been of the acute toxic varieties. The results of the phytoplankton sampling also provide an estimation of the other algae present that might have effects on marine fauna and result in mild toxicity to bathers.

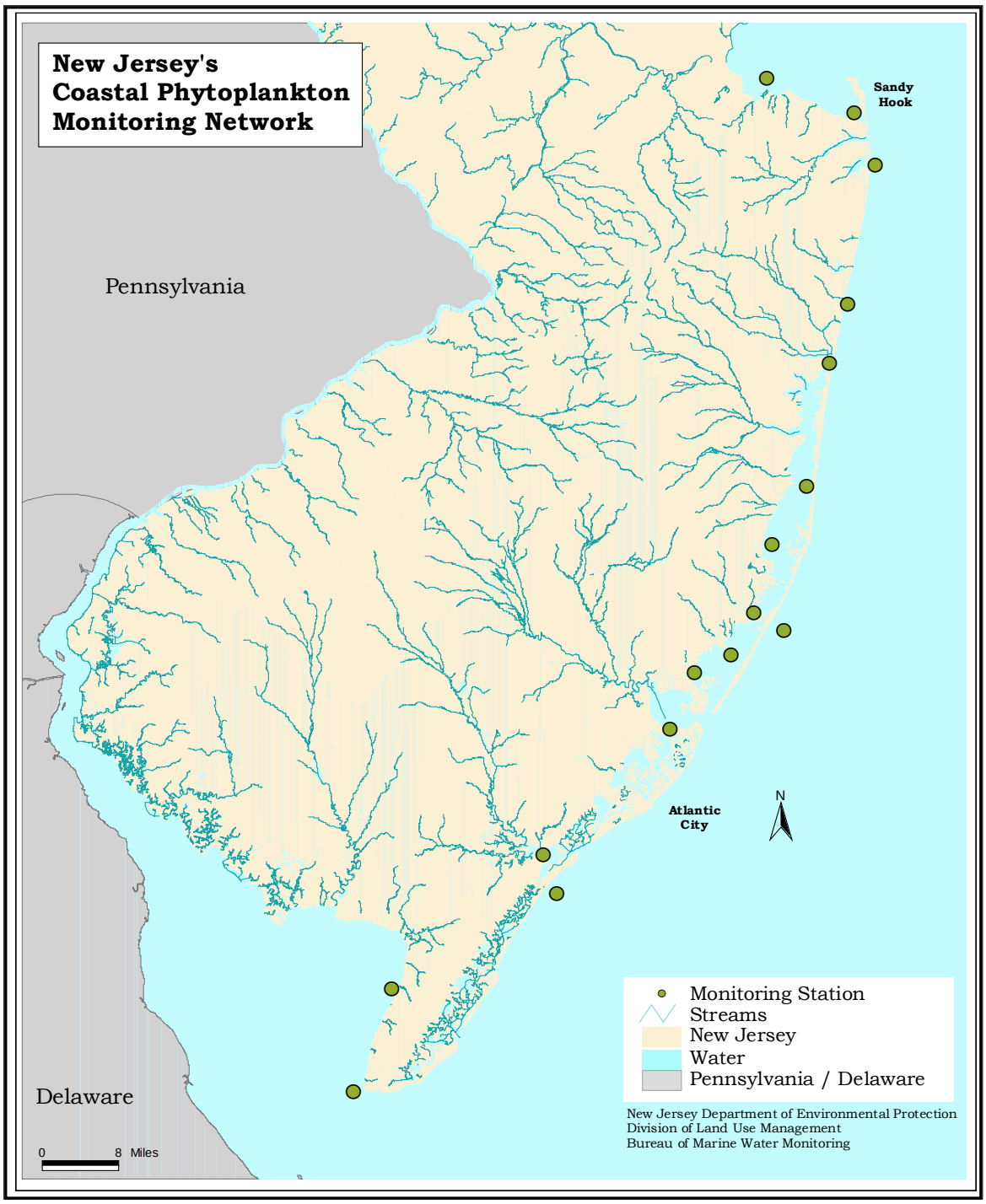
Under the guidelines of the National Shellfish Sanitation Program, the Bureau maintains a network of 16 stations as part of the state contingency plan to monitor for marine biotoxins. The stations are sampled biweekly from May through August each year. Samples are collected by EPA, via their helicopter, through a cooperative agreement with the NJ Department of Environmental Protection. The Bureau of Marine Water Monitoring analyzes the samples for the presence of potentially toxic forms of phytoplankton.



In 2006, chlorophyll a levels will be measured as shown in the figure to the right by a sensor attached to a plane. This remote sensing is being applied as a means to target traditional phytoplankton water sampling by boat to locations of elevated chlorophyll a concentrations as determined through remote sensing. High chlorophyll a concentrations are indicative of a possible phytoplankton bloom. Remote sensing

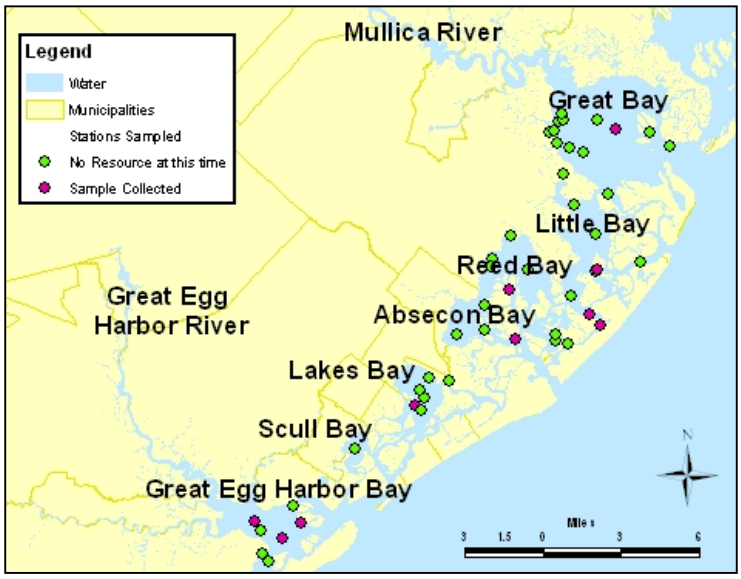
will compliment more traditional fixed-station monitoring performed by the Bureau (see map on next page).

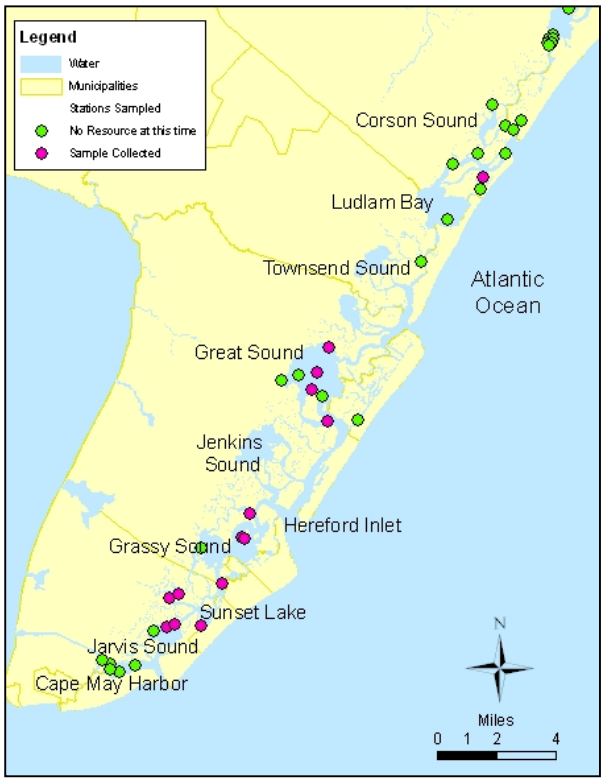
In recent years, no blooms of toxin producing algae have been detected in New Jersey waters. A non-toxic bloom called "Brown Tide" has recurred in Barnegat Bay in recent years. Also, a non-toxic dinoflagellate bloom occurred off the coast of Ocean City, NJ in 2002. Neither of these resulted in the significant water quality and economic impacts to fisheries and tourism that occurred with blooms in the mid-1970's and mid-1980's along the New Jersey coast. Results from the annual phytoplankton sampling may be obtained from the Bureau's webpage (www.state.nj.us/dep/wmm/bmw) or by calling the Bureau at (609) 748-2000.


New Jersey's
Coastal Phytoplankton
Monitoring Network
Pennsylvania
Sandy
Hook
Atlantic
City
N
Delaware
0
8 Miles
Monitoring Station
Streams
New Jersey
Water
Pennsylvania / Delaware
New Jersey Department of Environmental Protection
Division of Land Use Management
Bureau of Marine Water Monitoring

Toxic Pollutants in Shellfish Tissue

Shellfish are an important component in the economy of New Jersey. They also provide, over time, an excellent tool for monitoring coastal water quality. Monitoring toxic pollutants in shellfish can provide a long-term perspective on water quality. Shellfish filter large quantities of water and, in the process, accumulate pollutants to levels many times higher than are present in the water. This makes shellfish an excellent indicator for bioaccumulative, toxic pollutant levels in coastal waters. Regular testing of pollutants in shellfish began in Atlantic and Cape May Counties in 2005. In 2006, testing will be expanded to other coastal waters of the State. Pollutants measured include toxic metals (arsenic, cadmium, chromium, mercury, lead and nickel), pesticides and total polynuclear aromatic hydrocarbons (PAH's) in shellfish tissue. Results of this monitoring are compared to established federal standards and guidelines for safe consumption of shellfish. Comparisons to historical data will be made where possible to evaluate trends in pollutant levels in shellfish tissue. Data are made available on the Bureau of Marine Water Monitoring's web page at http://www.nj.gov/dep/wmm/bmw/EMPACT.htm.





Locations of 2005 shellfish toxics sampling in Atlantic County (above) and Cape May County (right).

OTHER WATER MONITORING CAPABILITIES

Nonpoint Source Monitoring –

Nonpoint source (NPS) monitoring is used to measure the impact of pollutants from sources other than wastewater discharges. These other sources would include stormwater runoff, atmospheric deposition and boat wastes. Stormwater runoff can result in significant impacts to the quality of surface waters. For that reason, Water Monitoring and Standards has been involved in monitoring of stormwater and associated nonpoint sources of pollution since 1994. Stormwater monitoring is performed for two primary purposes; 1) to measure the loads (quantities) of certain pollutants carried in stormwater to develop Total Maximum Daily Loads (TMDLs), and 2) to identify the actual sources of the pollutants so that corrective actions can be taken to reduce the impact of the source or to eliminate it. Currently, Water Monitoring and Standards is involved in both types of NPS monitoring that are described below.

Determination of Total Annual Nonpoint Source Pollution Loads to Watershed Management Areas 17, 18, & 20 (Lower Delaware)

The Lower Delaware Watershed Nonpoint Source monitoring study is a multi-year surface water quality investigation. It is being conducted by both the Department of Environmental Protection and the U.S. Geological Survey. Its purpose is to estimate the NPS loads of nutrients, bacteria, and suspended solids from various land use areas in Watershed Management Areas (WMA) 17, 18 & 20 (Lower Delaware).

The primary study objectives are:

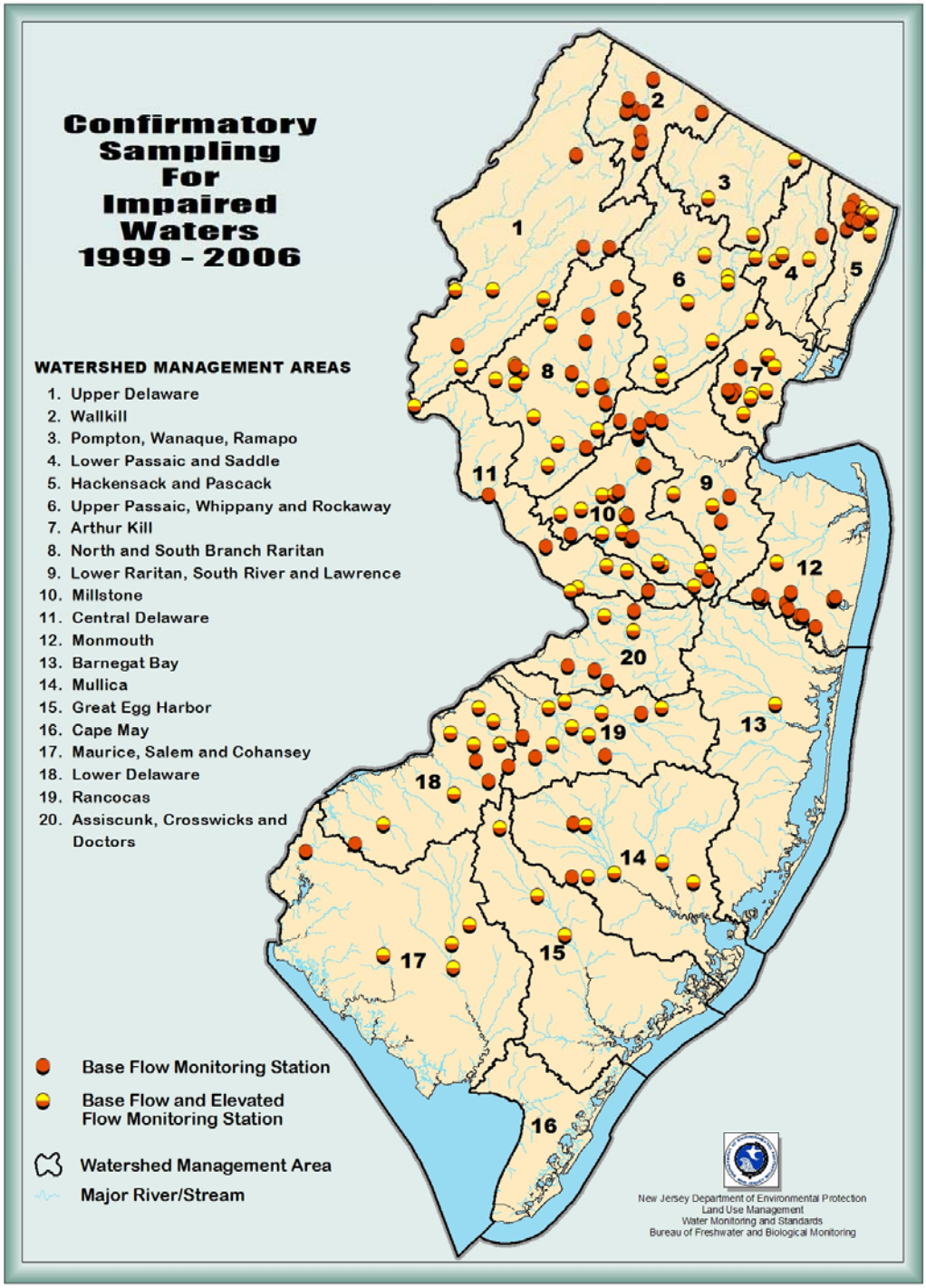
1. Document current water quality before NPS and stormwater management strategies are initiated, and
2. Develop a water quality model to estimate unit NPS loads of selected constituents associated with different land uses in WMA 17, 18, & 20.

In addition, synoptic sampling will be conducted during storm runoff conditions near the beginning of the baseline characterization phase of the study. This verifies the modeled land-use to water quality relationships, and identifies any anomalies to these relationships in the watersheds being studied. If major nonpoint sources are identified, a more focused implementation of Best Management Practices (BMPs) can be considered.

Confirmatory (303(d) or Sub-list 5) Sampling for Impaired Waters

Certain waters of the state are identified as "use impaired" due to exceedances of the Surface Water Quality Standards. Water bodies designated as "impaired" are listed in the NJDEP's *Integrated Water Quality Monitoring and Assessment Report*, which is submitted to the United States Environmental Protection Agency (USEPA) every two years. Within the Integrated Report, "impaired" water bodies are listed on Sub-list 5 (formerly 303(d)). The data used to classify these waters may be: (1) outdated and not reflective of current water quality conditions or (2) may have a positive bias due to older sample collection and analysis techniques now known to be inappropriate for ambient surface water metals monitoring. Evaluation monitoring, using newer collection procedures based on EPA's method 1669, and "Clean Methods Techniques – to be used when sampling for trace metals in aqueous samples, NJDEPE, 1993", in addition to updated laboratory analyses creates a metals database accurate to at least 1 part per billion (ppb). This allows for assessment relative to NJ's Surface Water Quality Standards. The determination regarding which sites and which parameters are being monitored is made by staff from the Water Monitoring and Standards' Bureau of Water Quality Standards and Assessment and the Division of Watershed Management's Bureau of Environmental Analysis and Restoration (BEAR).

Conventional parameters are being monitored concurrently with metals sampling where applicable. These data are used to expand the general water quality characterization of the waterbodies and will aid in determining boundaries and parameters for future Total Maximum Daily Load Studies. All monitoring activities are conducted under targeted flow conditions (base-flow and/or elevated flow).


Confirmatory Sampling For Impaired Waters 1999 - 2006
WATERSHED MANAGEMENT AREAS
1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors
Base Flow Monitoring Station
Base Flow and Elevated Flow Monitoring Station
Watershed Management Area
Major River/Stream
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

Sediment Toxicity Testing

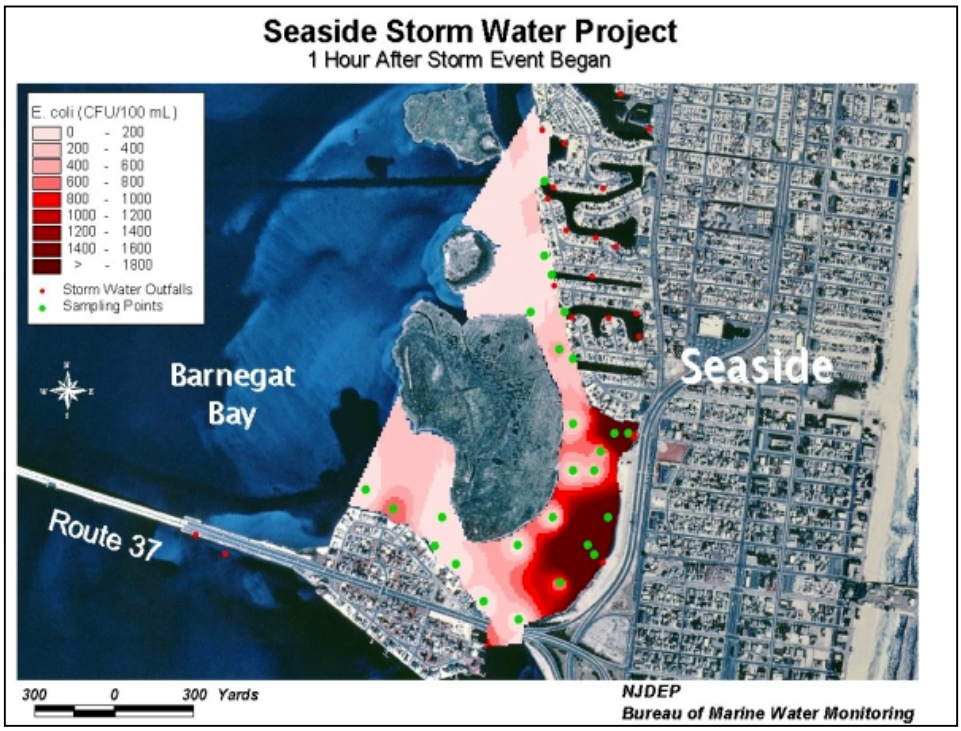
Sediment toxicity testing is performed to estimate the toxicity of sediments at sites determined to be environmentally degraded based on bioassessments of stream macroinvertebrate populations as part of the statewide Ambient Biomonitoring Network (AMNET). This is accomplished through the bioassay (toxicity testing) of sediments using the amphipod *Hyalella azteca* as the test organism. The toxicity testing measures both acute and chronic effect endpoints, the acute endpoints measuring survival and the chronic endpoints measuring growth and fecundity.

Test sites are selected from those assessed as "severely impaired" or that have shown a significant decline, based on AMNET results. Reference sites are selected from AMNET stations that are rated "non-impaired" and located within the same major water basin as the respective monitoring sites(s). AMNET routinely surveys a total of over 800 sites statewide, employing the Rapid Bioassessment Protocols developed by USEPA. AMNET sites are rated as *non-impaired*, *moderately impaired*, or *severely impaired* based on a multi-metric evaluation of the benthic macroinvertebrate species assemblages.

Toxicity is assessed by statistically comparing the monitoring station with the reference station results for significant differences. The data are used in watershed assessments, evaluation of toxic spills into ambient waters, in the Department's *Integrated Water Quality Monitoring and Assessment Report* (305(b) water quality inventory and 303(d) impaired waterbodies list), and will be used in its stressor identification (SI) work. Results from previous applications of this testing may be found on the Bureau of Freshwater & Biological Monitoring's webpage (www.state.nj.us/dep/wmm/bfbm/publications.html).

Alternate Microbial Indicator Monitoring

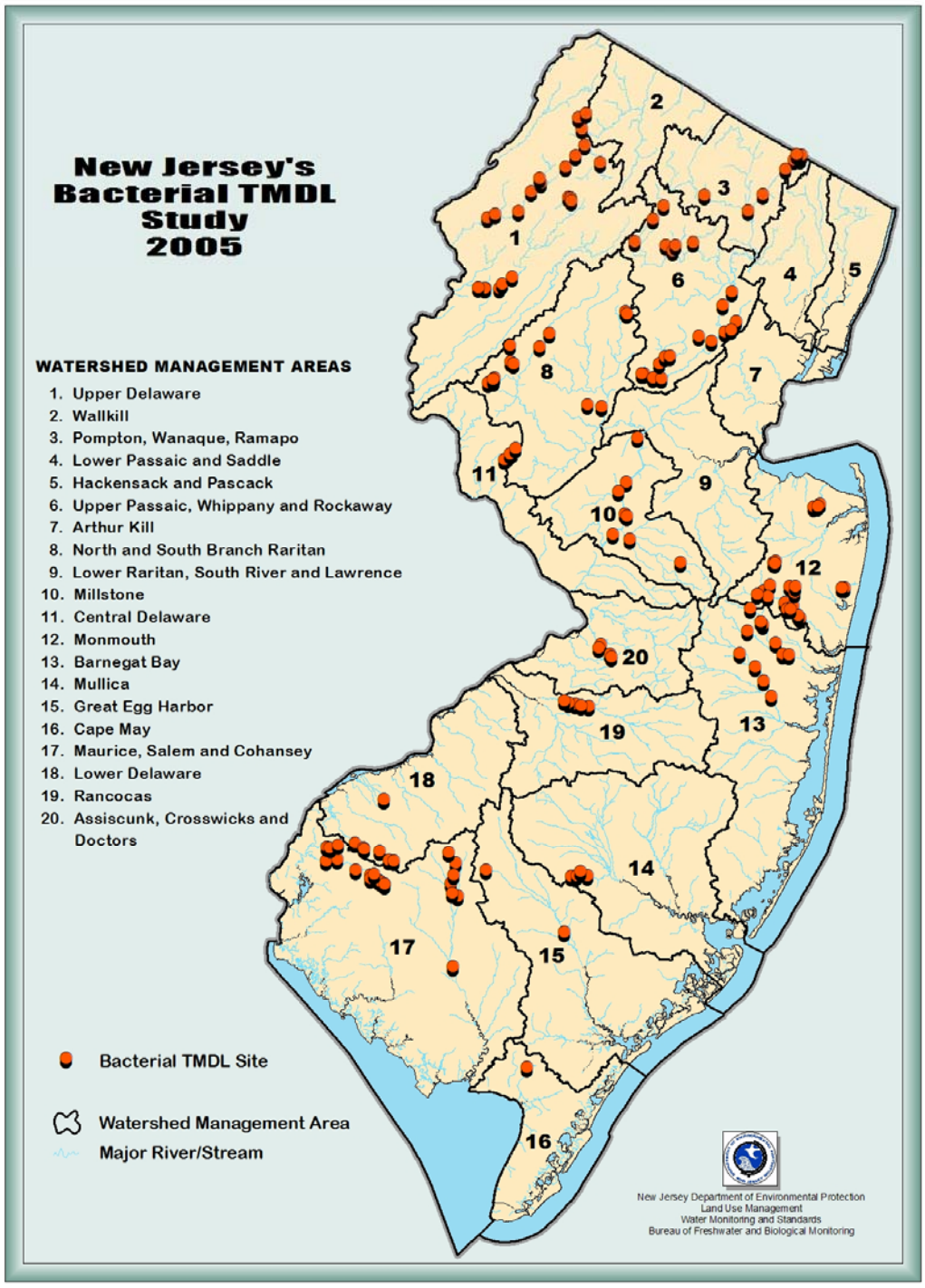
Traditional indicators (fecal coliform, *Enterococcus* , *E. coli*) can come from humans, but can also come from domestic animals and wild animals. There are a number of non-traditional indicators (alternate indicators) that are emerging as valuable tools for the identification of sources of fecal pollution. These new indicators can provide much better information about the source of the fecal pollution, distinguishing between human, domestic animal and wild animal sources. Some of the more promising of these new indicators include RNA Coliphage and Multiple Antibiotic Resistance (MAR). The Bureau of Marine Water Monitoring has a limited capability to test for RNA Coliphage and has successfully applied that capability to various source tracking projects over the past 10 years, including the Seaside storm water project depicted in the graph below. The Bureau is expanding its capability to include Multiple Antibiotic Resistance, as well as the capacity to handle the increasing demand for RNA Coliphage testing.



In this study, two stormwater outfalls were found to be impacting this bathing area. RNA Coliphage analysis determined that one of the two outfalls was primarily of a human source while the other was not. This information directed appropriate corrective actions.

Bacteria TMDL Monitoring

Other states are using alternate indicators to address TMDLs. In Maryland, alternate indicators are being used to assist in identifying non-point source pollution and to determine bacterial loadings. Alternate indicators have also been used successfully in Virginia as a component of a TMDL and are being made a component of routine water quality monitoring. Similarly, New Jersey is applying these alternate indicators to develop more meaningful microbial TMDLs. In 2004, for example, the BFBM and BMWM jointly began a statewide bacterial source trackdown study for the Department's TMDL program, using the RNA Coliphage and MAR indicators in addition to the more traditional bacterial indicators. During 2004 and 2005, 152 sites were sampled statewide as part of this study. In 2006 and 2007 an additional 69 sites will be sampled.


New Jersey's Bacterial TMDL Study 2005
WATERSHED MANAGEMENT AREAS
1. Upper Delaware
2. Wallkill
3. Pompton, Wanaque, Ramapo
4. Lower Passaic and Saddle
5. Hackensack and Pascack
6. Upper Passaic, Whippany and Rockaway
7. Arthur Kill
8. North and South Branch Raritan
9. Lower Raritan, South River and Lawrence
10. Millstone
11. Central Delaware
12. Monmouth
13. Barnegat Bay
14. Mullica
15. Great Egg Harbor
16. Cape May
17. Maurice, Salem and Cohansey
18. Lower Delaware
19. Rancocas
20. Assiscunk, Crosswicks and Doctors
Bacterial TMDL Site
Watershed Management Area
Major River/Stream
New Jersey Department of Environmental Protection
Land Use Management
Water Monitoring and Standards
Bureau of Freshwater and Biological Monitoring

Data Dissemination

Water Monitoring and Standards recognizes that availability of our monitoring data and results is as important as methods by which the data are collected and assessed. WM&S makes its monitoring data and results publicly available in a variety of ways. WM&S maintains a webpage (www.nj.gov/dep/wmm) through which much of our data and reports are electronically available. Data generated by WM&S can also be downloaded from EPA's STORET database at http://www.epa.gov/storet/dbtop.html or USGS' NWIS database at: http://nj.usgs.gov. Information from both STORET and NWIS is also available through USEPA's "Window To My Environment" (WME), a powerful web-based tool providing a wide range of federal, state, and local information about environmental conditions/features in an area of your choice. Using WME, you can find our fresh and marine ambient water quality monitoring stations in your area of interest and download our water quality monitoring results directly to your personal computer. Another method to access our monitoring data is through iMapNJ (http://www.state.nj.us/dep/gis/newmapping.htm), which is an interactive mapping application that allows users to utilize GIS functionality over the internet. Many of our reports are also available, electronically, from the New Jersey Environmental Digital Library at Rutgers University (http://njedl.rutgers.edu/njdlib). Additionally, hard copies of many of our reports can be obtained by calling WM&S at (609) 292-1623.

Additional Information about the Water Monitoring and Standards Program

Anyone interested in obtaining additional information about the monitoring networks and programs of Water Monitoring and Standards may contact::

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Or, visit our webpage at:: www.nj.gov/dep/wmm

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Bureau of Marine Water Monitoring

Bob Connell, Bureau Chief
Marion Petruzzi, Secretary

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Fish IBI Team Leader

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