New Jersey 1996 State Water Quality Inventory Report

A Report on the Water Quality in New Jersey
Pursuant to the New Jersey Water Quality Planning Act
and Section 305(b) of the Clean Water Act

State of New Jersey
Department of Environmental Protection
Policy and Planning
Office of Environmental Planning

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Christine Todd Whitman, Governor
Robert C. Shinn, Jr., Commissioner
Lewis J. Nagy, Assistant Commissioner

The mission of the New Jersey Department of Environmental Protection is to assist the residents of New Jersey in preserving, sustaining, protecting and enhancing the environment to ensure the integration of high environmental quality, public health and economic vitality.

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Chapter I

Executive Summary, Program Successes and Special State Concerns

EXECUTIVE SUMMARY

INTRODUCTION AND BACKGROUND

The *New Jersey State Water Quality Inventory Report*, is prepared every two years, pursuant to Section 305(b) of the federal Clean Water Act (P.L. 95-217). This 1996 edition focuses upon water quality assessments of the principal waters of the state using chemical/physical data collected between 1991 through 1995 inclusive. In addition to chemical assessments, biological assessments employing macroinvertebrate communities are now reported for the entire state for the first time. This current Report covers issues and programs up to the end of 1996.

New Jersey's surface waters are utilized for a variety of purposes including recreation, potable water supply, industrial process and cooling purposes, and agricultural irrigation. From a recreational standpoint, swimming is the second most popular outdoor recreation activity in the state, fishing is seventh, and motor boating is seventeenth.

New Jersey's water resources also provide a variety of aquatic habitats throughout the state. Freshwaters vary from cool trout waters in northern New Jersey, to acidic Pinelands streams in the southern regions. Tidal streams and rivers, along with coastal bays and estuaries, are used by anadromous fish, and various ocean fishes migrate through the state's coastal waters. The N.J. Division of Fish, Game and Wildlife also stocks sport fishes in many streams and lakes.

New Jersey's estuarine and coastal waters also contain viable commercial shellfisheries. The health of this resource is especially dependent upon clean waters. New Jersey's environmental protection efforts have made maintenance of this resource a statewide priority.

Ground water is an extremely important resource in New Jersey, providing approximately 40 percent of the state's potable water, with 31 percent coming from public-supply wells and 9 percent from domestic-supply wells. It also provides baseflow to streams, and is intimately associated with the ecology of the state's wetlands. New Jersey maintains regulations and programs aimed at protecting this resource.

NEW JERSEY WATER QUALITY STANDARDS

Water quality standards establish the water quality goals and policies underlying the management of the state's waters. These standards designate the use or uses to be made of the water and then set criteria and policies necessary to protect the uses, as well as the existing higher quality of many waters. The relationship between water quality standards and criteria evolved out of the Water Quality Act of 1965 which required states to adopt water quality standards to protect public health and welfare. This legislation also required that states enhance the quality of water, taking into consideration uses for public water supplies; protection and propagation of fish, shellfish and wildlife; recreation; agriculture; industry; navigation; groundwater recharge, and aquifer protection. These requirements continue in the Federal Clean Water Act which requires that wherever attainable, water quality standards should provide for the protection and propagation of fish, shellfish, and wildlife and to provide for recreation in and on the water.

In establishing water quality standards, the first step is to determine the **water uses** to be protected. The second step is to establish criteria based on sound scientific data to protect the designated uses. States are required to adopt water quality criteria that will protect both the existing and designated uses of a waterbody with an adequate degree of safety.

Modifications to the New Jersey Surface Water Quality Standards were proposed and formally adopted in 1993. Among the most significant changes were numeric criteria for toxic and hazardous substances, a definition for wetlands which will act as an initial step toward developing Surface Water Quality Standards for wetlands, and modifications to stream classifications based upon newly acquired information on trout streams.

New Jersey's current **Ground Water Quality Standards** (GWQS) were promulgated in 1993 and provide the basis for the protection of ambient ground water quality through the establishment of constituent criteria for ground water pollutants. These criteria in turn provide the primary basis for setting limits on discharges to ground water and standards for ground water cleanups. These constituent criteria also form the basis for the Department's regulation of affect to ground water quality from all discharges directly to ground water or to land surface that can affect ground water.

A significant feature of the new GWQS is their focus upon the interaction of ground and surface water quality. Ground water provides a substantial portion of the base flow to surface waters. In response to this fact the ground water standards are designed so that discharges to ground water will not impair surface waters.

SURFACE WATER ASSESSMENT

Threatened Waters are being redefined in this report to better assist in watershed management. Past Inventory Reports have classified <u>all</u> New Jersey waters that do fully support their uses as threatened because of the intensity of land use within the state, its dense population, the economic pressures for development and the ubiquitous nature of nonpoint source pollution. Now, to better meet the needs of this Department, the category of

"threatened" is being reapplied to only selected reaches that meet the strict definition of the term as defined by USEPA; that is waters that fully meet use, but where information indicates that future uses may be precluded if water management measures are not implemented. Because this re-application is still under going a Department review, it has not been applied to water quality assessments as an assessment category in this 1996 report, except for lakes which are not assessed by the Office Of Environmental Planning. The term is still used, however, throughout this report in the descriptive sense.

Freshwater Rivers and Streams

Of the 390 river miles assessed for sanitary quality necessary for the support of **primary contact recreation** (swimming), 25 percent support the use, 31 percent partially support the use, and 44 percent are not of a sanitary quality necessary to support the use.

The indicator employed to determine the primary contact use support is the level of fecal coliform bacteria within the water. Although in some cases point sources may be responsible for the observed bacterial loadings, the majority of the contamination is believed to be from nonpoint sources which include stormwater outfalls.

Comparisons between current swimming use attainment and past levels are not recommended due to changes that have occurred in the "swimmable" assessment methodology that are necessary in order to make swimmable assessments better conform to both the State's numerical criteria for primary contact recreation and the USEPA 305(b) guidance documentation. In the past, assessing attainment of this use was based upon the percentage of violations of the 200 MPN criterion in individual samples; whereas the current methodology makes greater use of the geometric mean to determine use attainment as delineated in the New Jersey Water Quality Standards. What has resulted from this change is an increase in the number of locations that fully meet this use and a corresponding substantial decline in the number of stations that are assessed as not supporting swimming. For an accurate determination of the trends in sanitary quality, see "Changes in Water Quality Status in Rivers and Streams" discussed later in this section.

A total of 3,815 stream miles have been assessed for their **ability to support a** healthy and diverse **aquatic community**. Thirty five percent fully supported the use, 53 percent partially support the use and 12 percent of the assessed miles fail to support the use.

The sources for the observed community impairments include habitat degradation, conventional pollutants and the effects of toxic compounds. In addition to the impacts observed within communities, many fish and shellfish are contaminated by pesticides and mercury, rendering them unsafe to eat under certain circumstances (see Lakes below). Further, dioxin and PCB contamination is observed in finfish caught within the lower tidal reaches located within the urban/industrialized centers of the state.

As with swimming, comparisons with the prior assessment of the proportion of waters supporting the aquatic life use are not encouraged. The past

assessment presented in the 1994 Inventory Report represents only part of the state. The results presented here represent a complete State assessment of all the major river basins for the first time.

The **most frequently encountered pollutants** in New Jersey's freshwater rivers and streams are pathogens, nutrients, suspended solids and dissolved solids. Habitat destruction resulting from certain construction and agricultural activities is also of concern. The extent of toxic impairment statewide is not completely known at this point as evidenced by the recent discoveries of mercury in fish tissue briefly summarized below (again, see Lakes). The sources of these pollutants include both point sources (industrial and municipal) as well as stormwater outfalls, agriculture, construction activities, urban runoff (including wintertime roadway deicing) and air deposition.

Freshwater Lakes

In New Jersey there are 380 public lakes representing 24,000 acres. To date, 126 lakes, with a total of 11,172 acres, have been evaluated for trophic status in New Jersey.

All freshwater lakes assessed are found to be either threatened or in a state of active deterioration (eutrophication) with respect to water quality. Note that "threatened" here is a category of use attainment and not just a descriptive term.

Pollutants responsible for lake deterioration include pathogens, nutrients and siltation. The sources of most of these pollutants are nonpoint sources including construction activity, agricultural and suburban runoff, and failing septic systems.

Recent investigations have uncovered a widespread occurrence of mercury contamination in the tissues of finfish taken from lakes statewide. As a result, numerous finfish consumption advisories have been issued by the Department. The sources of the mercury are numerous and include, but are not limited to, natural sources (geologic weathering), direct or indirect release due to agricultural applications, industrial activities (including those from out-of-state via atmospheric deposition) and landfills. Many of these sources could represent historical sources that are no longer operative. The Department is examining mercury sources, and recent data suggests that the principal current source may be wet and dry air deposition.

Coastal Waters

Current water quality assessments within the coast focus upon sanitary quality for swimming, as well as shellfish and finfish harvesting and consumption restrictions.

With regard to **swimming** within ocean waters, the coastal beaches from Sandy Hook south to Cape May are fully swimmable. Some beaches, however, are threatened by occasional short-term elevations of bacterial levels which have resulted in beach closures for brief periods. Within bays

and estuaries, generalizations are difficult. Back-bay beach closures can be a serious problem on a local basis. Some locations have only occasional closures while other regions, not designated for swimming, have chronically elevated bacterial levels and do not support swimming at all.

The Department monitors the sanitary quality of estuarine and ocean waters for the suitability of **shellfish harvesting** by observing measurements of coliform bacterial concentrations in the water column, and through shoreline surveys.

Approximately seventy-five percent of bay and estuary waters have the sanitary quality sufficient to support open shellfish harvesting. Eighteen percent partially support this use and seven percent do not have the sanitary quality required to support harvesting. In the ocean waters, seventy-eight percent fully support shellfish harvesting while twenty-two percent do not support the use. Both bay and ocean waters have shown increases in acreages that fully support shellfishing as compared to past assessments.

With respect to toxic impacts to coastal waters, the Department has found high levels of **PCB's and certain pesticides** (primarily chlordane) in finfish from New York-New Jersey interstate waters. As a result, recreational fishing advisories have been in effect for striped bass and bluefish taken in New Jersey territorial ocean waters from Barnegat Inlet northward. The NJDEP has also found high levels of PCBs and certain pesticides in finfish taken from the following state and interstate waters:

Arthur Kill
Kill Van Kull
Hudson River
Lower Cooper River
Raritan Bay
Newark Bay
Tidal Passaic River
Tidal Raritan River
Tidal Hackensack River
Mainstem Pennsauken Creek
Sandy Hook Bay
So. Branch Pennsauken Creek

As a result, commercial fishing bans and recreational fishing advisories have been in effect for these waters as well. Similar fish tissue contamination and accompanying consumption advisories occur within the Delaware River estuary. The sources of PCBs include direct discharges (sewerage treatment plants, industrial discharges), tributary loads, dredged spoils, and ocean dumped sewage sludge (now historic). These PCBs as a result have built up with time within the sediments of coastal waters.

Dioxin contamination is present in certain finfish and crustaceans in both the tidal Passaic River and New York Bight Apex waters. As a result, the State of New Jersey has ordered a prohibition on the sale and consumption of all fish and shellfish taken from the tidal Passaic River. The ban includes striped bass and blue crabs from Newark Bay, tidal Hackensack River, Arthur Kill, and Kill Van Kull.

The Delaware River Basin Commission has identified **volatile organic chemicals** as a cause of use impairment within the tidal and estuarine portions of the Delaware River.

The degraded water quality occurring in the New Jersey-New York interstate waters is due to a large extent to the large amount of untreated and primary

treated wastewaters still being discharged to these waters from combined sewer overflows (CSOs). CSOs are also a concern in the tidal Delaware River near Philadelphia.

Bacterial contamination in almost all estuarine waters is closely tied with stormwater discharges. Additional loads come from illegal discharges of marine sanitation devices on boats, the presence of large wildlife populations, and the resuspension of sediments by boat-created turbulence. The Department also suspects that additional bacterial contamination is coming from tributary inputs to the bays. These tributary inputs carry additional runoff and septic tank leachate from sources upstream.

Current Department Assessments Regarding Water Quality Impairment

In order to better remedy the pollution problems described in the previous section, the Department is currently involved in several information gathering efforts designed to allow the Department and the public to better understand the principal sources and causes of pollution on a site-specific basis. Such knowledge is vital to effectively reducing water pollution.

- The Department has cataloged the numerous sources of environmental mercury both within the state as well as on a national level. The Department is analyzing through its Geographic Information (computer) System the relationship between localized observations of mercury contamination in waterways and the physical locations of known and suspected mercury sources. The Department is studying mercury levels in precipitation and also studying the transport and fate of mercury on a site-specific basis.

- Several studies on long term water quality trends over several decades have been performed by the Department. Current efforts are being performed with the assistance of the U.S. Geological Survey and are taking a close look at changes that have occurred within the past 5 to 7 years. This perspective will allow us to observe the effectiveness of Department policies that have been enacted within the recent past.

- Understanding whether pollution sources within a waterway are largely point sources, nonpoint sources, or a somewhat even combination of both can be enormously helpful in deciding what water programs should be brought to bear regionally. To that end, the Department continues to work with the U.S. Geological Survey to examine the behavior of pollutant loads and concentrations under various flow conditions. By doing so, evidence of point or nonpoint source pollution dominance can be obtained. At this writing, the entire Passaic Basin has been completed.

- In watersheds with known (and significant) nonpoint source pollution contributions, the Department continues to examine the relationship between various land uses and the nature of their pollutant loadings (Barnegat Bay, Whippany and Toms River watersheds), as well as to monitor the effectiveness of implemented nonpoint source pollution controls (Barnegat Bay, Whippany, Musconetcong and Great Swamp watersheds).

- Extensive monitoring has been completed within the Whippany watershed in support of a Total Maximum Daily Load (TMDL) determination. This analysis will determine the relative pollution contributions of all the significant permitted sources as well as any important nonpoint pollution sources. The Department will soon remove heavy metal contamination assigned to the Whippany within the State's list of water quality limited waters (303d List) based on this monitoring.

- The Site Remediation Program within the Department is developing a new computerized database of hazardous waste sites that is designed not only to tract cleanup progress, but also to determine what specific media are affected and what specific contaminants and sources are involved. This database will allow the Department to update information, initially analyzed in the mid-1980s, regarding the relative importance of various types of hazardous sites in impairing ground and surface waters.

Changes in Water Quality Status in Rivers and Streams

In order to assess long term trends in surface water quality, a series of trend analyses have been performed on water quality data collected from New Jersey monitoring locations. One study examined trends of selected water quality constituents taken from 84 ambient monitoring sites sampled between 1974 and 1993. In terms of improvements in water quality, the study found widespread and significant declines in un-ionized ammonia, Kjeldahl nitrogen, total organic carbon and total phosphorus. On the reverse side, certain constituents that impair water quality showed widespread increases; fecal coliform bacteria, nitrate nitrogen and chlorides. Aspects of these trends combined with other trend assessments, notably those by USGS in 1990, point to a reduction in the discharge of oxygen-demanding materials into the state's waterways. These are probably the result of improvements in the quality of point source discharges such as through the upgrade of sewage treatment plants which have led to the release of waste constituents in more oxidated states. Also influencing these observations may be the regionalization of sewage treatment plants whereby significant amounts of treated effluent are routed out to the ocean and to the lower Delaware River, to take advantage of increased dilution, instead of being discharged into in-state freshwaters.

The treatment plant upgrades and regionalizations that have occurred throughout the 1980s and early 1990s are believed to have dramatically improved water quality. The recent improvements in discharge compliance are also believed to have improved water quality on a local basis. But concurrent with these changes are expansions of suburban development, road expansion, localized increases in population, etc., and these can simultaneously impede water quality gains.

GROUND WATER QUALITY AND MANAGEMENT

Ground water is a vital resource for the people of New Jersey. It provides approximately 40 percent of the state's potable water, with 31 percent coming

from public-supply wells and 9 percent from domestic-supply wells. It also provides baseflow to streams and is intimately associated with the ecology of the state's wetlands.

The available data suggest that at present there is an ample supply of good quality ground water in most of the state of New Jersey. However, ground water quantity (and quality) problems are usually concentrated in areas where the greatest volumes of ground water are needed.

Ground water pollution and over-pumping are usually concentrated in areas with high suburban population densities as well as in some agricultural areas. Over-pumping in these areas has created hydraulic gradients that sometimes result in the recharge of aquifers from undesirable sources such as seawater, polluted surface waters, or severely contaminated ground water.

Ground water quality in New Jersey is assessed for potability, as are surface waters, by means of the **primary and secondary drinking water standards**. Primary standards are directed to constituents that have the potential to impair the health of the water consumer. Secondary standards establish acceptable levels for those constituents that affect the aesthetic quality of the water, those that might for example affect the water's taste, odor and color.

Ambient ground water quality throughout the state is generally good for most purposes. Treatment for some undesirable naturally occurring contaminants and characteristics is needed, however, in some areas due to the physical and chemical nature of geologic materials comprising the aquifer. The most widespread violations of standards for naturally occurring contaminants involve the State's recommended secondary drinking water regulations. These contaminants include iron, total dissolved solids, sulfate and hardness. Less common, yet significant naturally occurring contaminants that violate drinking water regulations include manganese and chloride.

Anthropogenic contaminant discharges to ground water do occur and have an affect upon ground water quality, the full extent of which is not yet fully determined. What follows summarizes what is currently known.

- The **distribution of the pollution cases** is directly proportional to the population density within the 7 counties studied in the late 1980s. Of the 1,200 pollution cases, more than 40 percent had unknown pollution sources. Of the known sources, underground storage tanks (UST) affected the most wells (405). Industrial and commercial septic systems affected a disproportionately large number of wells (202), considering the total number of septic system cases reported in the study. Landfills, surface spills, lagoons, and industrial or commercial septic systems each accounted for at least 5 percent of all cases.

- The **contribution of agriculture** in ground water pollution is not clear. Only one agricultural pollution case was listed out of a total of 1,200 cases. However, data gathered from pesticide and nutrient studies in ground water clearly showed that there were violations of the State's drinking water quality regulations due to agricultural inputs. The existence of pesticides in ground water clearly implicates agricultural inputs as a likely source of contamination.

- The **most common pollutants encountered** in the ground water investigations (performed in the mid to late 1980s) were: volatile organic compounds (VOCs), metals, base neutrals, acid extractables, and PCBs/pesticides. Landfill contaminants, undifferentiated petroleum hydrocarbons, gasoline and fuel oil also ranked high in the long list of ground water pollutants.

Ground Water in the State's Physiographic Provinces

New Jersey has four geomorphologically distinct physiographic provinces, each having distinctive rocks and land-forms. They are the Coastal Plain, Piedmont, Highlands, and Valley and Ridge. There are general geologic structure and rock-type differences between each physiographic province which makes them hydrogeologically distinct from one another. Beginning with this Inventory Report, detailed descriptions of ground water within the state's principal physiographic provinces will be presented, with one province the focus of each of a succession of reports. This 1996 report initiates this cycle by discussing the Newark Basin, which comprises much of the Piedmont physiographic province within New Jersey.

Piedmont/Newark Basin

The Newark Basin coincides with the geographic trend of the Piedmont Physiographic Province in New Jersey and is home to most of New Jersey's population. About 21 percent of the purveyor and domestic supplied water is ground water. Undesirable constituents in ground water are not always anthropogenic in origin, and the federal and state primary and secondary drinking water standards are often exceeded under natural conditions. However, secondary drinking water standards are exceeded far more often than the health based primary standards. Defining natural ground-water quality in the region can be difficult. Many of the dissolved constituents in ground water, such as sodium and chloride from road salting, can come from widely distributed nonpoint sources as well as from natural sources. In the Newark Basin, however, manganese, hardness, corrosivity, total dissolved solids, iron, sulfate, sodium and chloride are in excess of secondary drinking water standards. More recently, concentrations of naturally occurring radionuclides that exceed the primary drinking water standards have been recognized and investigated.

Ground waters in sedimentary bedrock of the Newark Basin are somewhat oxidizing, slightly alkaline, fresh (usually have less than 1000 milligrams per liter of total dissolved solids), noncorrosive, and hard. In order of decreasing median abundance, the measurable cations are (1) calcium, (2) sodium, (3) magnesium, (4) potassium, (5) strontium, (6) barium, (7) zinc, (8) lithium, (9) iron, (10) manganese, (11) uranium, and (12) arsenic. The anions are (1) bicarbonate, (2) sulfate, (3) chloride,(4) nitrate plus nitrite, (5) fluoride and (6) orthophosphate. Sulfate is associated with high dissolved solids in the Brunswick Group formations.

Median nitrate levels from well water samples within the Newark aquifers were highest from wells in predominantly urban-residential regions, followed

by wells in predominantly agricultural areas, followed again by wells in predominantly urban-nonresidential regions. The lowest median nitrate levels were recorded from wells in predominantly undeveloped regions. No samples exceeded the USEPA MCL of 10.0 mg/l.

Ground Water Management in New Jersey

New Jersey is taking an active and progressive approach to the management of its ground water. Several federal, state, county, and municipal offices are involved in ground water management activities ranging from resource evaluation to the cleanup and restoration of contaminated aquifers. The major components of New Jersey's ground water management program are the following.

- Coordination of New Jersey's many laws and programs affecting ground water management occurs through ***A Ground Water Strategy for New Jersey*** which establishes major initiatives for protecting the potability of aquifers and for enhancing the effectiveness of pollution mitigation programs.

- **The Case Management System** coordinates case assignments, priorities, and technical standards for pollution cases involving hazardous substances.

- **Well Head Protection** further protects the quality of water which supplies drinking water for public community, public non-community (diners, hospitals etc.), and domestic wells.

- The Department's Office of Environmental Planning has developed best management practices (BMPs) for **aquifer-recharge areas**.

- The State, both alone and in conjunction with other agencies, has been conducting ground water **resource investigations** for several decades. Resource evaluation results in the description of surface and subsurface geology and an analysis of ground water quality and quantity.

SURFACE WATER MONITORING PROGRAMS

Monitoring data are used to establish baseline conditions, determine trends, and identify solutions to or further study water quality problems. The NJDEP's primary surface water quality monitoring unit is the Office of Water Monitoring Management, although monitoring functions are also performed by other units. The following is a listing and brief description of the Department's principal water resource monitoring programs.

- **NJDEP/USGS Cooperative Physical/Chemical Monitoring**: A network of eighty-four sampling sites exist (at the time of this report's preparation), and are designed to assess the instream chemistry and sanitary quality of New Jersey's nontidal freshwaters. The effort is a cooperative arrangement between the Department and the US Geological Survey.

- **NJDEP Ambient Biomonitoring Network (AMNET):** Ambient chemical monitoring is now extensively supplemented by biological assessments of in-stream benthic macroinvertebrate communities. These communities are examined using USEPA's Rapid Bioassessment Protocols. From this, evaluations regarding the overall health of instream biota are estimated. These biological assessments are useful in directly assessing the aquatic life support designated use, as well as revealing the affect of toxic contaminants, and detecting chronic water quality conditions which may be overlooked by the short-term view provided by ambient chemical sampling. The bioassessments have been performed for all the major watersheds within the state - 700 monitoring locations, all located in non-tidal portions of rivers and streams.

- **Shellfish Growing Water Classification Program:** The New Jersey Bureau of Marine Water Classification and Analysis (BMWC&A) within the Department monitors a network of approximately 2500 to 3000 stations for bacteria in order to assess the sanitary fitness of state waters for shellfish harvesting. The BMWC&A monitors waters, both bay and coastal, from Raritan Bay down to Delaware Bay. Shellfish classification status is published as a series of classification charts.

- **Cooperative Coastal Monitoring Program (CCMP):** This program monitors bathing zone waters for sanitary water quality in the ocean and bay areas of New Jersey's coastal waters. The program is overseen by the New Jersey Departments of Environmental Protection and Health and Senior Services and is performed in cooperation with the county health departments of Cape May, Monmouth, Atlantic, and Ocean Counties; as well as the regional health agencies of Atlantic City, Long Beach Island, Long Branch, Matawan, and Middletown.

- **New Jersey Marine and Estuarine Water Quality Monitoring Network:** This monitoring, performed by the Bureau of Marine Water Classification and Analysis, represents an effort by the State to provide baseline data on general water quality throughout the state's coastal waters beyond traditional sanitary monitoring to include both conventional and toxic pollutants. The program covers all major bodies of saline waters, including the Atlantic Ocean to within three nautical miles of the coastline. Parameters are sampled from the water column and include nutrients, dissolved oxygen, solids, salinity, fecal coliform bacteria, and ammonia.

- **Lake Monitoring:** Most lake monitoring in New Jersey is conducted under the umbrella of the Clean Lakes program which monitors public lakes for the purpose of assessing trophic status.

- **Compliance Monitoring:** This is a continuing program, performed by the Water Compliance and Enforcement Program, of 24-hour compliance sampling at selected NJPDES facilities throughout the state to determine their compliance with permit conditions.

National Environmental Performance Partnership System (NEPPS)

The U.S. Environmental Protection Agency (USEPA) and the Environmental Council of States (ECOS) have established a mechanism to allow states greater flexibility in addressing their priority environmental problems while reducing federal oversight where appropriate. This mechanism is the National Environmental Performance Partnership System (NEPPS) which emphasizes environmental management aimed towards true environmental results using various environmental goals and indicators as measures of progress. The NEPPS process places greater emphasis on scientific assessments of trends in environmental quality and, through the identification of key issues and the setting of priorities, lays the foundation for long-term environmental planning. In 1996, New Jersey was one of five states in the nation to pilot the NEPPS process.

Comprehensive Watershed Management

In order to more effectively administer the management needs of New Jersey's water resources, the Department has resurrected and expanded the "continuous planning process" of the mid 1970s. To render the process more efficient from a resource perspective, the planning regions have been shifted away from politically defined regions to regions defined on the basis of watersheds. Toward this end, the DEP has developed a *Draft Statewide Watershed Management Framework Document* for New Jersey which lays out the elements of a statewide watershed management process. It includes a delineation of watershed boundaries and proposes a phased, prioritized schedule for implementing watershed management activities throughout the state.

To begin instituting a watershed approach in the DEP's water management process, the Department is currently conducting a watershed protection pilot project in the Whippany River watershed. The project will help the DEP develop a workable watershed protection approach to water management and is being conducted in cooperation with local governments, permittees, regional interest groups and private citizens. The project will also demonstrate how the integration of planning, permitting, monitoring, modeling, financing and enforcement can better protect water resources.

Within the Whippany Watershed, a public advisory group and technical advisory committee have been meeting on a regular basis since the fall of 1993. Watershed planning and public outreach efforts are all on-going and will continue throughout the development and implementation of a watershed management plan for the Whippany River. The pilot project will culminate in a *Whippany River Watershed Management Plan* which will contain management strategies for the watershed.

Point Source Control Programs

New Jersey's point source-related programs are divided into the following major subject areas: the New Jersey Wastewater Treatment Financing Program, the New Jersey Pollutant Discharge Elimination System Program, the Treatment Works Approval Program for domestic sewage facilities, the industrial pretreatment program, and enforcement-related activities.

The NJDEP, through its **Municipal Finance and Construction Element**, administers various financial assistance programs which offer low-cost funding for the construction of wastewater treatment facilities throughout New Jersey including stormwater and nonpoint source management projects.

The **New Jersey Pollutant Discharge Elimination System** (NJPDES) program regulates facilities and activities discharging or releasing pollutants into the surface or ground waters of the state. Of the permitted municipal wastewater facilities, 351 discharge to surface water, and 211 discharge to ground water. Of the industrial facilities, 844 discharge directly to surface water, and 262 to ground water. There are also 95 indirect industrial dischargers that discharge wastewater to municipal wastewater facilities. There are approximately 45 landfills with NJPDES permits.

The NJDEP is undertaking a major initiative to update and improve the NJPDES program, including the first comprehensive revision to the program regulations since the program was delegated to the State by the Environmental Protection Agency in 1982. The central focus of this program improvement is to move to a watershed cycle for the issuance of discharge-to-surface-water permits.

The Department issues **Treatment Work Approvals (TWA)** which authorize the construction and operation of domestic and industrial treatment works, including sewage treatment plants, collection and conveyance systems, pumping stations, sewer-outfalls, holding tanks, equalization tanks, and certain septic systems. The purpose of the TWA program is to protect the integrity of state waters by preventing their pollution from inadequately functioning sewage treatment facilities.

New Jersey is currently implementing an **industrial pretreatment program** to help control discharges of industrial pollutants into municipal sewer systems. The discharge of such pollutants can result in water pollution and related problems at the local wastewater treatment plant. As such, the goal of the pretreatment program is to protect municipal treatment plants and the environment from the adverse affect that may occur when hazardous or toxic wastes are discharged into a sewer system.

Combined annual averages (calendar year 1987 versus calendar year 1992) show a reduction of heavy metals in the sludge ranging from 29 to 75 percent. These improvements in sludge quality are the result of decreases in heavy metal loading to the publicly owned treatment works (POTWs) and also to the POTWs' corresponding receiving waters.

The **Water Compliance and Enforcement Program** monitors compliance with, and enforces as necessary, all permits issued under the NJPDES permit program for surface water, ground water, landfill, and indirect discharges to publicly owned treatment works (POTWs).

The Clean Water Enforcement Act (CWEA) was adopted in 1990 and requires the Department to perform additional inspections, discharge compliance sampling, and follow-up inspections for permittees that incur "Significant Non-Compliance" (SNC) status. The Act requires the Department to impose mandatory penalties against a permittee that is guilty of a serious violation or found to be in SNC. The Enforcement Act also requires the Department to prepare an annual report on the implementation and enforcement actions taken by the Department and delegated to local agencies during the preceding year. The report describes the types of enforcement actions issued against each violator, the type of violations, penalties assessed, and the status of the penalty collection process.

This Act has been very effective in significantly reducing the number of facilities in noncompliance. Since 1992 the total number of significant noncompliers has gone from a total of 81 (in 1992) down to 38 in 1995 and 18 in 1996. This should result in notable water quality improvements on a local basis.

Nonpoint Source Control Programs

Nonpoint source (NPS) pollution is a contributing factor as to why fishable and swimmable goals have not been met in many of New Jersey's waters. Contaminated stormwater, for example, has been the principal cause of beach closings in New Jersey. Nonpoint sources, including contaminated stormwater, are also the principal causes of shellfish harvesting closures and restrictions along our coastal waters. The Clean Lakes Program has found that most of the public lakes investigated are either threatened with or are actively undergoing deterioration, largely because of NPS pollution. Current evidence, although limited, suggests that nonpoint sources can be a major source of pollution loading in our state's freshwater rivers and streams. Clearly, nonpoint source pollution threatens the water resources of the state. In response, the Department has since 1990 embarked on several nonpoint source control initiatives that are funded under the Federal Clean Water Act (CWA) and the Federal Coastal Zone Management Act (Section 6217 specifically).

The Department is preparing a revised **Nonpoint Source Pollution Assessment Program Plan** that identifies specific tasks necessary for nonpoint source pollution control. The Department will be providing opportunities for public review and comment on the draft NPS Strategy when developed.

The Stormwater and Nonpoint Source Best Management Practices (BMP) Manual has been developed by the DEP in cooperation with other governmental agencies and serves as guidance for nonpoint source and stormwater management. This manual shows how to integrate NPS and stormwater best management (control) practices into the development planning process.

It has long been recognized that stormwater that comes into contact with industrial activities and materials is a major contributor to water pollution. The **Stormwater Permitting Program** responds to this problem by addressing stormwater discharges associated with certain industrial activities. Each facility receiving a permit under this program is required to prepare and implement a stormwater pollution prevention plan which, when implemented, will eliminate all exposure between stormwater and industrial materials/activities.

The **Sewage Infrastructure Improvement Act** (SIIA) Program developed by NJDEP pursuant to the adoption of this State legislation has two main components: (1) to address polluting discharges from combined sanitary and stormwater sewer systems throughout the state and (2) to map and investigate stormwater sewer systems in the coastal municipalities of Atlantic, Cape May, Monmouth and Ocean counties.

The Barnegat Bay Management Plan (BBMP) identifies standards, controls, and institutional alternatives for effectively controlling NPS pollution within the Bay watershed. The Plan is used by the Department to provide specific recommendations to the Legislature, other State agencies, county, and municipal agencies regarding NPS pollution control and protection of the Bay from pollution.

NJDEP released *A Watershed Management Plan for Barnegat Bay* in July 1993. The Plan presents 133 management recommendations designed to deal with issues such as land use/nonpoint source pollution, regulatory streamlining, the protection of environmentally sensitive areas, recreational use of the water, fisheries management, waterfront public access, public participation and education, research and monitoring. Implementation of the plan will be a long term effort involving the cooperation of a variety of governmental agencies, nonprofit groups, and private citizens. In July 1995, USEPA Administrator Carol Browner designated the Barnegat Bay/Little Egg Harbor estuarine system as part of USEPA's National Estuary Program.

The focus of the **Musconetcong Watershed Project** is to develop and implement a NPS control pilot project in the Musconetcong River watershed. The goal is to implement comprehensive management of nonpoint pollution sources in a cost-effective, easily implemented and measurable manner.

A highly successful nonpoint source control initiative has been the **Navesink River Project** which has controlled nutrient and bacterial pollution from nonpoint sources through a ten-year multi-agency effort. Over 600 acres of shellfish waters have been reopened as a result of this program.

New Jersey's Statewide Water Supply Plan

To ensure that New Jersey can cope with all foreseeable water needs and droughts, the Water Supply Management Act and the Water Supply Bond Act (Bond Fund) were approved in 1981, establishing a management framework and a source of public funding -- $350 million -- to help fulfill it. In 1982, NJDEP adopted the first New Jersey Statewide Water Supply Master Plan, as required by the Water Supply Management Act. Recognizing that available supplies, projected needs for water supplies, development trends and knowledge regarding water needs and water management concepts were changing, NJDEP developed a new plan. This New Jersey Statewide Water Supply Plan (NJSWSP) was developed by the DEP with the assistance of three consulting firms, the Water Supply Advisory Council (WSAC) and its Public Advisory Committee (PAC). The new Plan constitutes a complete revision and replacement of the 1982 Plan.

As did the earlier 1982 Plan, the new Plan makes recommendations for water supply management. Some recommendations are management initiatives that prevent or delay deficits, others are capital project initiatives that will provide additional supplies. Two significant aspects of the new Water Supply Plan are -

- (1) the comparison between water supply availability (both surface and ground) with current water demand, and
- (2) the projecting of water demand through the planning period of 1990 to 2040.

A major conclusion of the plan is that protection of existing supplies is fundamental to New Jersey's ability to provide sufficient water in the future.

Wetlands Protection

Wetlands have become increasingly threatened by development as suitable land for building is rapidly diminishing. Since wetlands are scattered throughout the State, this affect is widespread. Specific protection is provided for New Jersey tidal wetlands through the Wetlands Act of 1970, and for freshwater wetlands through the Freshwater Wetlands Protection Act of 1987.

The State has completed a comprehensive mapping project to identify and classify all wetlands statewide. This information has been added to the State's Geographic Information System and, together with data on permit activity, will allow an evaluation of the cumulative affects to wetlands resulting from the State permitting program on a county, regional, or watershed basis.

New Jersey is working toward better integration of its wetlands protection activities with its stormwater program. The wetlands program has water quality requirements that must be met before stormwater can be discharged

within a wetland or buffer area adjacent to that wetland. These requirements focus on mechanical methods for removal of solids from the stormwater.

The State includes wetlands in the definition of "surface waters" and is proceeding to establish water quality standards for wetlands, thereby expanding the role of Clean Water Act Section 303 in the protection of these waters.

PROGRAM SUCCESSES AND SPECIAL STATE CONCERNS

Editor's note: The following two sections, "Program Successes" and "Special State Concerns," are largely drawn from material presented in New Jersey's draft Self Assessment Documents developed as part of the National Environmental Performance Partnership System (NEPPS) negotiated with USEPA. Copies of the current Self Assessment are available from the Division of Science and Research within NJDEP.

PROGRAM SUCCESSES

The NJDEP permitting, enforcement and financing programs have worked together to reduce the impacts of both point source and nonpoint source pollution throughout the state, with observable results apparent in several watersheds. In general, NJDEP and the regulated community appear successful in significantly reducing point source discharges of the reduced forms of nutrients (e.g., ammonia), thereby reducing in-stream oxygen demand and effluent toxicity. Some success stories are described below.

State-wide Water Quality Improvements

Improvements in the Swimmable Status of Coastal Waters: Between 1990 and 1995, no closings were caused by the wash up of floatables. Recent closings based upon sanitary quality have been very localized and usually limited to 24 hours. This contrasts with the closings of the late 1980s when extensive beach areas (e.g., several miles) were closed for up to 3 weeks due to the presence of high bacterial concentrations or floatable debris. The primary causes of bathing beach closures are elevated levels of fecal coliform bacteria, presence of floatable debris, and oil spills. Ocean beach closings have decreased from 803 in 1988 to 4 in 1995.

To prevent floatables from reaching New Jersey recreational waters, NJDEP since the late 1980s has participated in EPA's regional Floatables Action Plan which coordinates the management of floatables. To clean debris from beaches, NJDEP's Operation Clean Shores Program uses state prisoner labor to remove floatables from estuarine shorelines preventing the resuspension and subsequent wash-ups of floatables in recreational areas. The Clean Shores Program has removed over 65 million pounds of debris from the state's shorelines since 1989. To reduce pathogen and nutrient loadings to coastal waters, regionalized coastal sewage treatment facilities have been equipped with higher performance capabilities, have been subject to more stringent permit requirements, and have shown better compliance records. These taken together have been instrumental in achieving the significant improvements to coastal water quality.

Upgrades in the Classification of Shellfish Waters: New Jersey has opened additional marine waters for shellfish harvesting each year since 1988. Over a 20 year period, the overall availability of marine and estuarine

waters to shellfish harvesting has increased from 75% to 86%. The increased acreage of available shellfish waters can be attributed to the removal of backbay municipal wastewater discharges, refinements in shellfishing closure schedules located around ocean discharges and nonpoint source pollution control.

Reduction in Point Source Loadings Through Upgrades and Regionalization of Municipal Sewage Treatment Plants: Over the past 25 years, permitting, enforcement and funding programs have been instrumental in reducing point source loads of biochemical oxygen demand (BOD) from approximately 160,000 kg/day in 1985 to 75,000 kg/d in 1990. Instream decreases in un-ionized ammonia and total Kjeldahl nitrogen are also attributed to improvements in wastewater treatment. In the early 1970s there were approximately 100 primary sewage treatment plants in the state, which were designed to remove only 60 percent of the solids and 35 percent of the oxygen depleting pollutants. These plants have been upgraded at least to secondary treatment which is designed to remove 85 percent of the solids and oxygen depleting pollutants in wastewater. Over $4.5 billion was spent in New Jersey to upgrade all treatment plants to secondary treatment, financed largely by the construction grants program under the Federal Clean Water Act. This $4.5 billion represents 3.4 billion in state and federal funds combined with over one billion from local authorities.

Improvement in Sewage Sludge Quality: Prior to 1989, over half of the sewage sludge being generated by 6 New Jersey municipal treatment plants was disposed in the Atlantic Ocean. The industrial pretreatment program has facilitated improvements in sewage sludge quality so as a result, 92% of the municipal sewage sludge in New Jersey now meets the minimum requirements, and 69% meets the high quality requirements for land application under the Federal sludge regulations. The percentage of sewage sludge generated in New Jersey being utilized for beneficial purposes has increased from 6% in 1983 to almost 40% in 1996, with none being dumped into the ocean.

Reduction in Point Source Loadings Through the Reduction of Toxic Loadings to Municipal Sewage Treatment Plants: In New Jersey, 60% of industries discharge waste to sewage treatment plants. Through the industrial pretreatment program, loads of industrial pollutants have been significantly reduced, preventing pollution that may otherwise have reached surface water bodies via municipal treatment plant discharges.

Improvements in Combined Sewer Overflow (CSO) Management: The majority of the CSOs in the state discharge to marine or estuarine water bodies, however, a number of CSOs exist that affect the freshwaters in the state. The efforts of NJDEP's permitting, enforcement, planning and financing programs have resulted in significant progress in addressing this source of pollutants, through the virtual elimination of dry weather overflows at CSO discharge points and the development of short and long term CSO control plans.

NJPDES Permit Compliance Improved: Compliance rates with permit discharge limitations and reporting requirements have significantly improved over the past few years as a result of the Clean Water Enforcement Act requirements. From calendar year 1992 to 1995 the number of confirmed discharge limitation violations for which an enforcement action was issued decreased by 53% and the number of reporting violations decreased by 72%. The number of serious violations also dropped by 54%. The number of significant non-compliers identified in 1995 was 38, substantially fewer than the 81 facilities cited in 1992.

Improvements in Specific Waterbodies

Delaware River: The efforts of the four Delaware Basin states and the interstate Delaware River Basin Commission have led to significant improvements in water quality in the Delaware River and Estuary. The pollutant loads have been dramatically reduced as a result of wastewater treatment plant upgrades. Dissolved oxygen levels have increased from 0 ppm near Camden to healthy levels and the number of species of fish has increased from 16 in 1959 to over 40 today.

Cooper River/Big Timber Creek: Water quality improvement in the Cooper River, Big Timber Creek, and Newton Creek has been documented as a result of regionalization of sewage treatment within the past eight years. Although water quality is still poor in the Cooper River, dissolved oxygen has increased, and concentrations of total phosphorus, total organic carbon, suspended solids have decreased since 1988 due largely to the extensive municipal discharge regionalization that resulted in the elimination of most of the discharges to the Cooper River.

Whippany River: With the upgrade of four municipal treatment plants along the Whippany River, water quality has improved with respect to dissolved oxygen, total phosphorus, total organic carbon, suspended solids and potentially lead and mercury both in and downstream of Morristown.

Navesink River: Upgrades of sewage treatment plants and the management of domestic animal waste have significantly improved water quality in the Navesink to the point where unrestricted shellfish harvesting in a large portion of the Navesink is now permitted.

SPECIAL STATE CONCERNS

Although significant water quality improvements have occurred over the past 25 years within New Jersey, pollution problems still exist and continue to demand the focus of the State's water management efforts. What follows are the principal water quality concerns of this Department.

Aquatic Life Designated Use Impairments

Benthic macroinvertebrate population data are used to screen waters for attainment of aquatic life designated uses; these organisms can be classified by pollution tolerance and are relatively stationary residents whose populations reflect the cumulative effects of all aspects of their ecosystem. Of the waters so assessed, aquatic life designated uses are fully attained in 1,349 miles (35% of assessed miles), moderately impaired in 2,005 miles (52%) and severely impaired in 463 miles (12%). The causes of impairments to benthic aquatic life at each location have not been determined.

Nutrient Enrichment in Water

Phosphorus has been identified as the limiting nutrient, controlling eutrophication, in most freshwaters in New Jersey. Even though declines have been observed in phosphorus concentrations in many locations within the state, violations of the phosphorus criteria are common and still of concern on a statewide basis. Therefore, control of phosphorus is needed to protect drinking water supplies and prevent or reduce eutrophication.

Recorded violations of the State's phosphorus criteria are frequent in many of the state's monitored rivers and streams. Some New Jersey rivers also experience periodic algal blooms.

Of the 380 public lakes (24,000 acres) in New Jersey, 126 (11,172 acres) have been evaluated for trophic status. Of these, all are either threatened with eutrophication or are considered to be eutrophic. The natural eutrophication process in New Jersey lakes is being accelerated by inputs of nutrients and suspended solids from fertilizers, air deposition, stormwater and discharges from sewage treatment plants and septic systems. Eutrophic lakes must be managed to make them suitable for swimming and fishing through algal control practices.

A national survey on eutrophication in estuarine waters of the United States ranked New Jersey's estuaries high to very high for existing eutrophic conditions. Eutrophication has been confirmed by data from a New Jersey phytoplankton survey which measured chlorophyll a (an indicator for phytoplankton levels and eutrophic conditions) values. Data show that the Raritan Bay has very high intensity and high frequency blooms, the Delaware Bay near Cape May County has chronic but benign red tides and most other areas along the coast have levels considered slightly above normal throughout the entire summer season.

Eutrophication can lead to low dissolved oxygen (DO) concentrations which often occur in portions of New Jersey's coastal waters during the summer months. Between 1989 and 1994, approximately 15% of the state's coastal waters experienced oxygen levels recognized as stressful to aquatic biota (<4 mg DO/L). Such areas included Raritan Bay, the Shrewsbury River, Little Bay, Reeds Bay, Great Egg Harbor and the Great Egg River. Periodic red tide blooms have appeared in Raritan and Sandy Hook Bays.

Pathogens in Water

Based on the Clean Water Act, New Jersey has designated that most surface waters of the state should have the sanitary quality necessary to support swimming. However, of the total 390 linear stream miles monitored for the sanitary quality required to support primary contact recreation, 170 miles (44 percent) do not support the use and another 120 linear miles (31 percent of assessed waters) only partially support the use. Full support of the primary contact use is limited to 100 miles or 26 percent of assessed waters.

Data indicate that our success in controlling pathogens in coastal waters appears mixed. Concentrations of coliform bacteria in the NY/NJ Harbor have declined substantially since the 1970s. However, a recent case study of fecal coliform trends in the near shore and backbay waters of the Barnegat Bay found that 10% of the backbay waters which were pristine in the early 1970s now show low levels of chronic fecal coliform degradation. This trend is despite three regional sewage treatment plants which came on-line during the period (which removed discharges from the backbays and moved them out to the ocean), the elimination of dry weather overflows from combined sewers and extensive point source pollution control efforts instituted in the 1970s and 1980s. This situation suggests that existing efforts in the coastal region to control pathogens may not be sufficient, and additional management efforts must focus more on coastal development and the associated nonpoint pollution sources.

Toxic Substances in Water

Concerns regarding water column toxic contamination are currently focused on the state's estuarine waters adjacent to heavily urbanized and industrialized areas, the most impacted of which is the NY/NJ Harbor estuary. For the NY/NJ Harbor, exceedances of the mercury surface water quality standard have occurred harbor-wide. Additional efforts are directed toward PCBs, dioxins and polycyclic aromatic hydrocarbons, due to exceedances of FDA guidelines in fish and shellfish tissue (see "Toxic Substances in Fish Tissue," below), and elevated sediment concentrations. Current releases of these constituents to the environment from nonpoint source pollution, air deposition, and possibly point sources are suspected. Current effort is being directed toward detection of these compounds in ambient water at sites throughout the Harbor and at discharge points.

Data from the Delaware estuary demonstrate exceedances of surface water quality criteria for lead and copper in the lower estuary. Limited data have also indicated potential criteria exceedances for several other metals and two volatile organics in the lower estuary.

Toxic Substances in Fish Tissue

Consumption advisories, commercial fishing bans, and recreational fishing advisories for finfish have been in effect in New Jersey, some for many years now. High levels of PCBs and certain pesticides are found in finfish and blue-claw crabs collected in New Jersey waters. As a result, commercial fishing bans and recreational fishing advisories have been issued by the State for

striped bass, white perch, white catfish, American eel and blue-claw crab which are in effect for both fresh and salt waters.

Some consumption advisories are more recent. New Jersey is one of 32 states that have enacted widespread fish consumption advisories in response to mercury contamination. NJDEP recently issued statewide consumption advisories on pickerel and large mouth bass due to mercury. Consumption advisories target "at risk" segments of the population - pregnant women, women planning pregnancy within a year, nursing mothers, and children under five years old. Drinking water, however, supplied from affected waters has been tested and shown to be safe because the mercury resides primarily in sediments and aquatic life.

Toxic Substances in Ground Water

NJDEP has identified localized ground water contamination due to inorganics such as nitrate, mercury and lead, radiogenic contaminants such as radium. Also identified were organic contaminants such as chlorinated and aromatic volatile organic pollutants and pesticides. Many of these contaminants are of particular concern for private wells because there are no regulatory requirements for routine sampling of private wells. Also, private wells tend to be in shallow, unconfined aquifers, and thus are often more vulnerable to contamination from pollution sources at the surface than deeper community water supply wells. In addition, contaminants in ground water may migrate to surface waters, potentially contaminating streams, sediments and biota. In New Jersey, most to all of the surface water in streams is derived from ground water.

Ground Water Quantity

Water level monitoring by USGS and NJDEP have indicated declines in ground water level in areas throughout the state as well as salt water intrusion in coastal areas. These ground water depletions occur in areas dependent on these aquifers for drinking water supplies as well as for industrial and agricultural uses. Depletion of ground water aquifers as well as reduction of aquifer recharge has been the focus of several water supply planning and/or management programs within the Department.

RECOMMENDATIONS FOR IMPROVING WATER QUALITY IN NEW JERSEY

It is clear from the previous section that even though water quality has declined in some areas, much progress has occurred in New Jersey in improving water quality on a statewide basis. The question of how greater improvements in water quality can take place across the state has been posed with each iteration of this Inventory Report. Many of the recommendations issued in response to this question in past Inventory Reports have now become standard practice within this Department. The following are examples of past Inventory Report recommendations that have become a reality.

- The recommendation that a coordinated watershed-based approach be used when dealing with water pollution control management is being implemented by the Department. NJDEP has been developing a watershed-based pilot project within the Whippany Watershed for three years now. Major watershed efforts are beginning in the Passaic River and the Rancocas Creek Watersheds.

- The recommendation that this Department work to increase the identification and management of nonpoint sources of water pollution is being realized as a direct outcome of this watershed approach mentioned above. At present, regional stakeholders are focusing on all pollution sources within their respective watersheds.

- Through better permit compliance, point sources are better achieving their necessary effluent quality. The Clean Water Enforcement Act has greatly improved permit compliance within the regulated community.

Listed below are recommendations based on the conclusions in this report that continue to require attention and support. New recommendations are expected to arise as the watershed-based projects grow and more is learned regarding pollution sources in our state and the most effective ways to manage them.

Increased water quality monitoring activities

Much of the current physical/chemical fresh water monitoring conducted in New Jersey by this Department is in the form of a fixed-station network. This network utilizes a fixed number of monitoring stations located on the larger streams in the state. The major purpose of this network is to determine long-term water quality trends and general water quality conditions for use in the Water Quality Inventory reporting process. This network, which in the early 1980s consisted of well over 200 monitoring stations, now consists of less than 80 due to a slow but significant decline in financial support. Monetary support continues to be tenuous; hence we

recommend that a commitment be made by the State to support this network at least at its current level.

It is also recommended that a broad-based intensive-survey monitoring program be implemented in the State, designed to supplement the existing ambient monitoring network. Unlike the fixed system this intensive monitoring would identify -

- specific sources of water pollution,
- the assimilation or removal of pollution by the stream environment,
- the effectiveness of specific water pollution control activities at a level of detail that is necessary to support watershed-based management activities.

Using this system, watersheds or segments of watersheds would be intensively sampled on a periodic basis. The number of monitoring sites within a watershed would vary and be dependent upon the existing water quality, land uses, known and potential pollution sources, and the amount of available historical data. A critical aspect of this intensive work would be to support modeling directed to determine the assimilative capacity of the waterbody (Total Maximum Daily Load assessment process). The Whippany River pilot study, currently in progress and overseen by the Department, is a good first step towards a renewal of this detailed watershed-wide assessment process.

Ambient monitoring for estuarine waters

New Jersey's estuarine waters play a significant role in the vitality of many activities in the state. Their value as a resource has been well documented. Despite their value, very little ambient monitoring has been performed in these waters until recently. Historically, the bulk of the State's monitoring efforts have focused upon the sanitary quality of shellfish-growing waters and bathing waters. Broader-based water quality monitoring has been limited to waters under the jurisdiction of the interstate agencies: the Interstate Sanitation Commission (New Jersey-New York interstate waters) and the Delaware River Basin Commission (Delaware River and Bay). Since 1988, a marine/estuarine monitoring network has begun collecting data on a wide range of physical/chemical parameters throughout the state's coastal waters and it is hoped that the Department will continue to support this much needed ambient monitoring effort.

Improving water quality through the implementation of Total Maximum Daily Loads (TMDLs).

Efforts should be made to have all pollutant limitations (point and nonpoint) be based upon the water quality standards applicable to the respective receiving waters and the waters' assimilative capacity. Intensive monitoring efforts should delineate receiving waters where existing regulatory and technology-based effluent limitations have failed to protect or achieve water quality standards. Resources should be allocated so that modeling studies undertaken to establish Total Maximum Daily Loads (TMDL) within

waterways with known use impairments can be properly executed. A clear understanding of the assimilative capacity of the receiving waters coupled with knowledge of the relative contributions from all pollution sources, point and nonpoint, would significantly aid the Department in establishing effective pollutant loading limits. These TMDL assessments will be standard procedures within the watershed assessment process.

Effective nonpoint source (NPS) pollution control

Although the understanding of nonpoint source contributions to water quality problems, and of methods to control specific nonpoint sources is growing rapidly, New Jersey lacks a comprehensive framework for controlling NPS pollution, especially with regard to existing land uses. The institutional, financial and statutory focus on point source control is far more robust than for nonpoint source control. Failure to effectively implement such controls through a watershed-based approach will likely result in the failure of New Jersey's efforts to attain and maintain compliance with water quality objectives in both fresh and saline waters. A reliable cost estimate for NPS control needs must also be developed.

Chapter II

Introduction and Background

INTRODUCTION

The New Jersey 1996 State Water Quality Inventory Report, commonly referred to as the 305(b) report, is the twelfth in a series of State Water Quality Inventory Reports that have been prepared by the New Jersey Department of Environmental Protection (NJDEP) since 1975. The State Water Quality Inventory Report is prepared every two years, pursuant to Section 305(b) of the Federal Clean Water Act (P.L. 95-217). This 1996 edition focuses upon water quality assessments of the principal waters of the state using chemical/physical data collected between 1991 through 1995 inclusive. In addition to chemical assessments, biological assessments employing macroinvertebrate communities are now reported for the entire state.

This current Report covers issues and programs up to the end of 1996 and addresses the following issues:

- The quality of the state's surface and ground waters.
- An analysis of the extent to which surface waters will attain the aquatic life support and swimmable goals of the Clean Water Act, and the designated uses outlined by the State.
- A description of water pollution sources that are adversely affecting surface and ground water quality.
- The actions that are necessary to improve water quality in the state's waters so that clean water goals are achieved.
- A description of the Department's principal water quality management programs.

The Water Quality Inventory Report serves two major functions. First, it is the main public reporting document produced by the NJDEP that describes water quality conditions, trends or changes, and whether progress is being achieved in meeting designated uses and clean water goals. As such this report has much value to the state's citizens and interested public as an information source on water quality conditions and water pollution sources. Information from this report is also used in the Department's Clean Water Enforcement Act Annual Report and Self-Assessment Report of the National Environmental Performance Partnership System process.

Second, the report notifies Congress on what is necessary to clean our waters. New Jersey's report is incorporated into a National Water Quality Inventory Report by the United States Environmental Protection Agency (USEPA), and is then submitted to Congress. The report, therefore, is instrumental in shaping national policy regarding water pollution control mandates and priorities.

This report serves as the initial submittal vehicle to USEPA of certain information required by the Federal Water Quality Act of 1987. In addition, the Water Quality Act of 1987 requires states to submit assessments of their lake water quality as part of section 314(a)(2) of the Clean Water Act. In response, New Jersey is continuing a trophic assessment of public lakes and the results are presented in this report.

The information provided in this report is in response to requests made in USEPA's Guidelines for the Preparation of the 1996 State Water Quality Assessment. Much of the narrative in this report was originally prepared for previous reports, and has been updated accordingly. This Report contains five chapters and an appendix:

- Chapter I - Executive Summary, Program Successes and Special State Concerns begins by presenting a summary of the material contained within this Report. This is followed by descriptions of water pollution control success stories as well as areas where pollution management is still needed. Chapter I closes with specific recommendations that this Department feels need continued attention and support.

- Chapter II - Introduction and Background (the section you are currently reading) briefly introduces the reader to this Report and to the water resources of the state. Chapter II also describes the water quality standards which form the basis of New Jersey's water quality management effort.

- Chapter III - Surface Water Assessment presents major conclusions regarding the quality of the state's surface waters. The quality of the state's rivers, streams, lakes, estuaries and ocean waters is summarized in this chapter. Causes of nonsupport of designated uses are reviewed. The results of the State's ongoing determination of waters impacted by toxics, as required by the Water Quality Act of 1987, are also included in this chapter.

- Chapter IV - Ground Water Quality and Management is a detailed discussion of ground water quality and quantity conditions in the State, current management efforts, and management strategies for the future. Also included are ground waterbodies in New Jersey currently under investigation.

- Chapter V - Surface Water Monitoring, Assessment and Pollution Control Programs. This chapter presents the State's surface water quality management activities for the control of both point and nonpoint sources of pollution.

- Appendix - Watershed-Specific Water Quality Assessments. This section provides detailed descriptions of water quality conditions in the state's major rivers and streams using physical/chemical data as well as instream biological monitoring.

BACKGROUND

New Jersey is the fifth smallest state in the nation and yet contains a wide variety of land use types, water resources, geologic characteristics, and natural biota and fauna. Within the state's 7,836 square miles are sections of the Appalachian Mountains, 120 miles of coastline, large cities and industrial centers, rich crop-producing lands and a largely undeveloped Pinelands region. New Jersey has approximately 6,450 miles of rivers and streams, and 24,000 acres of public lakes, reservoirs and ponds. In addition, there are 1,400 square miles of fresh and saline marshes and wetlands, and 420 square miles of open estuarine waters. A summary of the state's population and water resources is presented in Table II-1 below:

Table II-1: New Jersey Geographic Atlas

State Surface Area:	7,836 sq. miles
State Population (1990):	7,730,188
Major River Basins:	Delaware, Passaic/Hackensack, Atlantic Coastal, Raritan, and Wallkill
River Miles:	6,450*
Border River Miles:	310*
No. of Public Lakes/Reservoirs/Ponds:	380*
Acres of Public Lakes/Reservoirs/Ponds:	24,000*
Square Miles of Estuaries/Bays:	420 (open waters)
Ocean Coast as Linear Miles:	120
Acres of Freshwater Wetlands:	661,000*
Acres of Coastal/Tidal Wetlands:	243,000*

* Approximate Figures

There are five major drainage basins in the state. The largest is the Delaware River Basin (3,000 sq. miles), followed by the Atlantic Coastal Basin (approximately 2,000 sq. miles), the Passaic/Hackensack Basin (1,200 sq. miles), the Raritan River Basin (1,100 sq. miles), and the Wallkill River (210 sq. miles) which drains to the Hudson River in New York State. The southern border of the state is formed by the Delaware Bay, the Delaware River forms the western border and the Atlantic Ocean, Raritan Bay, Arthur Kill, Kill Van Kull and Hudson River all together comprise the eastern boundary of the state. The principal watersheds of the state are shown on Figure II-1. For the purpose of environmental planning and management, these watersheds of the state are divided (or aggregated) into 20 roughly equally sized Watershed Management Areas (Figure II-2). The watershed specific assessments contained within the Appendix of this report are organized according to these Management Areas.

The waters of New Jersey are heavily influenced by the land uses and population centers in the state. In 1990, New Jersey had a population of slightly over 7.7 million people. By the year 2000, the NJ Department of Environmental Protection estimates that the state's population will climb to over 8.5 million. Although New Jersey is the most densely populated state in the nation, the state's population is not equally distributed. Densities are greatest in the regions surrounding New York City and Philadelphia, and along the northern Atlantic Coast. Most watersheds in the state flow through

a variety of land uses, usually within short distances. Generally, streams and rivers originate in rural, undeveloped, and agricultural lands before entering suburban/urbanized areas.

With regard to land use within New Jersey, undeveloped forests and other vacant lands are still the predominant uses in the state. The remainder is divided between agricultural, suburban, and urban (including industrial) uses. Many areas of New Jersey have been undergoing extensive and rapid growth during the past years. This growth consists of light industry/corporate centers, commercial facilities, and suburban development. The development, previously encouraged by a favorable economy and improved transportation corridors, is encroaching upon prime agricultural and vacant lands in most of northern and central portions of the state, in the northern coastal counties, and in the southern Delaware River drainage area near Philadelphia.

Waterfront development and redevelopment have also been occurring in an intense manner in New Jersey. Along the Lower Hudson River and the Delaware River, former piers and docks have been converted to commercial and residential centers. In older urban cities, redevelopment along available waterways is serving as the basis for entire urban renewal projects. Vacant buildable space along the state's coast and estuaries/bays is rapidly diminishing. Inland, lake-front property or land near lakes is in prime demand.

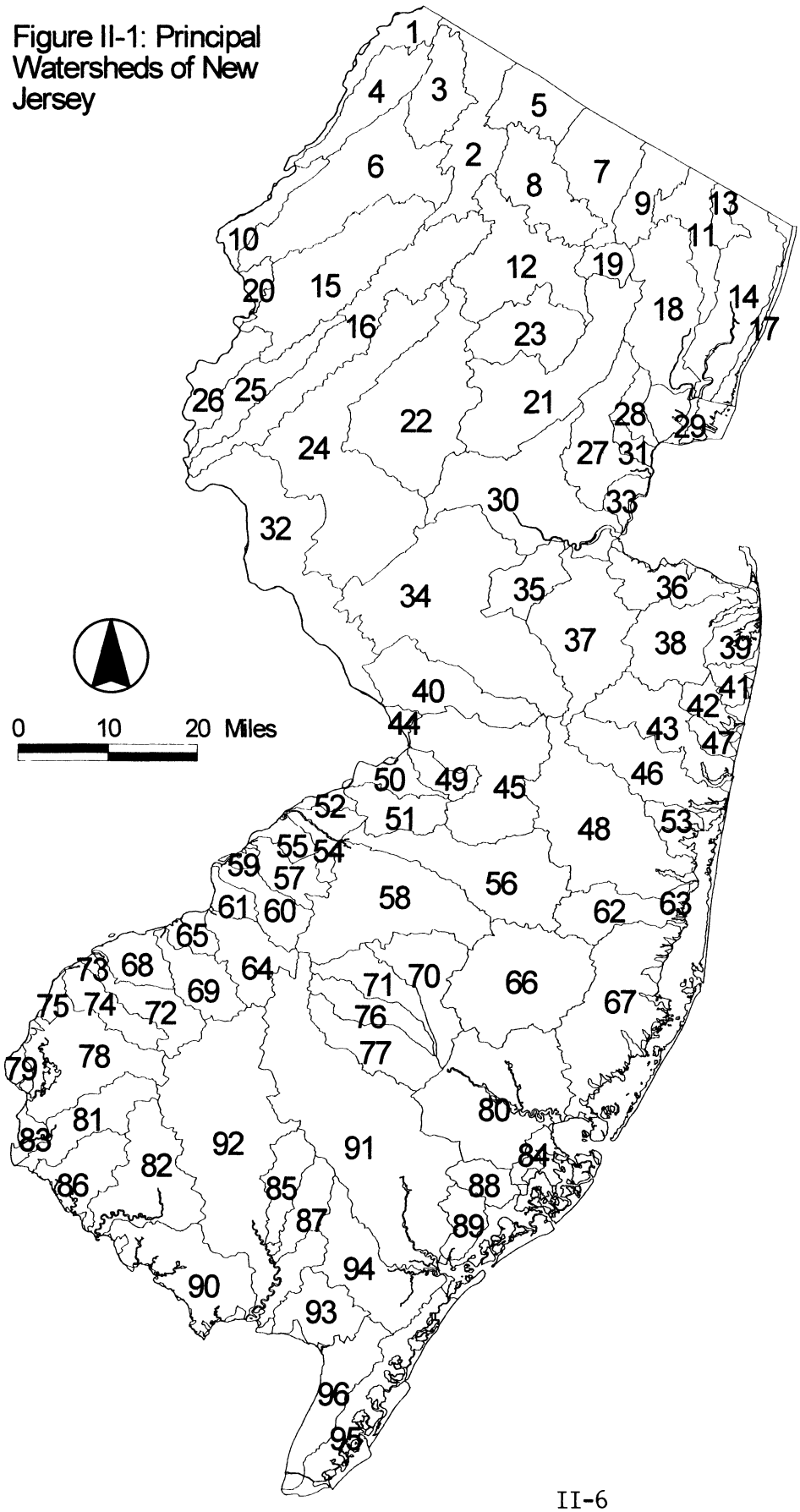
New Jersey's surface waters are utilized for a variety of purposes. Water diversions are so great that the state's three largest rivers, the Delaware, Passaic and Raritan Rivers, all have passing flow requirements. Diversion of stream flow for potable water supply, industrial process and cooling purposes, agricultural irrigation, and maintenance of reservoir/impoundment water levels is common throughout the state. NJDEP's Bureau of Water Allocation, as mandated in the State Water Supply Management Act (N.J.S.A. 58A:1 et seq.), requires water diversion permits for all withdrawals of more than 100,000 gallons per day.

The importance of surface waters as a foundation for recreation in the state has been documented (NJDEP, 1984). Overall, swimming is the second most popular outdoor recreation activity in the state; fishing is seventh and motor boating is seventeenth. Maintenance and improvement of water quality in the state is critical from a recreational standpoint. As recreational demand increases, so will our demand for clean water.

A variety of aquatic habitats are found throughout New Jersey. Freshwaters vary from cool trout waters in northern New Jersey to acidic Pinelands streams in southern areas of the state. Tidal streams and rivers, along with coastal bays and estuaries, are used by anadromous fish, and various ocean fishes migrate through the state's coastal waters. Figure II-3 indicates the extent of Trout Production waters, which are waters designated for trout spawning and nursery purposes within the state (NJDEP, 1983). Figure II-4 denotes Trout Maintenance waters - waters designated for the support of trout throughout the year. The remaining freshwaters of the state are classified as Nontrout, meaning that warm water fish predominate. Trout and nontrout classifications are outlined in New Jersey's Surface Water Quality Standards (N.J.A.C. 7:9B-1 et seq.). The N.J. Division of Fish, Game and Wildlife also

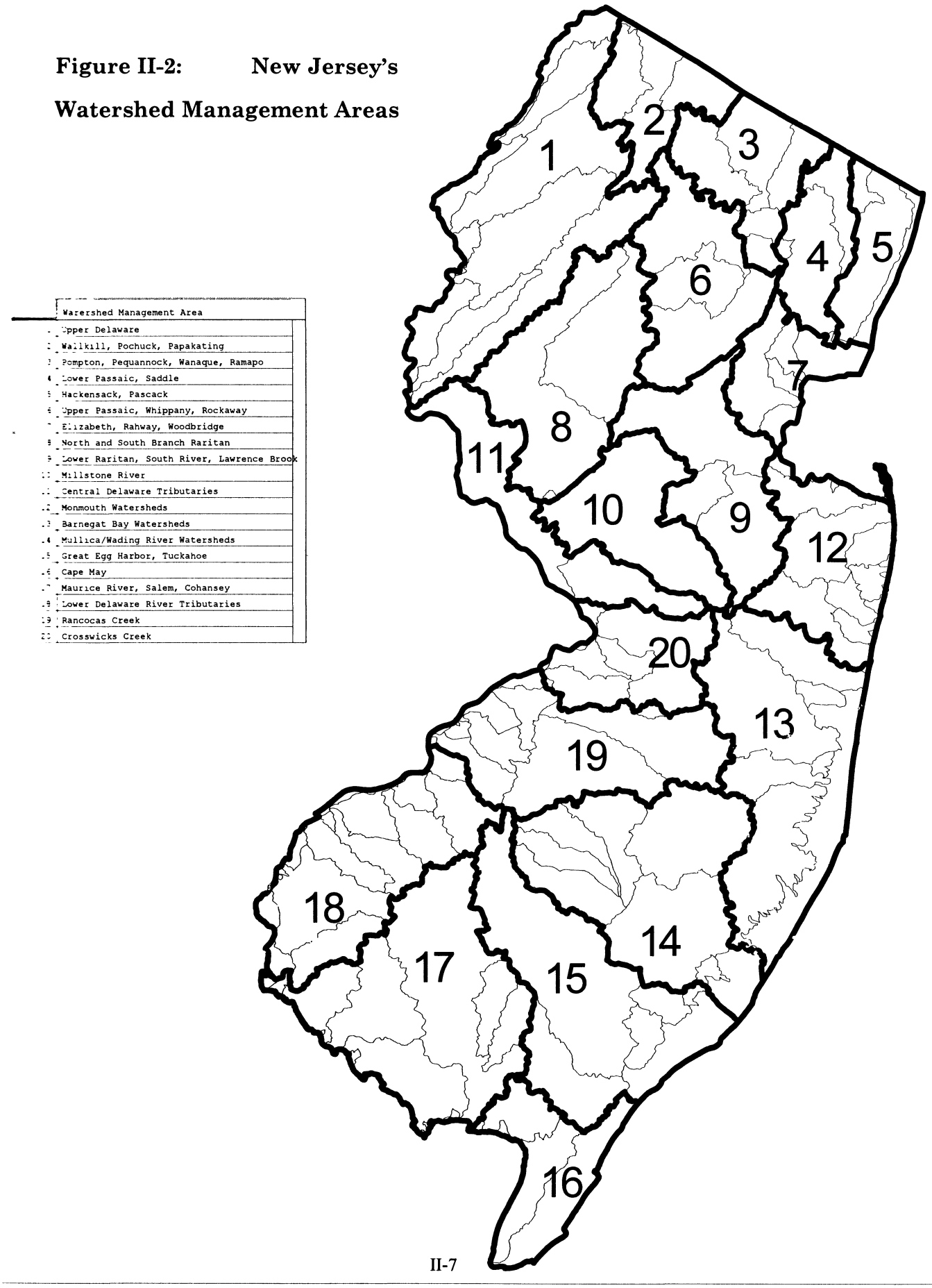
stocks sport fishes in many streams and lakes. Both trout species and warm water lake fishes are stocked annually.

Figure II-1: Principal Watersheds of New Jersey



1	SHIMMERS BROOK
2	WALLKILL RIVER
3	PAPAKATING CREEK
4	FLAT BROOK
5	POCHUCK CREEK
6	PAULINS KILL
7	WANAQUE RIVER
8	PEQUANNOCK RIVER
9	RAMAPO RIVER
10	VANCAMPENS BROOK
11	SADDLE RIVER
12	ROCKAWAY RIVER
13	PASCACK CREEK
15	PEQUEST RIVER
14	HACKENSACK RIVER
16	MUSCONETCONG RIVER
17	HUDSON RIVER
18	LOWER PASSAIC RIVER
19	POMPTON RIVER
20	DELAWANNA CREEK
21	UPPER PASSAIC RIVER
22	N BRANCH RARITAN RIVER
23	WHIPPANY RIVER
24	S BRANCH RARITAN RIVER
25	POHATCONG CREEK
26	LOPATCONG CREEK
27	RAHWAY RIVER
28	ELIZABETH RIVER
29	ELIZABETH CHANNEL
30	LOWER RARITAN RIVER
31	MOSES CREEK
32	LOCKATONG CREEK
33	WOODBRIDGE RIVER
34	MILLSTONE RIVER
35	LAWRENCE BROOK
37	SOUTH RIVER
36	MATAWAN CREEK
38	NAVESINK RIVER
39	SHREWSBURY RIVER
40	ASSUNPINK CREEK
41	WHALE POND BROOK
42	SHARK RIVER
43	MANASQUAN RIVER
44	DUCK CREEK
45	CROSSWICKS CREEK
46	METEDECONK RIVER
47	WRECK POND BROOK
48	TOMS RIVER
49	BLACK CREEK
50	CRAFTS CREEK
51	ASSISCUNK CREEK
52	MILL CREEK
53	KETTLE CREEK
54	RANCOCAS CREEK
55	POMPESTON CREEK
56	N. BRANCH RANCOCAS CREEK
57	PENNSAUKEN CREEK
58	S BRANCH RANCOCAS CREEK
59	BALDWIN RUN
60	COOPERS CREEK
61	NEWTON CREEK
62	CEDAR CREEK
63	SLOOP CREEK
64	BIG TIMBER CREEK
65	WOODBURY CREEK
66	WADING RIVER
67	FORKED RIVER
68	REPAUPO CREEK
69	MANTUA CREEK
70	BATSTO RIVER
71	ATSION CREEK
72	RACCOON CREEK
91	GREAT EGG HARBOR RIVER
73	MAPLE SWAMP
74	OLDMANS CREEK
75	WHOOPING CREEK
76	MECHESACTAUXIN CREEK
77	NESCOCHAQUE CREEK
78	SALEM CREEK
92	MAURICE RIVER
79	MILES CREEK
80	MULLICA RIVER
81	ALLOWAYS CREEK
82	COHANSEY RIVER
83	MILL CREEK
84	DOUGHTY CREEK
85	MANANTICO CREEK
86	STOW CREEK
87	MANUMUSKIN CREEK
88	ABSECON CREEK
94	TUCKAHOE RIVER
89	PATCONG CREEK
90	DIVIDING CREEK
93	DENNIS CREEK
95	CAPE MAY ATLANTIC COAST
96	DELAWARE BAY COASTAL

Figure II-2: New Jersey's Watershed Management Areas



	Watershed Management Area
1	Upper Delaware
2	Wallkill, Pochuck, Papakating
3	Pompton, Pequannock, Wanaque, Ramapo
4	Lower Passaic, Saddle
5	Hackensack, Pascack
6	Upper Passaic, Whippany, Rockaway
7	Elizabeth, Rahway, Woodbridge
8	North and South Branch Raritan
9	Lower Raritan, South River, Lawrence Brook
10	Millstone River
11	Central Delaware Tributaries
12	Monmouth Watersheds
13	Barnegat Bay Watersheds
14	Mullica/Wading River Watersheds
15	Great Egg Harbor, Tuckahoe
16	Cape May
17	Maurice River, Salem, Cohansey
18	Lower Delaware River Tributaries
19	Rancocas Creek
20	Crosswicks Creek

New Jersey's estuarine and coastal waters also contain viable commercial shellfisheries. The health of this resource is especially dependent upon clean waters. Disruption of shellfish beds by dredging and siltation combined with bacterial pollution has threatened the ability of the shellfish to reproduce and grow, or has rendered them unfit for consumption. This, in turn, has hindered or prevented harvesting. New Jersey's environmental protection efforts have made maintenance of this resource a statewide priority.

Ground water is an extremely important resource in New Jersey. It provides approximately 40 percent of the state's potable water, with 31 percent coming from public-supply wells and 9 percent from domestic-supply wells (Hoffman and Mennel, 1997). It also provides baseflow to streams, and is intimately associated with the ecology of the state's wetlands. New Jersey maintains regulations and programs aimed at protecting this resource. The available data suggest that at present there is an ample supply of good quality ground water in the State of New Jersey. However, ground-water quantity (and quality) problems are usually concentrated in areas where the greatest volumes of ground water are needed.

NEW JERSEY WATER QUALITY STANDARDS: THE FOUNDATION OF WATER RESOURCES MANAGEMENT

Water quality standards establish the water quality goals and policies underlying the management of the state's waters. The standards in a sense form the "wheel-hub" of water quality management. These standards designate the use or uses to be made of the water and then set criteria and policies necessary to protect both the uses, as well as the existing higher quality of many waters thereby establishing policies and procedures to protect water quality. The relationship between water quality standards and criteria evolved out of the Water Quality Act of 1965. Under the Water Quality Act, the states are required to adopt water quality standards to protect public health and welfare. This legislation additionally requires that they enhance the quality of water, taking into consideration uses for public water supplies, protection and propagation of fish, shellfish and wildlife, recreation, agriculture, industry, navigation, groundwater recharge and aquifer protection.

The terms "standards" and "criteria" are often confused. Under the Clean Water Act, surface water quality **standards** are a package of regulations consisting of policies, use classifications for the waters, and criteria which will protect the uses. **Criteria,** in contrast, are part of the standards. Criteria in most cases, are numeric constituent concentrations or levels. However, where a numeric value is not available or known, a narrative criterion can be used. In contrast to the Clean Water Act, under the Safe Drinking Water Act numeric constituent concentrations or levels (criteria) are regarded as standards.

The first step in establishing water quality standards is to determine the **water uses** to be protected. States are primarily responsible for designating water uses. The water uses are determined by analyzing the water's existing uses and the potential to attain particular uses based on physical, chemical, biological, and hydrological characteristics of the waters and the economic

affects of attaining various uses. The Clean Water Act requires that wherever attainable, water quality standards should provide for the protection and propagation of fish, shellfish, and wildlife and to provide for recreation in and on the water. Water uses, of course, vary from state to state, but one state's water use cannot result in the violation of another state's water use of the same waterbody.

The second step is to establish criteria based on sound scientific data. States are required to adopt water quality criteria that will protect both the existing and designated uses of a waterbody with an adequate degree of safety. In terms of commonly used criteria, the water quality standards of states contain criteria for dissolved oxygen, pH, bacteria, temperature, aesthetic qualities, toxic pollutants, and narrative criteria based on biomonitoring methods where numerical criteria cannot be established.

State and Federal monitoring, inspection, and enforcement programs ensure compliance with permits. With reference to wastewater pollution controls, two types of effluent limitations are required under the Clean Water Act for the National Pollutant Discharge Elimination System (NPDES). The first is **technology-based treatment standards** promulgated by USEPA. These standards are based upon Federal effluent guidelines and standards that take into account factors unique to specific types of industry and are not directly related to the characteristics of the receiving waterbody.

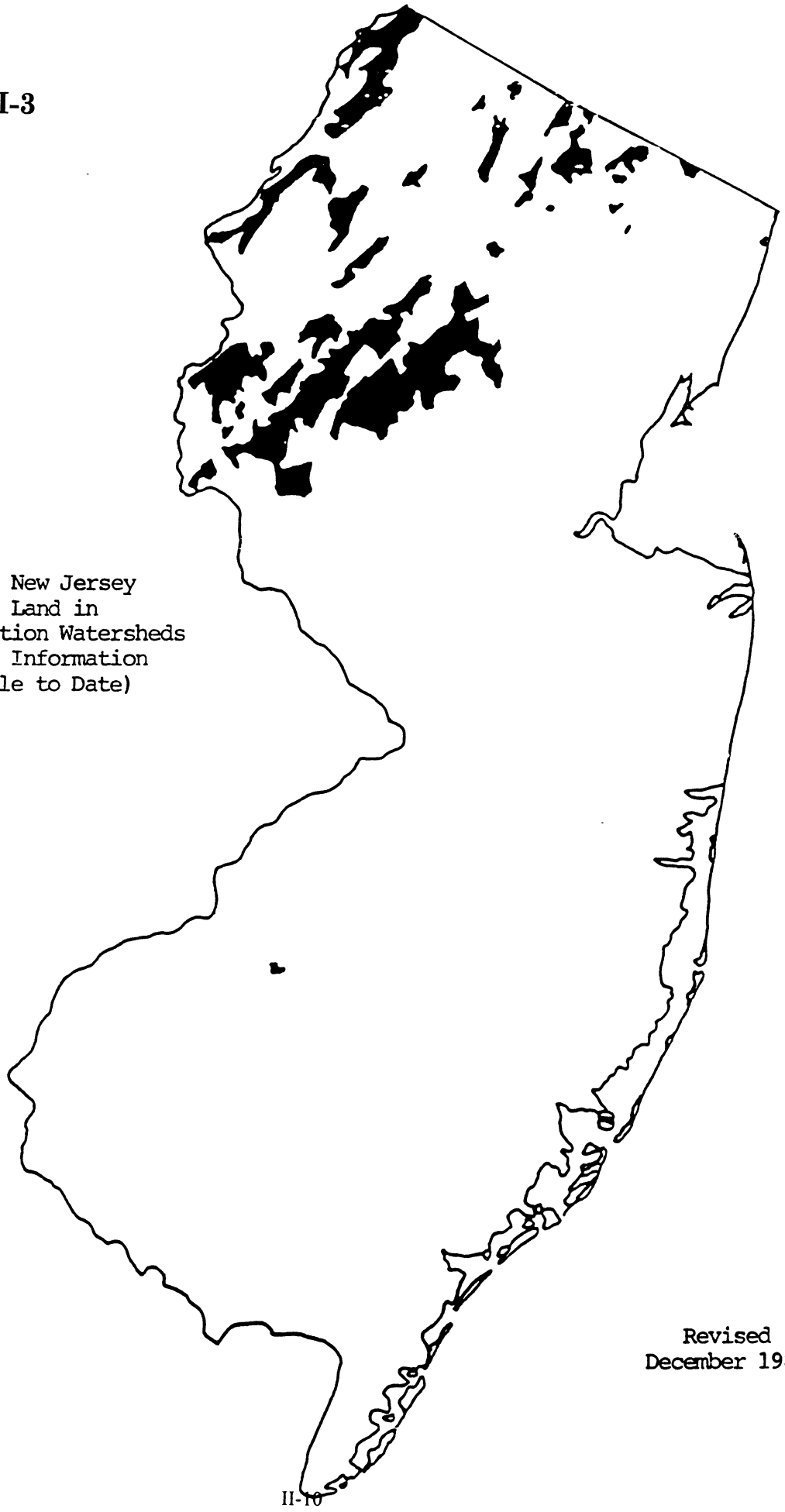
The second type of effluent limitation is **water quality-based limits**, which require watershed water quality assessments including water quality modeling based on state's water quality standards. These water quality-based treatment requirements are imposed when it has been determined that limitations more stringent than technology-based effluent limitations are necessary to meet water quality standards.

Surface Waters Standards

As stated earlier, all waters in New Jersey have been assigned a set of "designated uses" that the waters should be able to support throughout the year. These uses are in turn applied to "Water Classifications." Table II-2 delineates designated uses for surface waters and their associated classifications. These surface water designated uses are defined in the State's Surface Water Quality Standards regulations (N.J.A.C. 7:9B-1 et seq.) and are generally based on a set of numeric and narrative water quality criteria. In most areas of the state, the designated uses correspond to the swimmable and fishable goals of national clean water legislation. The swimmable goal is intended to have all possible surface waters be of sufficient quality to allow for primary contact recreation. The fishable goal is designed to have all possible waters supporting healthy and reproducing aquatic biota (usually both indigenous and introduced) and to have all fish and shellfish harvested from these waters safe for human consumption.

All freshwaters of New Jersey are assigned designated uses that reflect the national clean water goals (except for freshwater tidal portions of the Delaware River tributaries from Rancocas Creek to Big Timber Creek inclusive). Certain tidal and estuarine saline waters of the state are classified for less than these goals because the goals are regarded as not currently

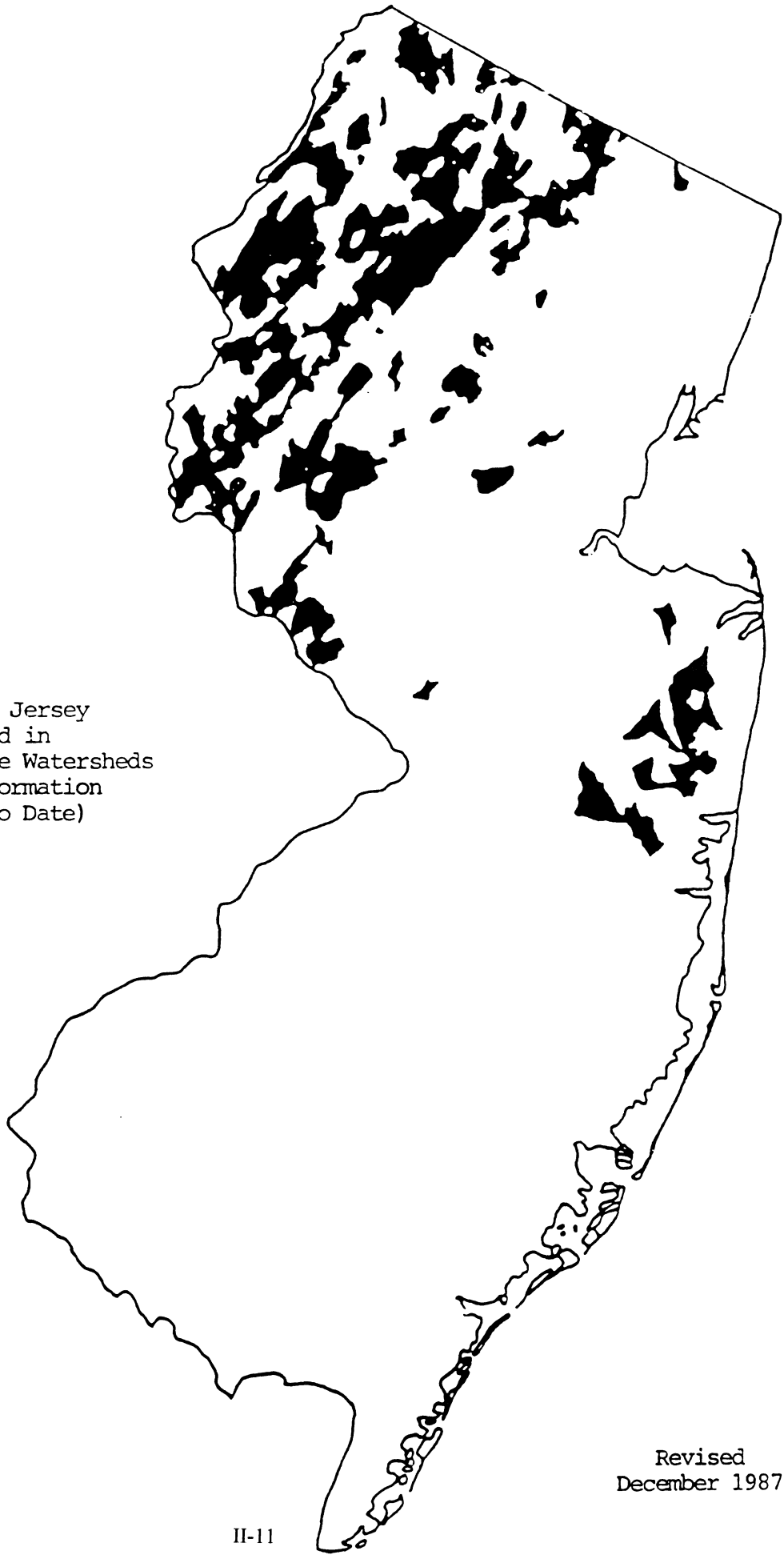
Figure II-3



Areas of New Jersey
With Land in
Trout Production Watersheds
(Based on Information
Available to Date)

Revised
December 1987

Figure II-4



Areas of New Jersey
With Land in
Trout Maintenance Watersheds
(Based on Information
Available to Date)

Revised
December 1987

attainable. SE-2 (Saline estuarine) waters only have to meet water quality criteria for secondary contact recreation, while SE-3 waters only have to allow for secondary contact recreation and the maintenance/migration of fish (not propagation). Waters in New Jersey assigned SE-2 and SE-3 classifications are found in the urbanized northeast and the Philadelphia/Camden region. They include the tidal Passaic, Hackensack, Elizabeth and Rahway Rivers, and specific tidal tributaries to the Delaware River from Big Timber Creek to Oldmans Creek. All interstate waters between New Jersey and New York do not have to meet The Clean Water Act's clean water goals, as defined by the Interstate Sanitation Commission. This is also true for the Delaware River from mile point 118 downstream to mile point 60, based on applicable criteria established by the Delaware River Basin Commission in concert with the NJDEP.

Table II-2 Selected Designated Uses for Surface Waters And Their Associated Classifications:

	Designated Use	Water Classification
1.	Primary and secondary contact recreation	FW-1, FW-2, SE-1, SC, and PL
2.	Secondary contact recreation	SE-2, SE-3
3.	Maintenance, migration and propagation of the natural and established biota (biota indigenous to the unique ecological region)	FW-1, FW-2, (PL), SE-1 SE-2, SC
4.	Maintenance and migration of fish populations	SE-3
5.	Shellfish harvesting in accordance with State regulations	SE-1, SC
6.	Public potable water supply, after such treatment as required by law or regulation	PL, FW-2

Anti-degradation policies apply to all surface waters of the state. Existing uses must be either maintained or protected, and no irreversible changes to water quality are allowed that would impair or preclude attainment of designated uses. Waters classified as nondegradation waters must be maintained in their natural state, and are not to be subject to any manmade wastewater discharges.

Ground Water and Drinking Water Standards:

New Jersey's current Ground Water Quality Standards (GWQS), N.J.A.C. 7:9-6 et seq., were promulgated January 7, 1993, and provide the basis for the protection of ambient ground water quality through the establishment of constituent criteria for ground water pollutants. These criteria in turn provide the primary basis for setting limits on discharges to ground water and standards for ground water cleanups. These constituent criteria also form the basis for the Department to regulate affects to ground water quality from all

discharges directly to ground water or to land surface that can affect ground water.

The relevant laws through which the GWQS may be applied include, but are not limited to, the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.), the Spill Compensation and Control Act (N.J.S.A. 58:10-23.11 et seq.), the Solid Waste Management Act (N.J.S.A. 13:1E-1 et seq.), the Environmental Cleanup Responsibility Act (N.J.S.A. 13:1K-6 et seq.), the Storage of Hazardous Substances Act (N.J.S.A. 58:10A-21 et seq.), the Realty Improvement Sewerage and Facilities Act (N.J.S.A. 58:11-23 et seq.), and the Pesticide Control Act of 1971 (N.J.S.A. 13:1F-1 et seq.).

In order to protect its designated uses, ground waters of the state are divided into three classifications. **Class I ground waters** are waters of special ecological significance. These include the ground waters within FW1 surface watersheds and those within the Pinelands area as delineated by the Pinelands Protection Act. **Class II ground waters** are waters for potable water supply. **Class III ground waters** represent ground waters with uses other than water supply. This category includes waters that because of their natural compositions (such as high chloride levels) are not suitable for potable water supplies.

A significant feature of the new GWQS is their focus upon the interaction of ground and surface water quality. Ground water provides a substantial portion of the base flow to surface waters. In response to this fact the ground water standards are designed so that discharges to ground water will not impair surface waters.

Potable Water Supply and Relationship Between Ground Water Quality Standards and Drinking Water Quality Standards. Because the Department has been striving for consistency in its approach to water criteria development, the derivation of human health-based criteria is essentially the same for both the ground water and drinking water programs. Where they differ is largely on how the two separate criteria are applied. The ground water quality criteria that are based upon human health criteria are used by the NJPDES program to derive discharge limits that are applied to the discharge point and by the Site Remediation Program to set ground water and soil cleanup goals. The drinking water standards (primary, see below) are also based upon human health but also consider analytical and water treatment factors as well. The drinking water standards are applied only to regulate water delivered by public water supplies.

Drinking Water Quality Standards and Overall Ground Water Quality. A **contaminant** is defined by the New Jersey Safe Drinking Water Act (N.J.A.C. 7:10) as "any physical, chemical, biological or radiological substance or matter in water." Accordingly, a contaminant can be natural or artificially introduced. In contrast, a **pollutant,** as paraphrased from New Jersey Pollutant Discharge Elimination System (1988 N.J.A.C. 7:14A-1.9), is any contaminant discharged directly or indirectly by humans to land, ground water, or surface water. Some other important definitions used in this chapter when discussing Drinking Water Standards are **maximum contaminant level** (MCL); **primary drinking water regulations**; and **secondary**

drinking water regulations, from DEP (New Jersey Safe Drinking Water Act Regulations, N.J.A.C. 7:10-1.1 through 7.3). As stated in the regulations, the maximum contaminant level is "the maximum permissible level of a contaminant in water measured at the point at which water is delivered to the free-flowing outlet of the ultimate user of a public water system or other water system to which state primary drinking water regulations apply." The primary drinking water regulation "...specifies contaminants which, in the judgment of the Commissioner, may have an adverse affect on the health of persons..." The secondary drinking water regulation "...specifies the recommended upper and/or lower levels of substances that are necessary to protect the public welfare...."

As mentioned in the preceding paragraph, undesirable constituents in ground water are not always anthropogenic in origin. In many cases violations of the federal and state primary and secondary drinking water standards are due to natural ground water chemistry. Natural ground-water quality is mainly a function of the composition of the water recharging the ground water system, the composition and mineralogy of the formation material that the ground water passes through, and the residence time of the ground water in the formation. The longer the residence time of ground water in a formation, the more time water has to dissolve minerals and become more mineralized.

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Chapter III

Surface Water Assessment

INTRODUCTION

This chapter presents a review of current surface water monitoring, assessment methodologies and water quality conditions in New Jersey's streams, rivers, lakes, wetlands, estuaries and ocean waters. Also discussed are the types of pollutants found in the state's surface waters, as well as the known and potential sources of these pollutants. A determination of waters that are achieving State designated uses is presented.

Water quality conditions within the interstate waters, specifically the Delaware River and Bay; Newark, Raritan, and New York Bays; the Hudson River; the Arthur Kill; and the Kill Van Kull are reported to USEPA under the section 305(b) requirements of the Delaware River Basin (P.O. Box 7360, West Trenton, NJ 08628) and the Interstate Sanitation Commission (311 West 43rd Street, New York, NY 10036). The reader is referred to these agencies for their corresponding reports for more detailed information regarding these interstate waters.

Chapter III is divided into 6 sections; they are: Surface Water Monitoring Programs, Surface Water Quality Assessment Methodologies, River and Stream Water Quality, Lake Water Quality Assessment, Coastal Water Quality, and Toxic Substances.

SURFACE WATER MONITORING PROGRAMS

What follows is a discussion of the water quality monitoring activities which are being conducted in the state. Monitoring data are used to establish baseline conditions, determine trends, and identify solutions to or further study water quality problems. The NJDEP's primary surface water quality monitoring unit is the Office of Water Monitoring Management, although monitoring functions are also performed by other units.

Since the end of the 1980s, there has been a gradual shift in the emphasis of the Office of Water Monitoring's monitoring activities. One trend has been a significant expansion of biological monitoring. A second trend has been a greater emphasis on the coastal area where the monitoring is expanding from just sanitary assessments to a broader based water quality assessment.

The present and anticipated water quality monitoring activities in New Jersey are summarized in the following paragraphs. All of the monitoring activities discussed below are conducted by the Office of Water Monitoring Management unless otherwise indicated.

State-Wide Fresh Water Routine Monitoring

NJDEP/USGS Cooperative Physical/Chemical Monitoring: Up until 1991, instream chemistry data used for this report originated from three ambient monitoring networks in the state, which when taken together, totaled some 115 monitoring locations, all located in freshwaters. Two networks were affiliated with the U.S. Geological Survey (USGS), and the third was part of USEPA's Basic Water Monitoring Network. In 1991, the NJDEP and the USGS jointly reevaluated and subsequently modified the combined networks in an effort to assure that the overall fixed station monitoring system would meet current as well as future regulatory and assessment needs with regard to the location of sampling sites, the frequency of sample collection, and the parameters monitored. Thirty-one stations were discontinued because they were either in close proximity to a neighboring station (and hence redundant), could not provide reliable discharge data (for flow-correction procedures), or monitored very small drainage areas.

As a result of the changes, the USGS/DEP and USEPA systems were combined and treated as one system with common parameters and sampling schedules. These 84 stations form the basis for most of the surface water quality assessments presented in this Report. Fiscal restraints, both on the part of the state and the federal government, have necessitated the termination of six more locations, leaving a total of seventy-eight sampling sites now existing in the system. For the purpose of maintaining the historical continuity of the system, stations were not moved, nor new sampling points established within the new combined system. Water column constituents are sampled five times a year at most locations. Dissolved metals continue to be sampled twice per year during high and low base flows, again at most locations. Bottom sediment samples are taken once a year during low flows in October. Three stations located within protected watersheds (state parks, etc.) that had shown stable water quality over time were selected to have their sampling frequency reduced.

Routine water column parameters and observations taken at each monitoring station include:

water temperature	flow-gage readings	weather conditions
dissolved oxygen	pH	specific conductivity
BOD	nitrite + nitrate	total phosphorus
TKN	fecal coliform bacteria	enterococus bacteria
TOC		

Also collected are dissolved minerals (chloride, fluoride, calcium, magnesium, potassium, sodium, silica, sulfate).

Supplemental water column parameters include:

sulfide	total hardness	beryllium	boron
arsenic	lead	selenium	mercury
cadmium	chromium	copper	iron
manganese	nickel	zinc	aluminum
phenol			

Supplemental sediment parameters include:
metals organic pesticides herbicides PCBs

The parameter list also includes the analysis of dissolved as well as total constituents: suspended solids, dissolved nitrate/nitrite, dissolved Kjeldahl nitrogen, dissolved phosphorus, biochemical oxygen demand (BOD), and chemical oxygen demand (COD) (the latter two at selected sites). These additions provide a detailed level of nutrient assessment, allowing a better understanding of the cycling, transport, and fate of nutrients and organic carbon in state waters.

The National Hydrologic Benchmark Network includes one monitoring station (McDonalds Branch in Lebanon State Forest). National Hydrologic Benchmark Network monitoring stations are selected based on their remoteness from the activities and influence of people. Parameters and observations include: specific conductance, water temperature, stream flow, pH, DO, fecal coliforms, fecal strep, BOD, suspended sediment, sand-silt fraction, common ions, nutrients, dissolved solids, TOC, trace metals, and radiochemicals.

NJDEP Ambient Biomonitoring Network (AMNET): Ambient chemical monitoring is now extensively supplemented by biological assessments of in-stream benthic macroinvertebrate communities. These communities are examined using USEPA's Rapid Bioassessment Protocols. From this, evaluations regarding the overall health of instream biota are estimated and in so doing, are categorized as nonimpaired, moderately impaired and severely impaired. These biological assessments are useful in directly assessing the aquatic life support designated use, as well as revealing the impact of toxic contaminants, and detecting chronic water quality conditions which may be overlooked by the short-term "snapshot" view provided by ambient chemical sampling.

Beginning with the 1992 Inventory Report, these macroinvertebrate surveys have been used to assess the aquatic life support designated use. The bioassessments have been performed for all the major watersheds within the state (700 monitoring locations, all located in non-tidal portions of rivers and streams) and their results are incorporated into this report. Summary tables of all assessments are presented at the end of each Watershed Management Area section.

Estuarine and Ocean Water Monitoring

Routine water quality monitoring in New Jersey bays, estuaries, and coastal reaches is performed by various governmental agencies. The interstate estuary and bay waters shared by New Jersey and New York, which include the Arthur Kill, the Kill Van Kull, the Hudson River, Newark Bay, and the tidal Hackensack River as well as the Raritan and Sandy Hook Bays, are monitored by the Interstate Sanitation Commission. The Delaware River and Bay are overseen by the Delaware River Basin Commission. Both of these agencies monitor sanitary conditions (bacteria), dissolved oxygen, nutrients, and toxic substances. Portions of the Raritan and Sandy Hook Bays as well as

Delaware Bay are also monitored by the Department's Bureau of Marine Water Classification and Analysis (see below).

The waters of the Atlantic Coastal Plain, both estuarine and coastal, as well as parts of Delaware Bay, are monitored principally by three networks overseen by the NJDEP: the Cooperative Coastal Monitoring Program, the Shellfish Growing Water Classification Program and the Marine and Estuary Monitoring Network. All three programs are discussed below.

Shellfish Growing Water Classification Program: N.J.S.A. 58:24 authorizes the Department to assess shellfish growing water quality and classify those waters for the harvest of shellfish. Pursuant to this the New Jersey Bureau of Marine Water Classification and Analysis (BMWC&A) monitors a network of approximately 2500 to 3000 stations at least 5 times per year for both fecal coliform and total coliform bacteria in order to assess the fitness of state waters for shellfish harvesting. The criteria for shellfish water quality is established by the Interstate Shellfish Sanitation Conference as part of the National Shellfish Sanitation Program. The BMWC&A monitors waters, both bay and coastal, from Raritan Bay down to Delaware Bay. Changes in water quality that affect shellfish classification status are incorporated into the administrative code at N.J.A.C. 7:12 et seq. and are published as a series of classification charts.

Cooperative Coastal Monitoring Program (CCMP): The CCMP is authorized by the County Environmental Health Act (N.J.S.A. 26:3A-21 et seq.) and is designed to monitor sanitary water quality (bacteria levels) in coastal waters with respect to both public health and water quality perspectives. The program is overseen by the New Jersey Department of Environmental Protection and the Department of Health and Senior Services in cooperation with the county health departments of Cape May, Monmouth, Atlantic, and Ocean, as well as the regional health agencies of Atlantic City, Long Beach Island, Long Branch, Matawan, and Middletown.

The program monitors bathing zone waters in the ocean and bay areas of the previously mentioned counties. Water column samples are taken once a week, May through September, from bathing-zone waters. In 1993 the program sampled a total of 180 ocean stations and 143 Bay stations for fecal coliform bacteria and enterococci. The CCMP sampling had been traditionally limited to coliform bacteria measurements. Recently, however, the CCMP has expanded its sanitary monitoring to include sampling for enterococcus bacteria.

New Jersey Marine and Estuarine Water Quality Monitoring Network: Historically, water quality sampling in the state's coastal waters has focused on sanitary quality (bacterial sampling) due largely to the intense concentration of recreational bathing and shellfish harvesting in New Jersey's coastal waters. Coastal monitoring efforts have expanded so as to encompass a wider range of water quality parameters.

This monitoring, performed by the Bureau of Marine Water Classification and Analysis, represents an effort by the State to provide baseline data on general

water quality throughout the state's coastal waters beyond traditional sanitary monitoring to include both conventional and toxic pollutants. The program covers all major bodies of saline waters, including the Atlantic Ocean to within two nautical miles of the coastline, through the use of over 200 sampling locations. All stations represent the preexisting shellfish sanitation monitoring network. Parameters sampled for include nutrients, DO, solids, salinity, fecal coliform bacteria, and ammonia. All samples are taken from the water column. No sediment sampling as yet is scheduled.

Other Monitoring

Lakes Monitoring: Most lake monitoring in New Jersey is conducted under the umbrella of the Clean Lakes program which monitors public lakes for the purpose of assessing trophic status. A detailed discussion is presented in Lake Water Quality Assessment, later in this chapter.

Coastal helicopter overflights: Daily helicopter observations are performed by the Department's Water Compliance and Enforcement Program during the bathing season. The program provides for a rapid assessment of coastal conditions which could impact bathing beaches such as the presence of floating material, pollution slicks, and algal blooms.

NJDEP/USEPA Cooperative New York Bight Water Quality Survey: The USEPA annually conducts monitoring of chemical and biological conditions in the New York Bight region from early April to late September. This sampling network performs bacteria, phytoplankton, and chemical monitoring along the coast out to nine miles offshore.

Compliance Monitoring

NJPDES Compliance Sampling: This is a continuing program of 24-hour compliance sampling at selected NJPDES facilities throughout the state to determine their compliance with permit conditions.

DRBC Compliance Sampling: This is a cooperative 24-hour sampling program carried out under a contract with the Delaware River Basin Commission on facilities located in the Delaware River drainage system.

Industrial Pretreatment 24-Hour Sampling Program: This program involves the sampling of certain municipal sewage treatment plants to determine what impact industrial effluents are having on municipal treatment systems.

Region-Specific Intensive Surveys/Special Studies

New Jersey Pinelands Surface Water Quality Monitoring Network: The Pinelands Commission and participating county health departments maintain a regional pinelands surface water quality monitoring and data management program. The objectives of the program are the collection, organization, and distribution of Pinelands surface water quality data. Water quality monitoring is performed at 214 stream stations located within Ocean, Burlington, and

Cape May Counties.

SURFACE WATER QUALITY ASSESSMENT METHODOLOGIES

In New Jersey, all freshwaters are assigned designated uses which reflect clean water swimmable and fishable goals of the Federal Clean Water Act. Swimmable implies that waters are to have a sanitary quality that will support primary contact recreation; this is the **primary contact designated use**. Fishable means that waters must be of a quality that supports a healthy and diverse community of aquatic life, and that the fish and shellfish harvested from these waters must be edible and free of pathogens and toxic substances. These are the **aquatic life support designated use** and the **fish consumption use,** respectively.

Most estuaries and all ocean waters (those classified SE-1 and SC-1) also have designated uses consistent with the clean water goals. Tidal waters in the New York Harbor area and the Delaware River around Philadelphia (SE-2 and SE-3 waters), however, are degraded to a degree that significant water quality improvements are not considered possible in the foreseeable future. Such waters are not required to meet clean water goals and their designated uses are less stringent than the goals. Refer to Chapter II, New Jersey Water Quality Standards: The Foundation of Water Resources Management, for further details regarding water quality standards.

Two levels of assessment are performed by the Department when appraising water quality as well as determining the causes and sources of water quality degradation. **Monitored assessments,** our principal methods, are those based on actual waterway sampling conducted within the past five years. **Evaluated assessments** are those based upon best professional judgment, the presence of known or potential pollution sources, fishery surveys, citizen complaints, or older monitoring data. These latter assessments are used when site-specific current monitoring data are unavailable.

Freshwater Physical/Chemical Data Evaluation

Physical/Chemical characteristics presented in this Report are drawn from an 84 (now 78) station fixed-location monitoring network, located in non-tidal portions of rivers and streams. Trend analyses presented here are based upon 79 stations. A host of water quality indicators are analyzed at each site and are used in this report to characterize water quality conditions. Parameters employed in these characterizations include: stream temperature, dissolved oxygen (concentration), biochemical oxygen demand, pH, specific conductance and dissolved solids, fecal coliform, total phosphorus, nitrogen-containing compounds (ammonia, nitrite-nitrate), and metals (arsenic, lead, mercury, cadmium, chromium, and copper). In order to supply sufficient data points, the computations involving water chemistry data in this Report use data collected over a continuous five year period, specifically data collected between 1991 through 1995, inclusive.

Factors that can impair a water's designated use are briefly described in terms of numerical criteria delineated in the Surface Water Quality Standards, or professional judgment based upon the characteristics of nonimpaired waters found within the state. Because of the extensive biological and fish tissue monitoring that occurs within the state, only the primary contact (swimming) designated use is determined using these data, specifically the fecal coliform bacterial data. Otherwise these data are used only to characterize waters and to delineate threatened status.

It needs to be noted that **heavy metals** data (except those collected for the Whippany River project) are analyzed as total recoverable and not just the dissolved fraction. In addition, field collection and preservation procedures are standard and not what are commonly termed "clean methods." By clean methods, we refer to procedures (mostly equipment cleaning methods) that are designed to avoid implanting a positive bias into samples at the ug/l level. This means that metal levels reported in this report (with the exception of the Whippany) may contain a positive bias and recorded violations of water quality standards noted in this report will need to be re-sampled at some point in time using the clean procedures to confirm the violations.

Physical/chemical **water quality in Pinelands** (PL) waters according to the NJ Water Quality Standards are "to be maintained in their existing state or that quality necessary to attain or protect the designated uses, whichever is more stringent." Except for some parameters such as pH and $NO_2 + NO_3$, specific numerical criteria are not provided in the Standards to assess water quality in PL waters. In an effort to assess these waters in the light of their "existing state," ambient monitoring data are:

1) contrasted with conditions regarded to be natural or "undisturbed" as based upon descriptions presented in Zampella (1994) and

2) compared in their current condition (1991-1995) to their state between 1975 to 1986 in light of their degree of disturbance observed during this earlier period as described by Zampella (1992).

Conclusions regarding attainment of the **swimmable designated use** (primary contact use) in freshwaters are based primarily on ambient monitoring results, specifically by the presence of fecal coliform bacteria. The criteria used to assign swimmable status were based upon New Jersey's numerical criteria for swimmable quality delineated in the Surface Water Quality Standards (N.J.A.C.7:9B) and operate in the following manner:

- If, over the five year period of monitoring (1991 to 1995, inclusive), fecal coliform geometric means are less than 200 MPN/100ml and individual measurements exceed the State criterion of 400 MPN/100 ml by no more than 10 percent of measurements, then the waters are deemed as **fully supporting swimmable use**.

- If individual fecal coliform samples exceed the criterion in greater than 10 percent of measurements, but the geometric mean is still less than 200 MPN, then waters are classified as **partially supporting swimmable use**.

- If the geometric mean exceeds 200, and the number of individual samples that violate the 400 MPN criterion exceeds 10 percent, then the waters are designated as **not supporting swimmable use**.

Comparisons between current swimming use attainment and past levels are not recommended due to a change that has occurred in the "swimmable" assessment methodology. In the past, assessing attainment of this use was based upon the percentage of violations of the 200 MPN criterion in individual samples, whereas the current methodology makes greater use of the geometric mean to determine use attainment. This change is designed to make swimmable assessments better conform to both the State's FW2 numerical criteria for primary contact recreation and the USEPA 305(b) guidance documentation. What has resulted is an increase in the number of locations that fully meet this use and a corresponding substantial decline in the number of stations that are assessed as not supporting swimming. For an accurate determination of the trends in sanitary quality, see "Changes in Water Quality Status in Rivers and Streams" discussed later in this Chapter.

It should be noted that regardless of the swimmable classification assigned to a stream, swimming is recommended only in those waters routinely monitored for bathing. Each monitoring station is thought to assess five stream miles (2.5 miles upstream and downstream). Primary contact use status in estuary and coastal waters was based upon the occurrence and frequency of bathing beach closures. Such closures are largely the result of violations of sanitary (fecal coliform) water quality (see NJDEP, 1997).

Freshwater Biological Data Evaluation

As stated above, ambient chemical monitoring is now extensively supplemented by biological assessments of in-stream macroinvertebrate communities. These biological assessments are used to directly assess the aquatic life support designated use and to reveal the impact of toxic contaminants. Achievement of the **aquatic life use** is supplemented with physical/chemical data in order to delineate a threatened status.

Protocol ratings of "no impairment" are judged to be fully supporting aquatic life use in this Report. Locations rated as "moderately impaired" are judged to be partially supporting use. No support of use is based upon a Protocol determination of "severe impairment." Because of this new methodology for determining attainment of the aquatic life use, certain waters that were formerly considered as fully supporting the use, based upon the older fin-fish assessments formally employed to assess use support, are now judged to be partially supporting, and vice versa.

The USEPA Protocol level employed is level II. USEPA Guidance for the 305(b) Report regards the strength of this level of assessment as "information level 2" (out of 4 levels), thereby having moderate level of environmental accuracy and discriminatory power. As a result, these assessments are regarded as screenings designed to determine where use impairment is likely. Locations assessed as impaired would need to be re-examined at some period in the future (during a site-specific watershed evaluation) to make a definitive determination of actual use impairment.

Tidalwater Data Evaluation

The results of physical chemical and biological monitoring are also utilized in characterizing estuarine and ocean water quality. These monitoring activities include a broad-based marine and estuarine water quality monitoring program (several parameters), shellfish harvesting water classification monitoring (bacteria), summertime bay and ocean beach sampling (also bacteria), and bay and ocean phytoplankton monitoring. In addition, two interstate agencies, the Delaware River Basin Commission (DRBC, 1996) and the Interstate Sanitation Commission (ISC, 1996a, b), perform monitoring of their respective waters which border on New Jersey.

Fish Consumption Status

The fitness of aquatic life for human consumption is also a measure of water quality. Degree of use support is based upon several sources of information that include shellfish sanitary classifications provided by the Bureau of Marine Water Classification and Analysis, and fin and shellfish tissue analyses performed by state and federal monitoring agencies.

The presence of toxic substances in lakes was examined in 1992-93 by the Academy of Natural Sciences working in conjunction with the NJDEP. The project collected fish tissue samples from New Jersey lakes, reservoirs, and rivers and analyzed the samples for mercury content.

Threatened Waters

Past Inventory reports have classified all New Jersey waters that do fully support their designated uses as threatened based upon the intensity of land use within the state, its dense population, economic pressures for development, and the ubiquitous nature of nonpoint source pollution. Under the watershed management approach being initiated by the Department, the threatened category will be redefined as - waters, that fully meet use, but where information indicates that future uses may be precluded if water management measures are not implemented. Because this re-application is still under going a Department review, it has not been applied to water quality assessments as an assessment category in this 1996 report, except for lakes, which are not assessed by the Office Of Environmental Planning. The term is still used, however, throughout this report in the descriptive sense.

RIVER AND STREAM WATER QUALITY

Water Quality

This section summarizes the quality of the freshwater rivers and streams in New Jersey and is based on detailed watershed assessments performed by the New Jersey Department of Environmental Protection. This report has assessed 390 monitored freshwater miles for primary contact use (swimming). Aquatic life support assessments are based upon 3815 monitored miles.

The freshwater river and stream mileage in the state which are supporting the primary contact use (swimmable use) and aquatic life use are presented in Table III-1 below.

TABLE III-1:

	DESIGNATED USE:	
ASSESSMENT CATEGORY	Primary Contact Recreation	Aquatic Life Support
Fully Supports:	100 (25.6%)	1350 (35%)
Partially Supports:	120 (30.8%)	2000 (53%)
No Support:	170 (43.6%)	465 (12%)
Total Miles Assessed:	390	3815

Note: Figures indicate linear stream miles; each monitoring location is assigned to be representative of five river miles. Percentages denote proportions taken from the total miles assessed for each designated use.

Of the total 390 linear stream miles monitored for primary contact use, 100 miles, or 26 percent, fully support the primary contact (swimmable) use (Table III-1). Another 120 linear miles (31 percent of assessed waters) partially support the use. Primary contact use is not supported in 170 miles (44 percent). High fecal coliform concentrations are the principal reason why so many waterways are not of swimmable quality.

The proportion of New Jersey's freshwaters supporting healthy and reproducing fish populations is slightly better (Table III-1). Of the approximately 3815 stream miles evaluated and monitored, 1350 miles, or 35 percent of assessed waters, are believed to be fully supporting the aquatic life use. Waters which have moderately degraded macroinvertebrate communities are considered to be partially meeting the aquatic life use; fifty-three percent of the assessed waters fall into this category. Only 12 percent are classified as not meeting the use, or in other words have severely degraded communities.

Comparison with prior assessments of the proportion of waters supporting the aquatic life use are not encouraged because different assessment methodologies are now employed to determine use attainment than were used in the past. Results on aquatic life support presented in the 1994 Inventory Report represent only part of the state, whereas the results presented here represent a complete state assessment. In 1994, extensive macroinvertebrate assessments had replaced many of the older fisheries surveys previously utilized. Still earlier editions of this report relied principally on water chemistry data before moving to fisheries surveys.

Changes in the assessment of the primary contact use have also made comparisons difficult. The Department has changed its criteria to better

conform to New Jerseys FW2 numerical criteria for primary contact recreation. These changes have significantly enlarged the number of river miles assessed as partially supporting the use, and they make comparisons with previous assessments misleading.

Sources and Causes of Water Quality Degradation in Freshwaters

The great majority of New Jersey's monitored freshwater streams contain elevated nutrients (phosphorus and nitrogen compounds) and bacteria (fecal coliform) levels. Table III-2 summarizes which pollutants are found in the state and their relative impact. The table indicates that nutrients, siltation and pathogens/bacteria are excessive in a majority of the monitored freshwaters. Other pollutants which are suspected of having statewide and significant impacts on water quality include organic enrichment/depressed dissolved oxygen levels, salinity, and oil and grease.

TABLE III-2. SUMMARY OF POLLUTANTS FOUND IN NEW JERSEY'S FRESHWATERS AND THEIR RELATIVE SIGNIFICANCE

Pollutant Categories	Major/Statewide Impacts	Moderate/Localized/Minor Impacts
Unknown Toxicity		?
Pesticides		X
Priority Organics		X
Nonpriority Organics		?
Metals		X
Ammonia		
Chlorine		?
Nutrients	X	
pH		X
Siltation	X	
Organic Enrichment/Dissolved Oxygen	X	
Salinity/Road Salts	?	X
Thermal Modification	?	
Flow Alteration		?
Habitat Alterations		X
Pathogens	X	
Radiation		?
Oil and Grease		?

Key:
? = Impact is suspected; however, monitoring data are lacking to substantiate the conclusion and its extent.

A number of other pollutant types are either known or suspected problems in the state. Known pollutants/water quality problems occurring in moderate to low levels statewide (or are locally significant) are certain pesticides, priority organics, metals, pH deviations, and temperature or thermal modifications. Most other categories of pollutants, as defined by USEPA (Table III-2), are suspected of being present in New Jersey's surface waters in small quantities. They include unknown toxic substances, nonpriority organics, and chlorine.

Habitat modifications and flow alterations also have impacts locally. Of note is the significant decline in ammonia toxicity compared to previous assessments. Ammonia was observed to be at toxic levels in some 14 percent of the monitored locations in 1992 but was found very infrequently during this assessment.

The actual source of these water quality problems is very difficult to assess. Table III-3 shows those pollutant source categories which are adversely affecting the state's freshwaters. No accurate quantification of the extent of these sources is currently available. This is because both point and nonpoint sources are present to some degree in practically every watershed in the state, and unless monitoring or predictive modeling is performed specifically for the purpose of defining pollutant inputs and stream response, such a determination cannot be correctly made. Even when modeling activities have been conducted in New Jersey, they have been usually directed towards specific applications such as wasteload allocations. As such, they analyzed low flow conditions and hence had been principally focused towards point source contributions.

In response to this concern, the Department is working with the USGS to evaluate the in-stream concentration and load characteristics of pollutants under varying flow conditions. This effort will isolate those watersheds where loading is largely dependent upon storm and higher flow conditions, from watersheds where loading is relatively constant under high and low flow. This will delineate nonpoint source dominated locations from point source dominated waters. In the middle will be a relatively large universe of locations somewhat equally dominated by both sources of pollution (point and nonpoint).

TABLE III-3. SUMMARY OF THE SEVERITY OF POLLUTANT SOURCES IMPACTING NEW JERSEY'S FRESHWATERS

Source Category	Major/Statewide Impacts	Moderate/Local/Minor Impacts
Point Sources:		
Industrial	X	
Municipal	X	
Combined sewer outfalls		X
Stormwater outfalls	X	
Nonpoint Sources:		
Agriculture	X	
Silviculture		X
Construction	X	
Urban Runoff	X	
Resource Extraction		X
Land Disposal	X	
Hydrologic/Habitat Modifications		X

Note: Sufficient information does not exist to quantify the extent of these pollutant source categories.

Generally, the 1,400 industrial and municipal wastewater discharges have significant impacts to water quality statewide. Nonpoint sources coming from urban runoff, construction activities, agricultural practices, and land disposal practices (including septic systems), are also extensive. In many instances, pollutants from these sources are released via stormwater outfalls. Other types of nonpoint sources found in New Jersey are more limited in scope and include silvicultural activities, resource extraction, and hydrologic/habitat modification. Combined sewer outfalls, surcharging sewage conveyance lines/pump stations and illegal discharges are also reported to be sources of water pollution in New Jersey. Note that formerly facilities in permit noncompliance were also a significant source of water impairment, however, this source has been almost completely eradicated by the Clean Water Enforcement Act.

The wet and dry deposition of air pollutants, including acid rain and possibly metals, is a pollution source whose significance is as yet unclear because of a lack of data.

Changes in Water Quality Status in Rivers and Streams

A trend analysis was applied to selected water quality constituents taken from 84 ambient monitoring sites sampled between 1974 and 1993. Results are summarized in table III-4 below. In terms of improvements in water quality, the study found widespread and significant declines in un-ionized ammonia, Kjeldahl nitrogen, total organic carbon and total phosphorus. On the reverse side, certain constituents that impair water quality showed widespread increases - fecal coliform bacteria, nitrate nitrogen, and chlorides. Some aspects of these trends combined with other trends assessments, notably Hay and Campell (1990), point to a reduction in the discharge of oxygen-demanding materials into the state's waterways. This is probably a result of improvements in the quality of point source discharges such as the upgrade of sewage treatment plants, which has led to the release of waste constituents in more oxidated states. Also influencing these observations may be the regionalization of sewage treatment plants whereby significant amounts of treated effluent are routed out to the ocean and to the lower Delaware River instead of being discharged into in-state freshwaters.

One must keep in mind that these trends delineated in Table III-4 represent the results of events that have occurred over a relatively long period of time. Various actions that would have brought about significant changes, both improvements as well as declines in various water constituents, would occur continuously throughout the period of record. In the meantime, other actions, such as regionalization projects would occur in short bursts. The sum total of these activities can or might be a series of either synergistic, or at other times contradictory activities that can make the analysis of these trends difficult.

The treatment plant upgrades and regionalizations that have occurred throughout the 1980s and early 1990s are believed to have dramatically improved water quality. The recent improvements in discharge compliance are also believed to have improved water quality on a local basis. But concurrent to these changes are expansions of suburban development, road expansion, localized increases in population, etc., and these can simultaneously contradict

water quality management efforts. This Department's response to this paradox is two fold.

- The first is to focus trend assessment efforts towards briefer and more recent time periods. The thought is that this will lead to a better understanding of the effectiveness of our current management efforts. It will also enable us to isolate the impacts of current pollution problems without the confounding influence of older, more historical factors.

- The second response is to perform problem assessments in a much more site-specific and detailed manner. In doing so, detailed analyses of all potential impairment sources, as well as local knowledge, history, etc., can all be brought to bear within the context of watersheds.

Table III-4 . Summary of Water Quality Trends for Selected Parameters. Number of stations out of 79 with statistically significant increasing or decreasing trends between 1974-1994

Parameter	# Stations with Increasing Trends (b)	# Stations with Decreasing Trend	Notes
Fecal Coliform	14	5	
Un-ionized Ammonia	9	42	Summer data only
Nitrate	46	5	
Total Kjeldahl Nitrogen	1	73	
Total Phosphorus	8	37	Assumes limiting nutrient
Copper	Not enough data	Not enough data	
Lead	Not enough data	Not enough data	
Mercury	Not enough data	Not enough data	
Chloride	70	4	Year-round data
Chloride	53	1	Winter data only
Total Organic Carbon	6	28	
Dissolved Oxygen	14	13	Summer data only
% DO Saturation	12	13	Summer data only
pH	39	1	
Suspended Sediment	Not enough data	Not enough data	

LAKE WATER QUALITY ASSESSMENT

In New Jersey there are 380 public lakes representing 24,000 acres. Water quality in these lakes is assessed principally through the Clean Lakes program, a program that is designed to help communities restore and maintain the recreational value of their local public lakes through the use of State and/or Federally funded grant projects. The program itself is implemented by the Department under the guidance of USEPA and is discussed in detail in chapter V within this report.

Out of the total number of lakes stated above, 126 lakes (with a total of 11,172 acres) have been evaluated for trophic status in New Jersey through the Clean Lakes Program thus far. Trophic assessments are based on Trophic State Criteria, as described in USEPA's Clean Lakes Program Guidance Manual. These criteria are total phosphorus, chlorophyll a, and Secchi disk transparency. Trophic status may also be determined by documented impairments caused by other factors such as excessive macrophyte populations, bacterial contamination, or sedimentation.

Currently, the focus of the Lakes Program has shifted from lake use restoration to resident fish-tissue analysis for toxic contamination. The current project assesses whole fish rather than edible portions; hence, fish consumption advisories cannot be initiated from this study. Rather, the effort is designed to detect the introduction of contaminants and to establish a baseline for future investigations into the bioaccmulation of toxic compounds within lake ecosystems.

Lake Quality Statewide

Lakes are regarded as eutrophic if total phosphorus levels are equal to or greater than 0.02 mg/l, and/or if macrophyte growth is extensive enough to impair recreational usage, and/or chlorophyll a levels exceed 10 ug/l. Of the lakes monitored, 123 (with a total acreage of 10,971) are considered to be eutrophic. The Department has taken the position that all of the state's public lakes are at the very least threatened with deteriorating water quality. For lakes that as yet have not been assessed, the official status assigned by the Clean Lakes Program is "Designated Water Quality Uses Threatened, Pending Further Information." Professional judgment combined with some limited data have caused the Clean Lakes Program to conclude that overall water quality in all of the state's lakes is either threatened or actively deteriorating. There is, however, not enough data to establish a strong statistical trend assessment for lake water quality. However, current information does suggest deteriorating water quality in all of the state's lakes.

Beginning in 1993, the Bureau of Water Monitoring (BWM) began a fish tissue collection and analysis survey. As stated earlier, this effort represents a redirection of the Lake Water Quality Assessment Project from its former focus on water column analysis towards fish tissue collection and analysis. A total of ten lakes have been assessed in 1993 and 1994. The lakes were:

LAKE NAME	COUNTY	LAKE NAME	COUNTY
Deal	Monmouth	Shepherd	Passaic
Greenwood	Passaic	Speedwell	Morris
Menantico Sand Pond	Cumberland	Splitrock Reservoir	Morris
Shaw's Mill	Cumberland	Stafford Forge	Ocean
Shenandoah	Ocean	Taylortown Reservoir	Morris

Two different species of fish were collected at each lake representing two stages on the food-chain. Largemouth bass were selected as representing predators, and black and/or brown bullheads were selected representing bottom feeders. Carp were taken when bullheads could not be captured or were not present. Each sample consisted of a total of 5 individuals of one particular species from one particular lake. Parameters were selected based on historical information regarding toxics found in fish tissue in this state as well as other surrounding states. The composite samples were analyzed for the following parameters:

Arsenic	Cadmium	Lead
Mercury	Selenium	Pesticide/PCBs
Base Neutral/Acid Extractable Organics		

Results are pending as of this writing.

The presence of toxic substances in lakes was also examined in 1992-93 by the Academy of Natural Sciences working in conjunction with the NJDEP. The project, titled Preliminary Assessment of Total Mercury Concentrations in Fishes from Rivers, Lakes and Reservoirs of New Jersey, collected fish tissue samples from New Jersey lakes, reservoirs, and rivers and analyzed the samples for mercury content. A copy of the report is available from the Office of the Director, Division of Science and Research, NJDEP. A summary of the findings is presented in "Toxic Substances" later in this chapter.

With regard to **acid precipitation**, the Clean Lakes Program does not directly monitor for nor address the effects of acidity in the state's lakes. However, a detailed discussion of acid precipitation and its overall effects upon state waters is presented in both the 1988 and the 1990 Inventory Reports. The reader is referred to these reports for such information.

COASTAL WATER QUALITY

The following is a description of the water quality as well as the sources and causes of water impairment of the coastal waters under the jurisdiction of the New Jersey Department of Environmental Protection. While the major responsibility for the identification of water quality problems lies with the NJDEP, there are large portions of this state's coastal waters that are under the watch of two interstate agencies: the Delaware River Basin Commission

(DRBC), and the Interstate Sanitation Commission (ISC). For a detailed assessment of the Delaware River and Bay, see Delaware River and Bay Water Quality Assessment (DRBC, 1996). Descriptions of Newark, Raritan, and New York Bays; the Hudson River; the Arthur Kill; and the Kill Van Kull are provided in Status Report on the Interstate Sanitation District Waters (ISC, 1996 a, b). These interstate agencies submit their own 305(b) reports separately to USEPA; hence, the reader is referred to these reports for more detailed information regarding these waters.

Coastal water quality monitoring historically has been conducted for several decades for limited parameters. In general, data collection had been restricted to coliform bacteria, salinity, and temperature data taken from shellfish harvesting areas and from bathing beaches. However, beginning in 1989 a Marine/Estuarine monitoring network was initiated. The study monitors several parameters on a quarterly basis taken from 200 stations in the marine and estuarine areas of the state (NJDEP, 1993b). Current use support assessments within the coast currently focus upon primary and secondary contact recreation, and shellfish and finfish restrictions.

Primary Contact Recreation

New Jersey ocean and bay waters are monitored for their sanitary fitness for primary contact recreation (swimming) by local environmental health agencies through the Cooperative Coastal Monitoring Program (CCMP). The program is, in turn, administered by the Department's Water Compliance and Enforcement Program.

Based upon the CCMP's assessments, the primary contact use support of New Jersey's waters can be summarized as follows:

> OCEAN: The Cooperative Coastal Monitoring Program (CCMP) monitoring results from the early 1980s up to 1996 indicate that the New Jersey coastal beaches from Sandy Hook south to Cape May are fully swimmable. Some beaches, however, are threatened by occasional short-term elevations of bacterial levels which have resulted in beach closures for brief periods.
>
> BAY AND ESTUARY: Beach closures in bay regions occur in such a manner that make generalizations difficult. It can be said that back-bay beach closures are a serious problem on a local basis. Some beaches are subjected to frequent short-term closures. Other locations have only occasional closures while some locations, not designated for swimming, have chronically elevated bacterial levels and do not support the primary contact use and would not support the use if they were designated swimming areas.

Bacterial monitoring along the coast for evaluating water quality in light of the surface water quality standards is performed during the bathing season and is summarized as the geometric mean of all samples collected during a season at each station. Expressed in these terms, the following percent of ocean and bay stations met water quality standards in 1994, 1995 and 1996:

Location	1994	1995	1996
Ocean	99.4%	98.8%	100%
Bay	95.8%	94.8%	96.9%

The data indicate that a substantial portion (all ocean in 1996) of the state's bathing beaches meet the water quality standards and are suitable for swimming. Beach closures do occur; however, in the ocean there appears to be a trend towards fewer widespread beach closures, with closings occurring as the result of sanitary problems that are even more local in nature (see Sources and Causes of Water Quality Degradation below). The table below illustrates the number of beach closures, ocean and bay, within the past 6 years and their causes:

OCEAN CLOSINGS:

Reasons	1996	1995	1994	1993	1992	1991
Bacteria	10	4	50	34	27	10
Floatables	0	0	0	0	0	0
Total	10	4	50	34	27	10

BAY CLOSINGS:

Reasons	1996	1995	1994	1993	1992	1991
Bacteria	75	73	171	54	84	97

Beach closure numbers have been proposed as an indicator of coastal water quality. In assessing coastal water quality strictly in these terms, it has been cautioned in the CCMP Report for the summer of 1992 that.....

> "The number and extent of beach closings alone do not conclusively demonstrate coastal water quality. Though beaches are closed when water quality problems ..... occur, the absence of beach closings does not establish that no such water quality problems exist. For example, a stormwater discharge could cause an excessive preliminary fecal coliform concentration at a monitoring station; however, if fecal coliform were dispersed before the confirming sample was taken, the beach would not be closed. In 1992, 38 preliminary samples from ocean stations exceeded the primary contact standard and were followed by confirming samples within the standard. For these reasons, the DEP recommends considering the bacterial data and the sanitary survey in conjunction with the data concerning beach closings in order to evaluate coastal water quality".*

* Cooperative Coastal Monitoring Program. The Annual Report for 1992 (NJDEP, 1993a).

Shellfish and Finfish Restrictions

The Department's Bureau of Marine Water Classification and Analysis (BMWC&A) monitors the sanitary quality of estuarine and ocean waters for the suitability of shellfish harvesting. Their criteria for determining shellfish growing water status is based on the presence of real or potential sources of contamination from both point and nonpoint discharges. The sanitary water quality is determined through actual measurements of coliform concentrations in the water column, through hydrographic (tracing), and through shoreline surveys.

In 1996, a total of 438 square miles of coastal (ocean) and 614 square miles of estuary and bay waters were assessed for sanitary fitness for shellfish harvesting. Of these totals, classifications are presented below:

BAY AND ESTUARY (as square miles):

Fully Supporting (but Threatened)	No Support	Partially Supporting	Total
458	43	113	614

OCEAN (as square miles):

Fully Supporting (but Threatened)	No Support	Total
340	98	438

See Chapter V for a detailed discussion of the overall shellfish monitoring program. Restrictions and alerts regarding the consumption of finfish due to toxic contamination within tidal and marine waters are presented in the section entitled "Fish Advisories" under the heading of "Toxic Substances," later in this Chapter.

Trends in Shellfish Harvesting Classifications

There has been a clear increase in the harvestable waters in New Jersey over the past 20 years. Figures III-5 and III-6 illustrate the trends in approved acres expressed as a percentage of total acres harvestable for the years 1976 to the present. Since 1976, the percentage of harvestable waters (waters classified as Approved, Restricted, Special Restricted, and Seasonal Restricted) has risen from just under 75 percent of total waters classified, to just over 86 percent as of 1996.

Table III-5: Classification Trends - Acreage Classifications In New Jersey Bays

DATE	APPROVED	CLOSED	RESTRICTED	SEASONAL	SEASONAL RESTRICTED	TOTAL
January 1976	280088	74951	28193	9620	0	392852
March 1977	281645	73394	28193	9620	0	392852

Table III-5 continued:

July 1978	281381	72902	27669	10900	0	392852
January 1979	276853	73170	27669	15160	0	392852
March 1980	276716	69276	26087	20773	0	392852
May 1981	278974	69149	25881	18848	0	392852
June 1982	278974	69510	25866	18502	0	392852
June 1983	278974	65323	25593	22962	0	392852
June 1984	281030	67010	11913	19899	13000	392852
June 1985	280287	67740	11833	19992	13000	392852
June 1986	280562	68139	11741	19410	13000	392852
Nov 1987	280339	36933	43205	19375	13000	392852
May 1988	280094	36653	42480	20625	13000	392852
July 1989	281440	36653	54900	19859	0	392852
August 1990	281380	33793	54550	23129	0	392852
January 1992	287852	27912	54893	22195	0	392852
January 1993	287596	27912	54866	22478	0	392852
April 1994	287774	27999	54779	22300	0	392852
December 1996	292843	27674	49611	22724	0	392852

Table III-6: Classification Trends - Acreage in New Jersey Ocean Waters:

Year	Approved	Closed	Restricted	Seasonal	Seasonal Restricted	Total
1976	185944	94764	0	0	0	280708
1977	184274	96434	0	0	0	280708
1978	179138	101570	0	0	0	280708
1979	186399	94309	0	0	0	280708
1980	195255	85453	0	0	0	280708
1981	198077	82631	0	0	0	280708
1982	198227	82481	0	0	0	280708
1983	200467	80241	0	0	0	280708
1984	203637	77071	0	0	0	280708
1985	204622	76086	0	0	0	280708
1986	203494	77214	0	0	0	280708
1987	203564	77144	0	0	0	280708
1988	202404	78304	0	0	0	280708
1989	202469	78239	0	0	0	280708
1990	205229	75479	0	0	0	280708
1992	211894	68814	0	0	0	280708
1993	213479	67229	0	0	0	280708
1994	213619	67089	0	0	0	280708
1996	217864	62844	0	0	0	280708

Sources and Causes of Water Quality Degradation

Tables III-7 and III-8 represent pollutants and pollution source categories, as defined by USEPA, that impact ocean waters. Pollutants and pollution source categories that impact estuarine water quality are denoted on Tables III-9 and III-10.

TABLE III-7: SUMMARY OF POLLUTANTS FOUND IN NEW JERSEY'S OCEAN WATERS[1] (SQUARE MILES)

Pollutant Categories	Major/Statewide Impacts Monitored	Major/Statewide Impacts Suspected	Moderate/Localized/ Minor Impacts Monitored	Moderate/Localized/ Minor Impacts Suspected
Unknown toxicity				?
Pesticides				?
Priority Organics	150			
Nonpriority Organics				
Metals		?		
Ammonia				
Chlorine				
Nutrients				270
pH				
Siltation				
Organics Enrichment/DO				270
Salinity/Road salts				
Thermal modification				
Flow alteration				
Habitat alterations				
Pathogens			?	
Radiation				
Oil and Grease				

Key: ? = Impact is suspected; a lack of monitoring data exists to substantiate the conclusion.
Footnote: 1 = Covers waters out to 3 miles.

TABLE III-8: SUMMARY OF THE SEVERITY OF POLLUTANT SOURCES IMPACTING NEW JERSEY'S OCEAN WATERS[1] (SQUARE MILES)

Source Categories	Major/Statewide Impacts Suspected	Moderate/Localized/ Minor Impacts Suspected
Point Sources		
Industrial	?	
Municipal		270
Combined sewer outfalls		120
Stormwater outfalls		
Nonpoint Sources		
Agriculture		120
Silviculture		
Construction		
Urban Runoff		120
Resource Extraction		
Land disposal		
Hydrologic/habitat modifications		

Key: ? = Impact is suspected; a lack of monitoring data exists to substantiate the conclusion.
Footnote: 1 = Covers waters out to the 3 mile limit.

TABLE III-9: SUMMARY OF POLLUTANTS FOUND IN NEW JERSEY'S ESTUARIES (SQUARE MILES)

Pollutant Categories	Major/Statewide Impacts Monitored	Major/Statewide Impacts Suspected	Moderate/Localized/ Minor Impacts Monitored	Moderate/Localized/ Minor Impacts Suspected
Unknown toxicity				?
Pesticides	70			
Priority Organics	70			
Nonpriority Organics				?
Metals				?
Ammonia				
Chlorine				
Nutrients	70	?		
pH				
Siltation		140		
Organics Enrichment/DO		?		
Salinity/Road salts				
Thermal modification				
Flow alteration				
Habitat alterations				
Pathogens	142			
Radiation				
Oil and Grease				?

Key: ? = Impact is suspected; a lack of monitoring data exists to substantiate the conclusion

TABLE III-10: SUMMARY OF THE SEVERITY OF POLLUTANT SOURCES IMPACTING NEW JERSEY'S ESTUARIES (SQUARE MILES)

Source Categories	Major/Statewide Impacts Suspected	Moderate/Localized/ Minor Impacts Suspected
Point Sources		
Industrial	?	
Municipal	140	
Combined sewer outfalls		
Stormwater outfalls	140	
Nonpoint Sources		
Agriculture	70	
Silviculture		
Construction	140	
Urban Runoff	140	
Resource Extraction		
Land disposal		?
Hydrologic/habitat modifications		

Key: ? = Impact is suspected; a lack of monitoring data exists to substantiate the conclusion.

Ocean Waters

Ocean beach closures in New Jersey represent short term responses to very local events that bring about elevated ambient fecal coliform levels. In turn, the principal source for elevated bacterial levels affecting these beach closures is stormwater discharge along the coast as suggested by Cooperative Coastal

Monitoring Program (CCMP) data (NJDEP, DRAFT 3-year CCMP report, 1994; 1995; 1996, D. Rosenblatt personal communication). The significance of sanitary conditions in beach closures can be seen in the draft 3-year CCMP report for 1994, 1995 and 1996. During the 1994 summer season, 44 of the 50 ocean beach closures were reported to be due to stormwater discharges during rain events that resulted in elevated ambient coliform levels. Four closures were brought about by large concentrations of birds roosting along a pier in Seaside Heights (bird feces causing elevated fecal coliform levels). The remaining two closures in Spring Lake were due to excessive bacterial concentrations from an unknown source. In 1995 two of the four ocean beach closures were due to rain events and two were caused by excessive bacterial concentrations from an unknown source. A similar pattern was observed in 1996. There have been no beach closures due to floatable debris washing up on beaches in the past six years.

The regionalization of sewage treatment along the New Jersey coast has improved bay and estuary water quality, yet maybe also responsible for greater amounts of nutrients and oxygen-demanding materials being discharged to open ocean waters. There is concern that these sources, in concert with tributary inputs, the disposal of dredged materials, and the outflow from the Hudson/Raritan estuary, are all contributing to the gradual enrichment of our coastal waters, leading perhaps to more extensive benthic anoxia (very low dissolved oxygen levels) in the summer, and to phytoplankton blooms of ever increasing intensity and frequency.

Estuarine Waters

The degraded water quality occurring in the New Jersey-New York interstate waters as well as in the tidal Delaware River near Philadelphia is primarily due to the large amount of untreated wastewaters still being discharged to these waters during wet weather via CSOs. A use attainability study (NJDEP, 1985) determined that even with the projected improvements in sewage treatment from New York and New Jersey facilities, pollution from nonpoint sources and combined sewer outflows, together with high benthic oxygen demands, will continue to severely stress these waters.

Bacterial contamination in estuarine waters monitored by the CCMP, specifically the Atlantic Coastal Basin and some Delaware Bay estuaries, is closely tied with stormwater discharges and overland nonpoint source runoff. Bay beach closures that occurred are primarily due to bacterial loadings carried in stormwater discharges during rainfall. This stormwater effect on the fecal coliform concentrations in the bays can be further compounded by the bacterial loading from the illegal discharge of marine sanitation devices on boats, the presence of large wildlife populations, and the resuspension of sediments by boat-created turbulence.

The Department's Bureau of Marine Water Classification and Analysis agrees that based upon its observations, stormwater serves as a significant source of bacterial contamination, and that natural sources such as waterfowl populations often are significant additional contributors to the overall problem. The Department also suspects that additional bacterial contamination is coming from tributary inputs to the bays. These tributary inputs carry additional runoff and septic tank leachate from sources upstream.

While the Department is encouraged by recent gains in water quality and the associated improvements in coastal water classifications, there are, nonetheless, concerns for the immediate future. There continues to be extensive building pressure for commercial, residential, and industrial facilities in coastal communities. The major concern regarding this construction is the degraded stormwater runoff that is associated with developed areas. Of concern, also, are the presence of marinas and the grouping of boat docking facilities, and their corresponding impacts upon shellfish harvesting water quality and habitat. Water quality gains resulting from the regionalization of wastewater treatment could be negated through extensive new construction and its associated runoff. The estuarine waters of the coastal areas which are jeopardized by this development are often among the most productive in the state.

TOXIC SUBSTANCES

Up until 1991, the NJDEP maintained an ongoing program assessing waters where impairment is suspected due to toxic discharges from point sources. Toxic discharges as defined here are what USEPA has defined as the 126 "priority pollutants." These assessments are now supplemented with current fish-tissue surveys and instream biological community assessments. Tables in this section represent the current list of waterbodies suspected of being impaired by toxics. With the exception of the fish consumption advisories, use impairment in most of these waters is currently only suspected; these are not necessarily waters with known problems.

Waters where designated use impairment is suspected due to toxic discharges from point sources. This list is based upon violations of USEPA's Federal acute toxicity criteria as observed in Discharge Monitoring Reports in concert with ambient monitoring water quality data from the receiving water in question.

Waterbody Name	Waterbody Description
Hackensack River	From the Oradell Reservoir to the confluence with Newark Bay.
Upper New York Bay	From the confluence of the East River to the confluence with the Kill Van Kull.
Newark Bay/Arthur Kill	From the confluence with the Passaic and Hackensack Rivers to the confluence with the Rahway River and the confluence with the Upper New York Bay.
Arthur Kill	From the confluence of the Rahway River to the confluence with the Raritan River Bay.

Raritan Bay	From the confluence of the Arthur Kill/Raritan River to the confluence with the Waackaack Creek.
Lower Millstone River	From the confluence with Bedens Brook to the confluence with the Raritan River.
Mid Millstone	From the confluence with Stony Brook to the confluence with Bedens Brook.
Lower Pequest River	From the confluence with Bear Creek to the confluence with the Delaware River.
Passaic River	From the confluence of the Dead River to the confluence with the Whippany River.
Raccoon Creek	From the confluence with the South Branch Raccoon Creek to the confluence with the Delaware River.
Kings Creek	From the headwaters to the confluence with the Rahway River.
Hudson River	From the New York/New Jersey State boundary to the confluence with the East River.

The following are stream locations where toxic contaminants are suspected of impairing waters based upon biological monitoring evidence. Such evidence is either a significant number of physical abnormalities detected on the bodies of aquatic insects collected and/or an unexplainable low number of organisms present at the study site.

Water Way	**Location**
Wallkill River	Sussex
Clove River	Rose Marrow Road
West Branch of Papakating Creek	Blumbsock
Ramsey Brook (trib. to Saddle River)	Mahwah
Valentine Brook (trib. to Saddle River)	near Allendale
Valentine Brook (trib. to Saddle River)	Allendale
Hohokus Brook (trib. to Saddle River)	Allendale and Ridgewood

Saddle River	Ridgewood, Rochelle Park, and Garfield
Whippany River	Hanover Twp.
Bear Brook (trib. to Millstone River)	Entire length
Stony Brook (trib. to Millstone River)	Princeton
Millstone River	Blackwells Mills, and Manville

The following lakes have been reported by the USEPA (Alcyon Lake) and NJDEP (remaining four lakes) as being affected by toxic substances:

Lake	Area(acres)	Source
Alcyon Lake	30	Landfill (Superfund site)
Newton Lake	30	Unknown
Cooper River Lake	150	Unknown
Strawbridge Lake	25	Unknown
Stewart (Woodbury) Lake	45	Unknown

Fish and Shellfish Consumption Advisories

Ocean: The NJDEP in the recent past has found high levels of PCBs and certain pesticides (primarily chlordane) in finfish from New York-New Jersey interstate waters. As a result, recreational fishing advisories have been issued by the State for striped bass and bluefish taken in New Jersey territorial ocean waters from Barnegat Inlet northward (NJDEP, 1990).

Freshwater/Estuary: The NJDEP has found high levels of PCBs and certain pesticides (primarily chlordane) in finfish taken from the following state and interstate waters (NJDEP, 1990, 1993c):

Arthur Kill	Tidal Passaic River
Kill Van Kull	Tidal Raritan River
Hudson River	Tidal Hackensack River
Lower Cooper River	Mainstem Pennsauken Creek
Raritan Bay	Sandy Hook Bay
Newark Bay	So. Branch Pennsauken Creek

As a result, commercial fishing bans and recreational fishing advisories have been issued by the State for these waters. Recommendations to limit consumption are in effect on striped bass, bluefish, white perch, white catfish, and American eel. Commercial sale of striped bass and American eel taken from most of these waters is prohibited.

Extensive sampling has turned up widespread dioxin contamination in certain finfish and crustaceans in both the tidal Passaic River and New York Bight Apex waters. Because tissue concentrations of dioxin above the U.S. Food and Drug Administration's "level of concern" were identified, the State of New Jersey has ordered a prohibition on the sale and consumption of all fish and shellfish taken from the tidal Passaic River. The ban includes striped bass and blue crabs from Newark Bay, tidal Hackensack River, Arthur Kill, and Kill Van Kull.

Recent studies (1993) have encountered fish contamination in regions outside the areas currently covered by fishing advisories mentioned above. These areas are the Passaic River at Elmwood Park and at the Pompton River (PCBs in carp), Raccoon Creek near the Delaware River (PCBs in one Brown Bullhead), and a stretch of the Atlantic Ocean between Seaside Park and Brigantine (PCBs in striped bass). It has been recommended by the Department's Division of Science and Research that additional studies be performed in order to clarify the degree of contamination within these areas, as well as other regions not currently under fishing advisories.

The sources of these PCBs in the state's waters include direct discharges, tributary loads, dredged spoils, ocean dumped sewage sludge (now historic). It should be noted that PCBs are not widely distributed in high concentrations statewide, but are encountered in high concentrations in the sediments within the New Jersey metropolitan areas.

The Department has also recently issued consumption advisories on pickerel and largemouth bass in certain freshwater bodies listed below where elevated levels of mercury have been found in fish tissue. It is important to note that although data do show elevated levels of mercury in fish taken from the waterbodies listed, water from the drinking-water supply waterways listed here remains safe to drink.

In general, the advisories range from "no consumption" to consumption rates of once per week. The most restrictive consumption advisories apply to those segments of the population most at risk to mercury: pregnant women, women planning pregnancy within a year, nursing mothers, and children under five years old. Readers are referred to the report entitled Mercury Contamination in New Jersey Freshwater Fish. Report of the Toxics in Biota Committee, dated July 1994 and issued by the Department's Division of Science and Research for details regarding these advisories.

Mercury contamination in fish tissue represents a national problem, with New Jersey joining 32 other states that have enacted similar mercury advisories. Many sources for the mercury are suspected; environmental mercury has many origins and because it is an element, it does not degrade with time but can instead cycle and change its form with time. Known sources of mercury on a nation-wide basis include geologic weathering, agricultural pesticides, atmospheric deposition from coal and oil-fired furnaces and waste incinerators. Other sources are consumer products such as batteries, electric lights, paints, and thermometers, etc., which become part of the waste stream and can end up in landfills and/or incinerators (NJDEP, 1994).

Waterways with Advisories on Largemouth Bass: Studies have indicated that largemouth bass from the following waterways have elevated levels of mercury in their tissue (NJDEP, 1994).

Batsto Lake	Lake Carasaljo	Wanaque Reservoir
Monksville Reservoir	Clinton Reservoir	Woodstown Mem. Lake
Union Lake	Maskells Mill Pond	Atlantic City Reservoir
Carnegie Lake	Spring Lake	Assunpink Lake
Manasquan Reservoir	Merrill Creek Reservoir	Mountain Lake
Delaware R (Easton-Trenton)	Dundee Lake	Pompton Lake
Delaware R (Trenton-Camden)	Cooper River Park	Shadow Lake
Passaic R. (Great Piece)	Rockaway River	Lake Hopatcong
Round Valley Reservoir	Mirror Lake	Alcyon Lake
Spruce Run Reservoir	Big Timber Creek	Crosswicks Creek
Crystal Lake	Canistear Reservoir	

Waterways with Advisories on Chain Pickerel: Studies have indicated that chain pickerel from the following waterways have elevated levels of mercury in their tissue (NJDEP, 1994).

East Creek Lake	Harrisville Lake	Mullica River
Batsto Lake	Batsto Lake	Union Lake
Lake Nummy	Monksville Reservoir	Wading River
New Brooklyn Lake	Wilson Lake	New Brooklyn Lake
Stafford Forge	Lake Carasaljo	Cranberry Lake
Wanaque Reservoir	Maskells Mill Pond	Lake Lenape
Assunpink Lake	Lake Hopatcong	Alcyon Lake
Rockaway River	Mirror Lake	Swartswood Lake
Stanfford Forge		

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Chapter IV

Ground Water Quality and Management

OVERVIEW

Ground water is an extremely important resource for the people of New Jersey. It provides approximately 40 percent of the state's potable water, with 31 percent coming from public-supply wells and 9 percent from domestic-supply wells (Hoffman and Mennel, 1997). It also provides baseflow to streams and is intimately associated with the ecology of the state's wetlands. New Jersey has regulations and programs aimed at protecting this precious resource. This chapter summarizes information on the state's ground water quality, quantity, and protection programs. Note that a description of the **ground water quality standards**, a significant aspect to the DEP's ground water quality management effort, is contained in Chapter 2 of this report.

QUANTITY STATUS

The available data suggest that at present there is an ample supply of good quality ground water in most of the State of New Jersey. However, ground water quantity (and quality) problems are usually concentrated in areas where the greatest volumes of ground water are needed. For example, ground water pollution and over-pumping are usually concentrated in areas with high suburban population densities as well as in some agricultural areas. Over-pumping in these areas has created hydraulic gradients that sometimes result in the recharge of aquifers from undesirable sources such as seawater, polluted surface waters, or severely contaminated ground water. Proper management of ground water resources in these areas is critical to insure a constant supply of good-quality water. Also, the statewide impact of ground water quality degradation from nonpoint sources of pollution, such as agricultural areas, has not been fully assessed. Studies leading to a better understanding of the state's ground water resources are being conducted to guide management practices.

QUALITY STATUS

Note: Discussions of pollution levels in this chapter will be based largely upon criteria established by the New Jersey Safe Drinking Water Act and its subsequent amendments unless otherwise stated.

Pollutants enter the ground water system either by migrating from, at or near the surface down through the unsaturated zone or by being directly discharged into the saturated zone (e.g., septic systems, leaking underground storage tanks). The unconfined aquifer is usually the first aquifer affected and may be the only one impacted depending on the hydrogeologic setting and the physical and chemical character of the contaminant. If ground water flows downward and/or contaminants sink because of their density, confined units may also be affected.

Ground water quality in New Jersey is assessed for potability, as are surface waters, by means of the **primary and secondary drinking water standards**. Primary standards are directed to constituents that have the potential to impair the health of the water consumer. Secondary standards establish acceptable levels for those constituents that affect the aesthetic quality of the water, those that might for example impact the water's taste and odor. **A more complete discussion of standards for groundwater in New Jersey appears in chapter 2 of this report.**

Natural ground water quality throughout the state is generally good for most purposes. Treatment for some undesirable naturally occurring contaminants and characteristics is needed, however, in some areas due to the physical and chemical nature of geologic materials comprising the aquifer. The most widespread violations of standards for naturally occurring contaminants involve the State's recommended secondary drinking water regulations. These contaminants include iron, total dissolved solids, sulfate and hardness. Less common, yet significant naturally occurring contaminants that violate drinking water regulations include, manganese, corrosivity, and chloride.

Anthropogenic contaminant discharges to ground water do occur and have an impact upon ground water quality, the full extent of which is not yet fully determined. Current data regarding sources and causes of ground water impairment are not computerized so are not in a form that facilitates a rapid state-wide assessment. Older data, collected in the late 1980s in seven of the state's twenty-one counties, has been computerized and assessed by the Department, and has provided clues as to pollution sources, at least within the counties studied. This information has been reported in detail in previous Inventory Reports and is summarized in the following paragraphs.

These assessments found the distribution of the pollution cases to be directly proportional to the population density within the counties studied. Of the 1,200 pollution cases, more than 40 percent had unknown pollution sources. Of the known sources, underground storage tanks (USTs) affected the most wells (405). Industrial and commercial septic systems affected a disproportionately large number of wells (202), considering the total number of septic system cases reported in the study. Landfills, surface spills, lagoons, and industrial or commercial septic systems each accounted for at least 5 percent of all cases.

The study failed to clarify the role of agriculture in ground water pollution. Only one agricultural pollution case was listed out of a total of 1,200 cases. However, data gathered from pesticide and nutrient studies clearly showed that there were violations of the State's drinking water quality regulations in the ground water due to agricultural inputs. The existence of pesticides in ground water clearly implicate agricultural inputs as a likely source of contamination; however, the extent of their contribution is not clear.

The most common pollutants encountered in the ground water investigations performed in the late 1980s were: volatile organic compounds (VOCs), metals, base neutrals, acid extractables, and PCBs/pesticides. Of all the investigations where ground water was sampled for VOCs, 87.4 percent were positive, a far greater percentage than the next two highest: base neutrals and metals with 58.3 percent and 55.0 percent respectively. Landfill

contaminants, undifferentiated petroleum hydrocarbons, gasoline and fuel oil also ranked high in the long list of ground water pollutants.

The status of current ground water quality conditions is unclear. Since these data were reported (1990), six years of remediation efforts have been instituted by this Department. Arnold Schiffman, formerly a special projects manager within the Division of Publicly Funded Site Remediation (personal communication), felt in 1992 that underground storage tanks may still be responsible for the greatest number of ground water pollution cases within the state even though they have declined in absolute numbers. This is because, most likely, all contamination sources have declined in number through the replacement of leaking tanks and the cleaning up of contaminated sites. Industrial/commercial septic systems cited in the 1990 data base have largely been eliminated due to the liability associated with contaminated ground water and the restrictions on permits for these systems. Mr. Schiffman had stated that although the absolute numbers of pollution sources have changed as a result of remedial actions, the relative importance of pollutants and their sources may have remained much the same, with some exceptions, as the rankings seen in 1990.

GROUND WATER IN THE STATE'S PHYSIOGRAPHIC PROVINCES

New Jersey has four geomorphologically distinct physiographic provinces, each having distinctive rocks and land-forms, covering the state's approximately 7,500 square miles (figure IV-1a). They are from south to north: the Coastal Plain, Piedmont, Highlands, and Valley and Ridge. There are general geologic structure and rock-type differences between each physiographic province which makes them hydrogeologically distinct from one another. In addition, the northern provinces contain glacially deposited materials which have a unique hydrologic character. The geology, hydrology, and water quality characteristics of each province, and the glacial deposits, are discussed below. Aquifers associated with these provinces are illustrated in figure IV-2 (and for the cross-sectional Coastal Plain in figure IV-1b).

Beginning with this Inventory Report, detailed descriptions of ground water within the state's principal physiographic provinces will be presented, with one province being the focus of each of a succession of reports. This 1996 report will initiate this cycle by discussing the **Newark Basin**, which comprises much of the Piedmont physiographic province within New Jersey. This report will begin by briefly describing the ground water quality of the Coastal Plain, Highlands, and Valley and Ridge physiographic provinces. These summaries will be followed by a more detailed discussion of ground water quality within the Newark Basin.

Coastal Plain

The Coastal Plain is the largest of the physiographic provinces in New

Figure IV- 1a

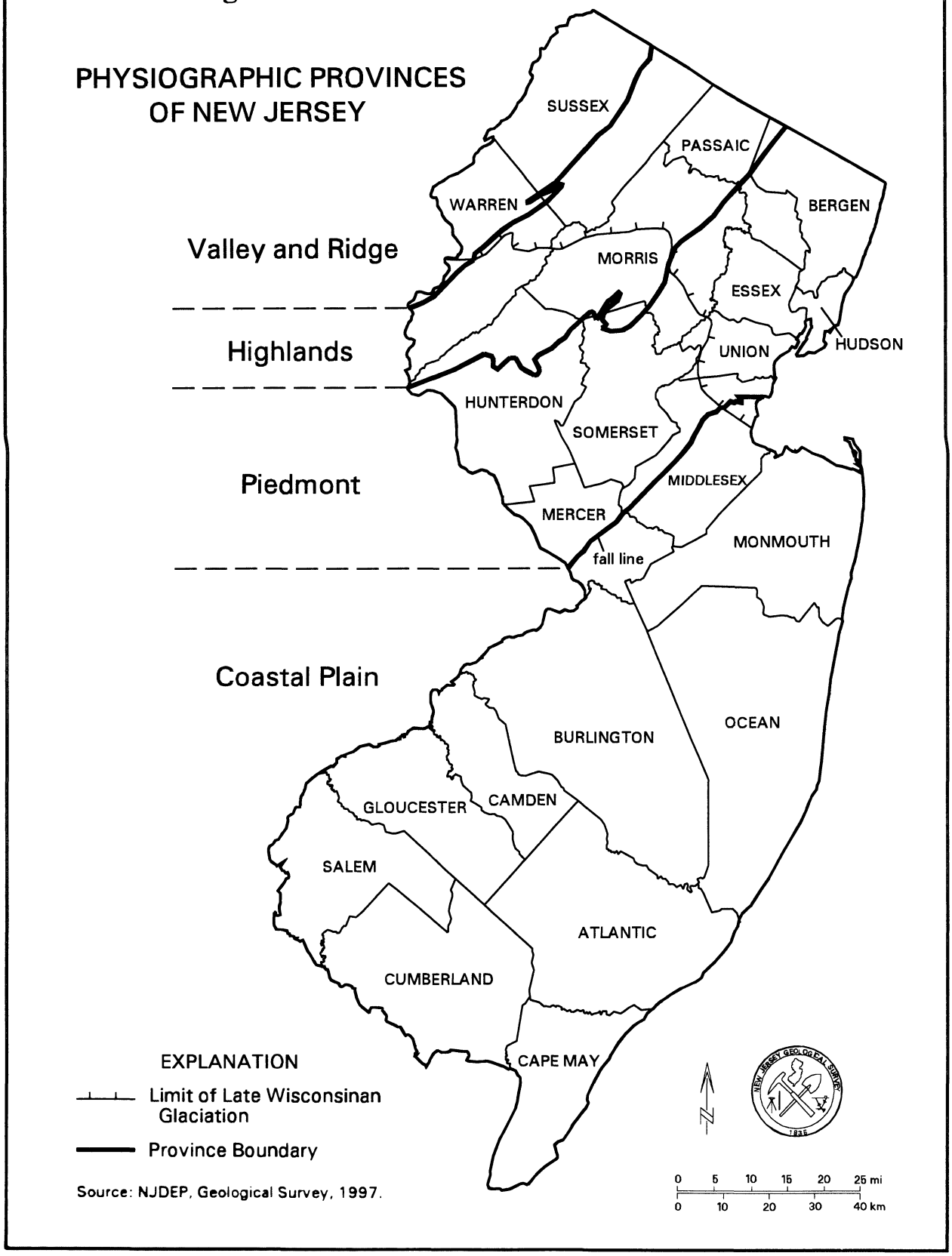
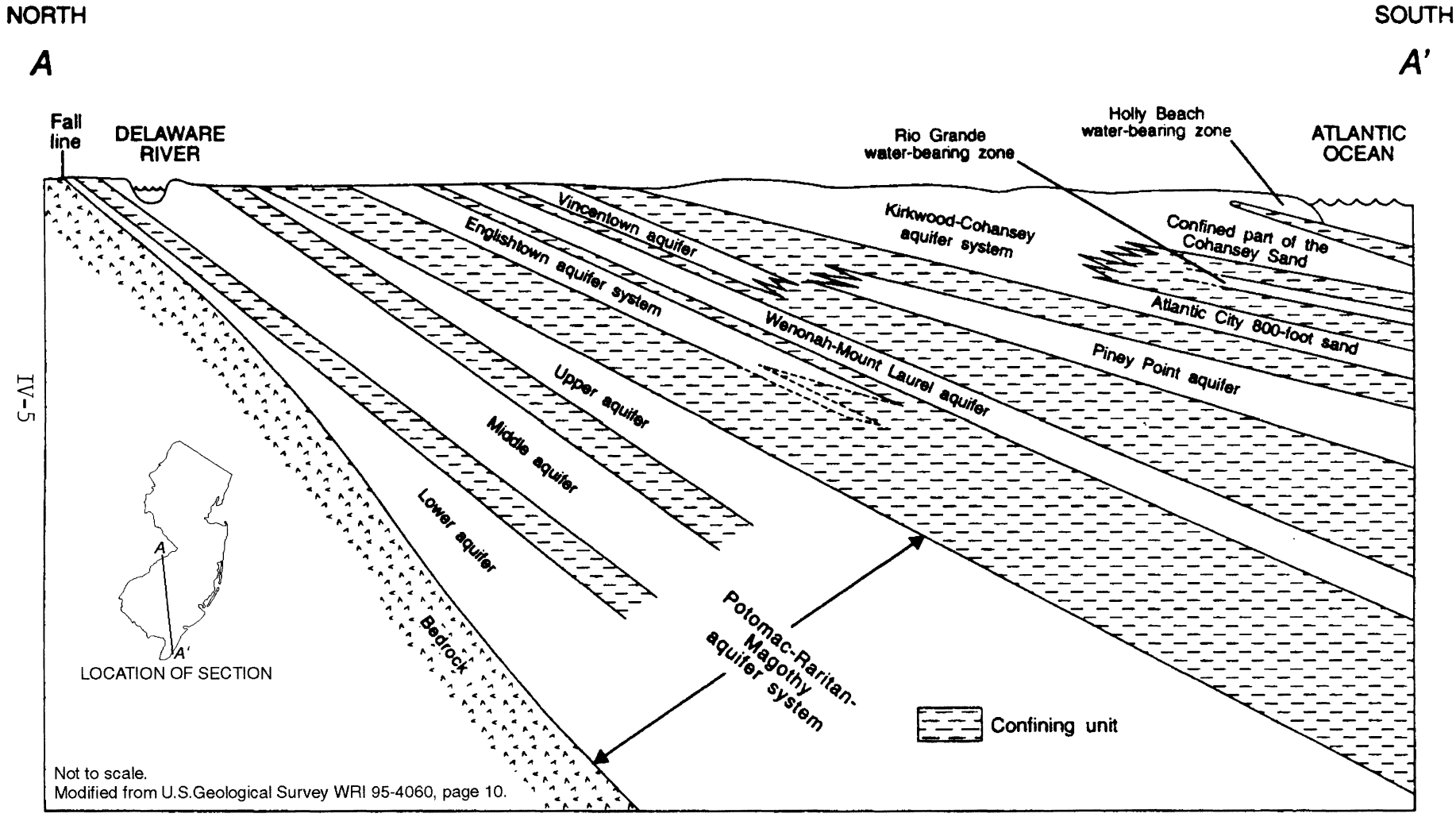

PHYSIOGRAPHIC PROVINCES
OF NEW JERSEY
Valley and Ridge
Highlands
Piedmont
Coastal Plain
fall line
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
UNION
HUDSON
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
MONMOUTH
OCEAN
BURLINGTON
GLOUCESTER
CAMDEN
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
EXPLANATION
Limit of Late Wisconsinan Glaciation
Province Boundary
Source: NJDEP, Geological Survey, 1997.
N
0 5 10 15 20 25 mi
0 10 20 30 40 km

Figure IV-1b

DIAGRAMMATIC HYDROGEOLOGIC CROSS SECTION OF THE NEW JERSEY COASTAL PLAIN.



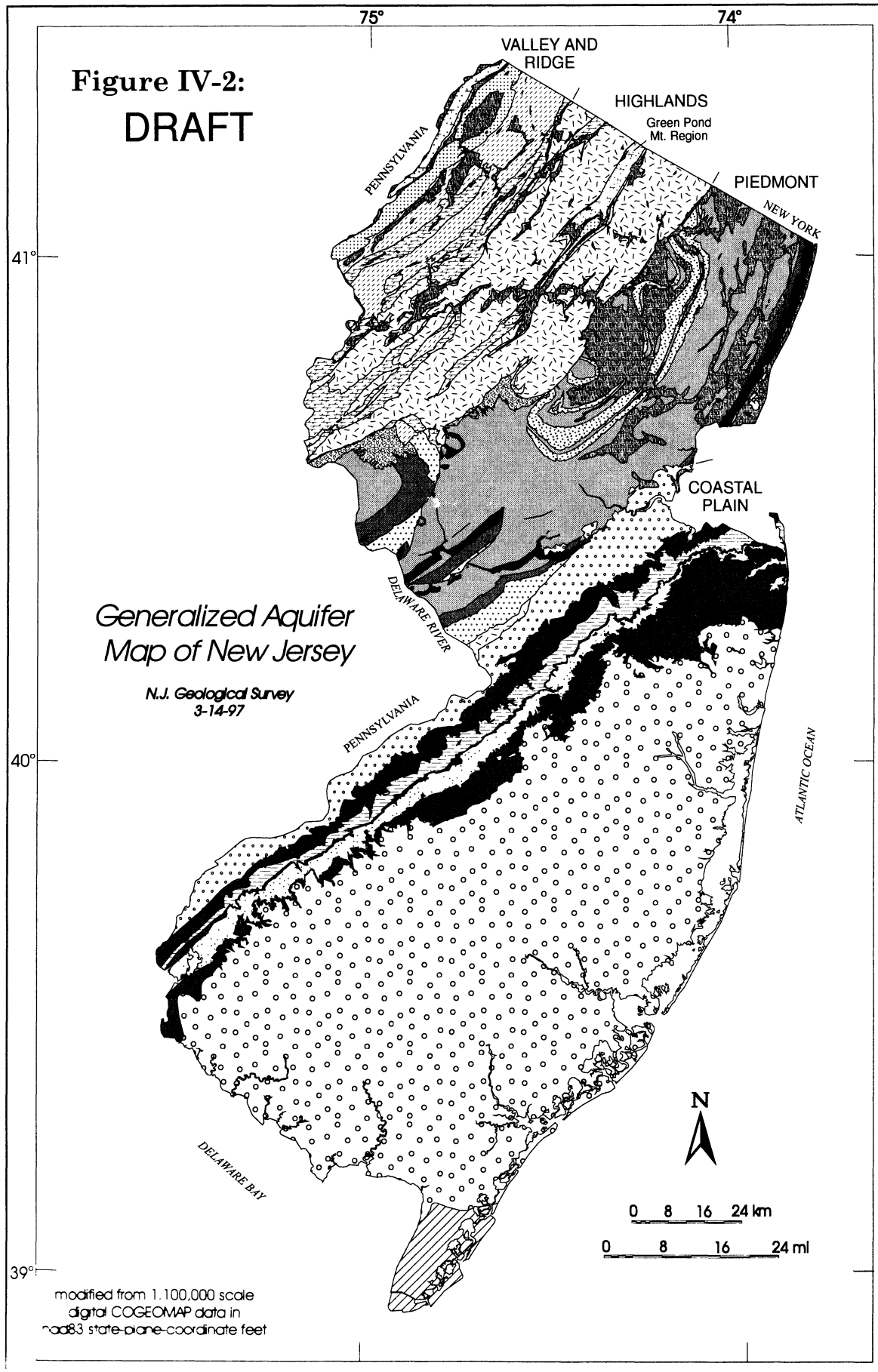


Figure IV-2:
DRAFT
75°
74°
VALLEY AND RIDGE
HIGHLANDS
Green Pond Mt. Region
PIEDMONT
PENNSYLVANIA
NEW YORK
41°
COASTAL PLAIN
DELAWARE RIVER
Generalized Aquifer Map of New Jersey
N.J. Geological Survey
3-14-97
PENNSYLVANIA
40°
ATLANTIC OCEAN
N
0 8 16 24 km
0 8 16 24 mi
DELAWARE BAY
39°
modified from 1:100,000 scale
digital COGEOMAP data in
nad83 state-plane-coordinate feet

DESCRIPTION OF AQUIFERS AND CONFINING UNITS

UNCONSOLIDATED AQUIFERS OF THE COASTAL PLAIN

BEDROCK AQUIFERS OF THE PIEDMONT, HIGHLANDS, AND VALLEY AND RIDGE

Peistocene Glacial Sediments - Till and stratified deposits of sand, gravel, and lake-bottom sediments that exceed 50 ft thickness. Inlcudes glacial fans or deltas, fluvial outwash, ice-contact and morainal deposits. Primary intergranular porosity and permeability. Average yield of high-capactity wells in sands and gravels approximately 525 gpm. Ground-water quality varies with the sedimentary texture and mineral content. Average ground water is fresh, slightly alkaline, moderately-hard to hard, and of the calcium-bicarbonate type.

Tertiary Sand and Gravel Aquifers near Cape May - Sand and gravel deposits of the Beacon Hill Gravel, Bridgeton Formation, and Cape May Formation. Water-table aquifers. Primary intergranular porosity and permeability. Average yield of high-capacity wells in Cape May Formation is approximately 220 gpm Ground-water quality is similar to the unconfined portions of the Kirkwood-Cohansey aquifer system.

Tertiary Kirkwood-Cohansey Aquifer System - Sand, gravel, and clay. Includes water table aquifer, confined Kirkwood aquifers (Atlantic City 800-foot sand aquifer and Rio Grande water-bearing zone), and confined Cohansey aquifer in Cape May County . Primary intergranular porosity and permeability. Leakage to confined parts provides water. Average yield of high capacity wells is approximately 390 gpm Average ground water is fresh, acidic, highly corrosive, and has low dissolved solids. Less corrosive water is common in confined aquifers. High iron and magnanese problems locally. Salinity may be elevated in confined parts near coastal areas. Sodium chloride type water is common.

Cretaceous Mount Laurel-Wenonah Aquifer - Glauconitic sand overlying micaceous sand. Unconfined in outcrop and confined in the subsurface. Primary intergranular porosity and permeability. Leakage to confined parts provides water. Average yield of high-capacity wells is approximately 200 gallons per minute. Average ground water is fresh, moderately hard and alkaline. Iron levels may be elevated. Calcium and magnesium levels decrease with depth while sodium and potassium levels increase. Calcium-bicarbonate type waters dominate.

Cretaceous Englishtown Aquifer System - Upper and lower sand with localized clay beds. Unconfined in outcrop and confined in the subsurface. Primary intergranular porosity and permeability. Leakage to confined parts provides. Average yield of high-capacity wells approximately 290 gpm. Average ground water is fresh, moderately hard and is alkaline. Salinity, sodium, and potassium levels increase with depth. Calcium and magnesium levels decrease with depth. Locally elevated Iron and manganese levels. Calcium-bicarbonate type waters dominate.

Cretaceous Potomac-Raritan-Magothy Aquifer System - Interbedded sand, gravel, silt, and clay separated into lower, middle and upper aquifers. Unconfined in outcrop and confined in the subsurface. Primary intergranular porosity and permeability. Leakage to confined parts provides water. Average yield of high-capacity wells 600 gpm. Average ground water is fresh, moderately hard with a near-neutral pH. Salinity increases towards the coastline near Delaware and Raritan Bays. Elevated iron and manganese are common. Calcium and magnesium levels decrease and sodium and potassium levels increase with depth. Calcium-bicarbonate type waters dominate.

Confining Units of Cretaceous and Tertiary Age - Composed of silt, clay, and thin layers of sand. Includes the stratigraphic interval from the Shark River Fm. to the Navisink Fm., the Marshalltown Fm., and the the combined Woodbury, Merchantville, and Cheesquake Fms. The confining units locally contain important sandy aquifers such as the Red Bank Sand, Tinton Sand, Vincentown Formation, Shark River Formation, and Piney Point aquifer. Ground-water quality is generally good, but may locally require quality treatment.

Jurassic Basalt - Hard, dense, and highly-fractured igneous rocks. Secondary fracture porosity and permeability. Average yield of high-capacity wells 90 gpm. Ground-water quality data is sparse but normally fresh, somewhat alkaline, moderately hard, and of the calcium-bicarbonate type.

Jurassic Diabase - Hard and dense igneous rocks. Secondary fracture porosity and permeability. Few high capacity wells. Ground-water quality data is sparse but normally fresh, somewhat alkaline, moderately hard, and of the calcium-bicarbonate type.

Jurassic-Triassic Brunswick Aquifer System - Sandstone, siltstone, and shale of the Passaic, Towaco, Feltville, and Boonton Formations. Secondary fracture porosity and permeability Average yield of high capacity wells approximately 200 gpm. Average ground water is fresh, slightly alkaline, non-corrosive and hard. Calcium-bicarbonate type waters dominate. Subordinate calcium sulfate waters are associated with high total dissolved solids. Inlcudes conglomerate of Jurassic-Triassic age along the Newark basin border fault system.

Triassic Lockatong Formation - Silty argillite, mudstone and fine-grained sandstone and siltstone with minor limestone. Secondary fracture porosity and permeability. Average yield of high capacity wells approximately 50 gpm. Average ground water is fresh, slightly alkaline, noncorrosive and hard. Calcium bicarbonate type waters dominate.

Triassic Stockton Formation - Arkosic sandstone. Secondary fracture porosity and permeability Average yield of high capacity wells approximately 200 gpm. Average ground water is fresh, slightly acidic, corrosive and moderaterly hard. Calcium-bicarbonate type waters dominate.

Devonian Formations - Sandstone, shale, conglomerate and limestone in the Valley and Ridge and Green Pond Mt. Region. Stratigraphic interval from the Rondout Fm. and Connelly Conglomerate to the Marcellus Shale and Skunnemunk Conglomerate. Secondary fracture porosity and permeability. Few high capacity wells. Yields best in bottom carbonates. Ground-water quality is very good for most purposes, however, treatment may locally be required for parameters such as hardness, iron and manganese.

Silurian Formations - Conglomerate, sandstone, siltstone and shale in the Valley.and Ridge and Green Pond Mt. Region. Stratigraphic interval from the the Shawangunk Formation and Green Pond Conglomerate to the Roundout and Bershire Valley Limestone. Secondary fracture porosity and permeability. Few high capacity wells yielding approximately 35 gpm in Bloomsburg Red Beds. Ground-water quality is very good for most purposes but may locally exceed hardness, iron, and manganese parameters.

Ordovician Martinsburg Formation - Claystone slate, siltstone and sandstone. Secondary fracture porosity and permeability.Water stored and transmitted in fractures. Average yield of high capacity wells approximately 50 gpm. Average ground water is fresh, slighltly alkaline, noncorrosive, and moderately hard. Calcium-bicarbonate waters dominate.

Cambrian-Ordovician Carbonates - Dolomite and limestone with minor shale, sandstone, and quartzite. Sequence includes the Jacksonburg Limestone, Kittatinny Supergroup, and Hardyston Quarzite. Secondary fracture porosity and permeability with solution enhancement of both bedding-plane and non-bedding fractures. Average yield of high capacity wells approximately 250 gpm. Average ground water is fresh, slighltly alkaline, noncorrosive and hard. Calcium-magnesium-bicarbonate type waters dominate.

Lower Paleozoic and Precambrian Igneous and Metamorphic Rocks - Gneiss, marble, and granite of the Reading and Trenton Prongs. Secondary fracture porosity and permeabilitySolution channels occur in marble. Average yield of high capacity wells approximately 85 gpm. Average ground water is fresh, slighlty acidic, corrosive and moderately hard. Calcium-bicarbonate type waters dominate.

Jersey, covering an area of 4,689 square miles (figure IV-1). It is a southeasterly dipping and thickening wedge of stratified unconsolidated sediments. The changing depositional environment during the Coastal Plain's formational history produced a multilayered aquifer system consisting of one major unconfined aquifer (Kirkwood-Cohansey) and four major confined aquifer systems (figure IV-2). All of these confined aquifers become unconfined in their outcrop areas to the northwest portions of the province, just below the fall line (see Figure IV-1a).

Ground water supplies most of the potable water to the inhabitants of the Coastal Plain. Eighty-five percent of the total purveyor-supplied and domestic water in the province consists of ground water (Hoffman and Mennel, in press). Population growth in the Coastal Plain is expected to put further demands on the ground water in the province (NJDEP, 1985a).

The unconfined portion of the Kirkwood-Cohansey aquifer system is composed mostly of quartz sand and covers approximately 3,000 square miles of the Coastal Plain. Here, shallow ground water flow is mostly controlled by local topography and deeper regional flow by the location of major discharge areas. Ground water in the shallow local flow systems discharges chiefly to streams or, in the regional flow system, the Atlantic Ocean through submarine outcrops. The environmentally sensitive Pine Barrens region, protected by the New Jersey Pinelands Protection Act of 1979, directly overlies and is intimately associated with the Kirkwood-Cohansey aquifer system. In much of the Coastal Plain, this aquifer system is the major supplier of water to domestic wells.

Previous work on this unconfined system (for example, Rhodehamel, 1970, Means, et al., 1981) has shown that because of the chemical inertness of the quartz aquifer material, the major element cycles are mainly controlled by precipitation chemistry. Work by Demir (1989) in McDonalds Branch Basin, Lebanon State Forest, Burlington County, New Jersey, showed that some minor and trace elements are also controlled by precipitation chemistry. For example, iron and manganese in shallow ground water here are mostly derived from geochemical weathering, whereas most of the lead, copper and cadmium originated from precipitation. The lead levels fluctuated seasonally and often exceeded the drinking water action level for lead of 15 parts per billion. The maximum lead level analyzed in ground water for this study was 83 parts per billion. Ground water in the Kirkwood-Cohansey aquifer is acidic with a pH generally less than 6.0. It is low in total dissolved solids, usually less than 100 mg/L. Such water can be strongly corrosive to plumbing systems (Barringer, 1989). Because of the chemical inertness of the quartz sands, ground water in this aquifer is highly susceptible to pollution from anthropogenic sources (Rhodehamel, 1970; Means, et al., 1981).

Over-pumping in some of the aquifers within this system has resulted in water level declines in four major areas: around Camden, Atlantic City, the South River/Raritan Bay area, and Mount Laurel and Englishtown in Monmouth and Ocean Counties (USGS WRIR 86-4028). These areas are characterized by extensive cones of depression in the regional flow field deep enough to cause saltwater encroachment from nearby saltwater bodies. The lower hydraulic head in these areas also results in increased flow or recharge from adjacent aquifers. Studies have been conducted by the New Jersey Geological Survey (NJGS) within NJDEP in cooperation with the United

States Geological Survey (USGS) to more fully understand this problem so that water supply planners can effectively manage the state's ground water supply.

In general, ground water quality in the major confined aquifers of the Coastal Plain is suitable for most uses with minor treatment. The most widespread problems are iron, manganese, and high chloride concentrations in aquifers affected by saltwater intrusion. The confined aquifers are most susceptible to anthropogenic pollution in their outcrop areas where they lack a protective layer of low permeability. Water quality in the Kirkwood-Cohansey aquifer system is generally good but the water may require treatment for high iron, sometimes manganese, and corrosiveness (Rhodehamel, 1970; Harriman and Sargent, 1985). Water from some wells near the Kirkwood outcrop area have reported radium and gross alpha levels above the EPA-established maximum contaminant levels of 5 picocuries per liter and 15 picocuries per liter respectively. The radiological contaminants are thought to occur naturally, however, their mobility is enhanced by the addition of agricultural chemicals (Kozinski et al, 1995). It has recently been determined that the concentration of radium-224 in the ground water of the Kirkwood-Cohansey aquifer system is higher than originally thought. The Department and USGS are currently investigating this new finding. Mercury levels exceeding the MCL of 2 parts per billion have also been found in ground water from other wells in the same geologic setting. The origin of the mercury is unknown, however, this problem is being investigated by the DEP and USGS.

Highlands

The Highlands Province (figure IV-1) is 1,016 square miles in area and is characterized as a belt of northeast-southwest trending ridges separated by broad valleys. Seventeen percent of the purveyor and domestic supplied water is ground water. However, that percentage would be much higher if surface water withdrawals for use outside the Highlands were not considered. Ground-water flow in the Highlands is mainly unconfined and is controlled by topography, fracture, and foliation plane geometry. Well yields vary locally but James (1967) found that yields are generally higher in lowland than upland areas. He also observed that yields in the Precambrian igneous and metamorphic rock types become progressively less as one progressed from pyroxene granite and gneiss, through hornblende granite, biotite gneiss, amphibolite, to quartz diorite.

Natural ground water in the Highlands is of a good quality for most purposes, however, localized quality problems do occur (Serfes, in press). Based on the analytical results from 45 wells, the most common problems are associated with the state-recommended secondary drinking water standards. The acceptable standards and ranges exceeded are: corrosivity (84 percent less than lower limit of -1 pH unit); manganese (16.3 percent exceeded 50 parts per billion); hardness (13.6 percent less than lower limit of 50 and 4.5 percent greater than upper limit of 250 parts per billion); and iron (6.9 percent exceeded 300 parts per billion). Gross alpha exceeded the primary drinking water standard of 15 picocuries per liter in 19 percent of those wells sampled. In 1987, 154 wells in the crystalline rocks were sampled for radon. The radon values in the water ranged from 36 to 24,000 pCi/L and 90 percent of the

wells sampled had radon levels greater than USEPA's proposed MCL for radon in drinking water of 300 pCi/L (NJDEP, 1992).

Valley And Ridge

This province (figure IV-1) is 515 square miles in area and mainly comprised of thick sequences of sedimentary rocks. This province has a relatively low population and the predominant land uses are recreational in the northwest and agricultural in the southeast. Eighty-seven percent of purveyor and domestic supplied water is ground water (Hoffman and Mennel, 1997).

Most of the ground water storage is within 300 feet of the land surface. The ambient ground water quality here is generally satisfactory for most purposes. However, in some places ground water must be treated for hardness, low pH, high iron, and high sulfate content (Miller, 1974). Some of these problems are more characteristic of one rock type than another. For example, water from limestone and dolomite generally is harder than from other rock types; however, this water is also rarely low in pH, and iron problems are less common.

Glacial Deposits

New Jersey has been glaciated at least three times. The last major glaciation, and most important for aquifer formation, peaked approximately 21,000 years ago during the late Wisconsinan stage of the Pleistocene epoch (Ridge, 1983). From 21,000 to approximately 17,000 years ago, the ice front receded and the melt-water deposited stratified drift in most valleys north and south of the Terminal Moraine.

Where stratified drift is thick and permeable it may produce significant quantities of water. For example, in Morris and Essex counties, 78 percent and 68 percent respectively of non-domestic potable supply wells receive pumped ground water from stratified-drift deposits with a combined yield of approximately 18 billion gallons (J. Hoffman, personal communication).

Ground water chemistry in these aquifers is variable and is mainly a function of the source of the recharge water, the chemistry and grain size of the aquifer material, and the residence time of the ground water. Water quality in the glacial aquifers is generally suitable for most uses; however, concentrations may locally exceed the secondary drinking water standards for iron, dissolved solids and hardness (Miller, 1974). Many of these aquifers have ground water pollution problems due to their shallow depth.

Piedmont/Newark Basin

The Newark Basin, a regional geologic trough containing lithified sediments, coincides with the geographic trend of the Piedmont Physiographic Province in New Jersey (fig. IV-1). What follows is excerpted from a report by Serfes (1994) titled Natural Ground-Water Quality in Bedrock of the Newark Basin, New Jersey. This report summarizes the natural ground-water quality in sedimentary bedrock formations of the Newark Basin. This information will

provide natural ranges of many water-quality parameters. Uses for this data include (1) establishment of baselines for assessing ground-water pollution; and (2) assisting local governments, water companies, drillers and private well owners in recognizing the potential for natural water-quality problems.

Within the Newark Basin, home to most of New Jersey's population, about 21 percent of the purveyor and domestic supplied water is ground water (Hoffman and Mennel, 1997). The Piedmont Physiographic Province in New Jersey is an approximately 1,580 square mile lowland region. This basin is a down-faulted trough that was filled with non-marine stream and lake deposited sediments during the Triassic [245-208 million years ago (mya)] and early Jurassic (208-187 mya) periods. It is part of the greater Newark Supergroup which extends discontinuously from South Carolina to Nova Scotia. From older to younger, the major units include the sedimentary Stockton, Lockatong and Passaic Formations (figure IV-2). The Brunswick group contains the Passaic Formation, and younger Jurassic sedimentary and igneous formations (comprised of diabase and basalt). The igneous rocks intrude and are interlayered with the sedimentary rock. Basically, the sedimentary units in the Newark Basin are comprised of shale, mudstones, siltstones, sandstones, and minor conglomerate. Reddish brown mudstones, siltstones, and sandstones of the Passaic Formation are the most widespread surface exposure. The Passaic, Lockatong and Stockton Formations underlie most of the basin; they are the predominant aquifers, yielding 95 percent of the water drawn from the bedrock (NJDEP, 1987).

Most ground water in the bedrock of the Newark Basin flows through a network of interconnected fractures, bedding plane partings, and other openings. The size and abundance of hydraulically connected fractures decreases with depth; Kasabach (1966) noted that most ground water in the Stockton and Passaic Formations in Hunterdon County is restricted to the uppermost 500 feet.

Undesirable constituents in ground water are not always anthropogenic in origin, and the federal and state primary and secondary drinking water standards are often exceeded under natural conditions. Defining natural ground-water quality, however, can be difficult. Many of the dissolved constituents in ground water, such as sodium and chloride from road salting, can come from widely distributed anthropogenic nonpoint sources as well as from natural sources. In the Newark Basin, however, manganese, hardness, corrosivity, total dissolved solids, iron, sulfate, sodium and chloride in excess of secondary drinking water standards have long been recognized, at some locations, as natural (for example, Kasabach, 1966; Nichols, 1968). More recently, concentrations of naturally occurring radionuclides that exceed the primary drinking water standards have been recognized and investigated (Zapecza and Szabo, 1987).

Elsewhere, it is clear that human activities have degraded ground-water quality. Previous studies in Newark, New Jersey, and the adjacent urban area to the east and northeast show naturally-occurring and induced poor ground-water quality in the fractured rock of the Brunswick Group. Local saltwater intrusion due to overpumping has degraded water quality, resulting in chloride concentrations as high as 1900 milligrams per liter in the area around Newark Bay (Nichols, 1968). Deep, slow moving ground water in this area commonly requires treatment for naturally high levels of

dissolved solids, hardness, iron and sulfate (Carswell, 1976). Ubiquitous ground-water pollution in this area is related to extensive industrialization and urbanization.

Assessment Methods

The water quality data used in this section were obtained from two projects: (1) The Ambient Ground Water Quality Network and (2) a combined NJDEP and Unites States Geological Survey (USGS) study of radionuclides in ground water of the Newark Basin. The Ambient Ground-Water Quality Network was established by the NJDEP and USGS to monitor the environmental quality of ground water in the state. Its present focus is to determine natural ground-water quality throughout the state and examine how geologic conditions influence water quality. Each year 22 wells are selected and sampled. Analytical data from 44 network wells from the Newark Basin are used in this report.

The DEP-USGS study of radionuclides was undertaken to determine the occurrence and distribution of naturally occurring radionuclides in the Newark Basin in New Jersey. Water samples were collected from 260 ground-water sites geographically distributed throughout the basin. One hundred and twenty-five samples were analyzed for major ions, trace metals, radioactive constituents and field parameters such as pH, specific conductance and dissolved oxygen. The analyses presented here from the DEP/USGS study of radionuclides in ground water are for samples collected between 1985 and 1987.

Well water in both projects was analyzed for major ions, trace elements and field parameters such as pH, specific conductance and dissolved oxygen. However, nutrients and volatile organic compounds, if they were detected in a preliminary scan, were also analyzed in the network wells. Radionuclides were exclusively analyzed in the second project. For both the ambient network and the study of radionuclides, wells near known pollution sites were avoided. Also, the few wells found to contain volatile organic compounds from the ambient network wells were eliminated from the database used in this analysis. All analyses were done at the U.S. Geological Survey National Laboratory using standard methods presented in Fishman and Friedman (1985).

Ground Water Chemistry

The chemistry of precipitation at Washington Crossing State Park is presented in table IV-1 for illustration purposes, and is probably representative of precipitation elsewhere in the Newark Basin. Precipitation at the park, like most precipitation, is a dilute, acidic, oxidizing solution. The chemistry of precipitation is controlled by dissolved atmospheric gases (such as oxygen and carbon dioxide), natural and anthropogenic airborne particles, and other natural and anthropogenic inputs. Although specific conductances greater than 100 microsiemens per centimeter (µs/cm) have been reported in urban areas, values less than 50 µs/cm are more normal (Hem, 1985). Atmospheric carbon dioxide produces an acidic pH of about 5.7 in rainwater.

Acidic components from anthropogenic processes have lowered this value in New Jersey.

Table IV-1. Water quality characteristics of precipitation at Washington Crossing State Park, Mercer County, New Jersey [µs/cm, microsiemens per centimeter, based on samples collected weekly through 1990 (National Atmospheric Deposition Program, 1991)]

	pH standard	Conductivity (µs/cm)	Ca mg/l	Mg mg/l	K mg/l	Na mg/l	NH4 mg/l	NO3 mg/l	Cl mg/l	SO4 mg/l
Minimum	3.86	5.5	.01	.005	.003	.014	.03	.21	.06	.45
Median	4.32	26.1	.09	.032	.016	.123	.28	1.75	.27	2.16
Maximum	6.44	84.6	.55	.341	.135	2.290	1.11	7.96	3.74	7.14

As water from precipitation percolates from the land surface through the unsaturated zone and flows through the ground-water system, it generally becomes more alkaline, mineralized, and reducing due to its chemical interaction with the materials it contacts. To illustrate this, the median values of alkalinity, specific conductance and dissolved oxygen for ground waters of the sedimentary units in the Newark basin (table IV-2) are compared with the precipitation values above. The median pH for precipitation is 4.32, which is equivalent to no or zero alkalinity. In ground water the median value for alkalinity is 135.5 milligrams per liter. The specific conductance, which is a direct indicator of the amount of dissolved material in the water, increased from a median value of 26.1 microsiemens per centimeter in precipitation to 420 microsiemens per centimeter in ground water. The greater the concentration of dissolved oxygen in water the more oxidizing the solution. Rain water is in direct contact with the atmosphere and the dissolved oxygen concentration will vary from approximately 14 milligrams per liter at 0°C to 8.5 milligrams per liter at 25°C (American Water Works Association, 1975). In ground water the median concentration of dissolved oxygen is 2.7 milligrams per liter which is less oxidizing (more reducing) than rain water.

Median values in table IV-2 show that ground waters in sedimentary bedrock of the Newark Basin are somewhat oxidizing, slightly alkaline, fresh (usually have less than 1000 milligrams per liter of total dissolved solids), noncorrosive, and hard. In order of decreasing median abundance of the measurable cations are (1) calcium, (2) sodium, (3) magnesium, (4) potassium, (5)strontium, (6) barium, (7) zinc, (8) lithium, (9) iron, (10) manganese, (11) uranium, and (12) arsenic. The anions are (1) bicarbonate, (2) sulfate, (3) chloride,(4) nitrate plus nitrite, (5) fluoride, (6) orthophosphate. Sulfate is associated with high dissolved solids in the Brunswick Group formations.

The differences in ground-water quality among formations of the Newark Supergroup are related mainly to their different mineralogy, petrology and hydrogeologic characteristics exhibited by different rock units. Some of the more obvious differences are: (1) Waters from the Brunswick Group sediments (fig. IV-2) are hardest and highest in calcium, magnesium, chloride, lithium, and strontium. They have higher extreme dissolved solid, sulfate and iron values. (2) Waters from the Lockatong Formation are

highest in potassium, sodium, silica, iron, and manganese, and are lowest in

TABLE IV-2: Statistical summary of analyses of water from the Brunswick Group, Lockatong and Stockton Formations in New Jersey[1] Table includes the chemical characteristic and constituent sampled and reporting units; the number of samples where parameter was analyzed, the minimum value, 25th percentile, median or 50th percentile, and maximum value in the population of analytical values (this is a standard way of reporting positional measures as it yields information concerning the population distribution); the primary (p) and secondary (s) Maximum Contaminant Levels (MCL) for applicable characteristics and constituents; and the percent of the sample population exceeding or outside the MCL limits.

[p, primary drinking water standard; s = secondary drinking water standard; µS/cm = microsiemens per centimeter, mg/L = milligrams per liter; ug/L = micrograms per liter; -- = no data available]

CHARACTERISTIC OR CONSTITUENT	Number of Samples	Minimum	25th per-centile	Median	75th per-centile	Maximum	Maximum Contaminant Level p=primary s=secondary	percent exceeded
CHARACTERISTICS								
Temperature (^{0}C)	147	9.5	12.5	13	13.5	17	--	--
Specific Conductance (µS/cm)	147	140	342	417	550	2040	--	--
Oxygen, dissolved (mg/L)	147	<0.1	0.5	2.7	5.0	14.7	--	--
pH (standard units)	148	5.5	7.1	7.6	7.8	9.3	6.5 - 8.5^s	6.1%<(6.5), 3.4%>(8.5)
Field Alkalinity (mg/L as $CaCO_3$)	147	21	101	134	161	338	--	--
Solids[2], dissolved (mg/L)	147	106	259	316	416	1540	500^s	13.6
Corrosivity (pH units)[3]	142	-3.86	-1.68	-0.23	-0.5	1.04	-1 to 1^s	31.2%<(-1), 0%>(1)
Hardness,(mg/L as $CaCO_3$)	147	12	140	180	220	1100	50-250^s	3.4%<(50) 20.8%>(250)
MAJOR AND MINOR DISSOLVED CONSTITUENTS (mg/L)								
Calcium	147	2.5	35	45	62	365	--	--
Magnesium	147	0.27	10	15	19	69	--	--
Sodium	147	2.1	12	15	27	270	50^s	8.5
Potassium	147	0.4	1	1.3	2	6.6	--	--
Chloride	147	1.7	1.0	16	28	130	250^s	0
Sulfate	147	1.1	22	36	64	1200	250^s	8.2
Fluoride	44	<0.01	0.1	0.1	0.2	1.4	4^p	0
Silica	147	11	19	22	26	45	--	--
NUTRIENTS, DISSOLVED (mg/L)								
Nitrogen, NH_3, (as N)	54	<0.01	<0.01	<0.01	0.62	0.28	--	--
Nitrogen, NO_2, (as N)	55	<0.01	<0.01	<0.01	<0.01	0.02	1^p	0
Nitrogen, NH_3 + Organic, (as N)	54	<0.2	0.2	0.3	0.5	1.1	--	--

1 Analyses from wells sampled twice were averaged into one value and are counted here as one sample.

2 Product of a constant derived using linear regression analysis and specific conductance.

3 pH unit below or above $CaCO_3$ saturation defined as zero using the Langelier Index (American Water Works Association, 1975).

TABLE IV-2 continued:

CHARACTERISTIC OR CONSTITUENT	Number of Samples	Minimum	25th per-centile	Median	75th per-centile	Maximum	Maximum Contaminant Level p=primary s=secondary	percent exceeded
Nitrogen, NO_2+NO_3, (as N)	55	<0.1	0.29	1.5	3.0	7.6	10[p]	0
Nitrate, [NO_2+NO_3]-[NO_2], (as N)	55	<0.1	0.33	1.6	3.0	7.4	10[p]	0
Phosphorous Ortho, (as P)	49	<0.01	0.01	0.02	0.05	0.16	--	--
Phosphorous, (as P)	40	<0.01	0.02	0.04	0.06	0.3	--	--
TRACE AND MINOR DISSOLVED CONSTITUENTS (ug/L)								
Aluminum	57	<10	<10	<10	8.5	20	50-200[s]	0
Arsenic	43	<1	<1	2	3	19	50[p]	0
Barium	119	<2	34.5	110	200	1200	2000[p]	0
Beryllium	119	<0.5	<0.5	<0.5	<0.5	1	--	--
Cadmium	145	<1	<1	<1	<1	3	5[p]	0
Chromium	43	<1	<1	<1	<1	5	100[p]	0
Cobalt	119	<3	<3	<3	<3	<3	--	--
Copper	147	<10	<10	<10	<10	200	1300[p]	--
Iron	147	<3	<3	7	24	11000	300[s]	14.5
Lead	147	<10	<10	<10	<10	16	15[p]	.7
Lithium	121	<4	9	20	29	100	--	--
Manganese	147	<1	<1	5	55	1600	50[s]	26.9
Mercury	43	<0.1	<0.1	<0.1	<0.1	.3	2[p]	0
Molybdenum	119	<10	<10	<10	<10	170	--	--
Strontium	119	50	227.5	430	712.5	11000	--	--
TRACE AND MINOR DISSOLVED CONSTITUENTS (µg/L)								
Vanadium	121	<6	<6	<6	<6	25	--	--
Zinc	148	<3	9	22	54	1100	5000[s]	0
ORGANIC CONSTITUENTS								
Carbon, Organic, (mg/L, as C)	43	0.3	0.7	0.8	1.4	3.1	--	--
Phenols Total, (µg/L)	38	<1	1	2	3	7	--	--

1 Analyses from wells sampled twice were averaged into one value and are counted here as one sample.

2 Product of a constant derived using linear regression analysis and specific conductance .

3 pH unit below or above $CaCO_3$ saturation defined as zero using the Langelier Index (American Water Works Association, 1975).

dissolved oxygen and chloride. (3) Waters from the Stockton Formation are highest in barium and lowest in pH, dissolved solids, Langelier Index (most corrosive), sodium and lithium. The highest barium concentration, however, is from a sample from the Lockatong. Also, the interquartile ranges, (25th to 75th percentile) of most constituents and total dissolved solids are generally much smaller than those of the other formations.

Previous workers have noted an increase in total dissolved solids and a decline in water quality with well depth in the Newark Basin (Kasabach, 1966; Anderson, 1968). However, this is not apparent from the relationships between well depth and conductivity. Conductivity reflects the concentration of numerous dissolved ions such as sulfate, sodium and chloride. The expected relationship between well depth and conductivity in the Brunswick sediments and Lockatong Formation is weak or nonexistent.

Comparisons with Drinking Water Standards

Ground-water quality in the sedimentary formations of the Newark Supergroup in New Jersey is generally good, but locally may require treatment for undesirable characteristics and constituents. State-recommended secondary drinking water standards are exceeded far more often than the health based primary standards (N.J.A.C. 7:10-1.1 through 7.3). An excellent summary of federal and state drinking water standards, water testing, and water treatment is in Shelton (1991). Much of the information on standards (below) is from that reference.

Primary Drinking Water Standards

Primary drinking water standards target contaminants that, in the judgment of the Commissioner, may have an adverse effect on the health of persons. These standards, at a minimum, apply to public water supplies.

Radionuclides

Naturally occurring radionuclides exceeded primary drinking water standards in a small percentage of samples. A study of natural radioactivity in the ground water of the Newark Basin by Szabo and Zapecza (1987) showed that uranium enrichment occurs in black mudstones near the Lockatong-Passaic Formation contact and that complex hydrogeochemical relationships control the radionuclides content of ground water. Gross alpha-particle activity and radium-226 concentrations in water are ultimately related to uranium decay within the water and the surrounding sediment, respectively. The percentages of analyses exceeding actual and recommended radioactivity standards in the Newark Supergroup sediments (modified from Szabo and Zapecza, 1987) in New Jersey are:

Characteristic or constituent	Number of samples	Standard (MCL) (picocuries per liter)	Percent exceeded
Gross alpha:	259	15	5.8
Radium-226:	177	5[1]	3.9

[1]Standard for radium-226 + radium-228

Barium

Barium levels greater than 1 mg/L are reported in Szabo and Zapecza (1987), but none exceed the present primary drinking water standard or maximum allowable concentration level of 2.0 mg/L. A reported barium concentration of 2.13 mg/L in Hunterdon County was investigated by the DEP in 1988. Barite ($BaSO_4$) mineralization occurs locally throughout the Newark Basin (Dombroski, 1980) and presumably accounts for most of the barium in ground water. However, anthropogenic sources are also possible.

Lead

The highest lead concentration in this study is 16 parts per billion from a well in the Brunswick group. It barely exceeded the primary drinking water action level of 15 parts per billion.

Secondary Drinking Water Standards

Secondary drinking water standards are recommended standards that protect the public welfare from characteristics and constituents that affect the aesthetic quality of the water (for example, its appearance, taste or odor). Undesirable characteristics and constituents in water are treated in public and private water supplies using various systems.

Corrosivity

Corrosivity and scaling potential are measured using the Langelier Index, a calculation that uses pH, alkalinity, calcium concentration and total dissolved solids to determine if calcium carbonate will dissolve or precipitate in that water (American Water Works Association, 1975). The acceptable corrosivity ranges between slightly corrosive (-1) to slightly encrusting (+1). If the water is too corrosive (< -1) it can corrode plumbing systems releasing harmful metals such as lead and copper and decrease the life of water systems. If the water is slightly scaling (0 to +1), calcium carbonate will precipitate out and encrust the inside of the plumbing system with a protective coating. If the Langelier Index is greater than 1, too much scale can build up. This will impede the flow of water and degrade the heat conducting properties of boilers and water heaters. The Stockton Formation has the highest percentage of well water samples considered too corrosive (69 percent <-1). In comparison, the Brunswick Group has 22.5 percent <-1 and the Lockatong Formation 31.8 percent <-1. None of the samples were too encrusting.

Hardness

Hardness is mainly the result of calcium and magnesium dissolved in water. High hardness affects lather formation in soaps and can indicate a potential scale problem in hot water heaters and boilers. Calcite ($CaCO_3$) and dolomite

([Ca,Mg]CO3) are common minerals that contribute calcium and magnesium to water as they dissolve. In this study 26.6 percent of the wells in the Brunswick Group, 13.6 percent of the wells in the Lockatong Formation, and 6.9 percent of the wells in the Stockton Formation were found to have high hardness (>250 mg/L).

Iron and Manganese

Iron and manganese generally occur together because they have similar chemical properties. Some manganese generally substitutes for iron in iron bearing minerals. For example, pyrite (FeS), biotite (hydrous iron alumino silicate), and some pyroxenes and amphiboles all contain iron with some manganese. Generally, the lower the concentration of dissolved oxygen in water the higher the concentration of dissolved iron and manganese. When iron and manganese in water come into contact with oxygen, they precipitate and may leave red and black stains on laundry and plumbing fixtures. High iron and manganese levels affect the taste of the water. Well water from the Lockatong Formation has the lowest overall dissolved oxygen content and the highest percentage of wells exceeding the iron standard (19 percent) and manganese (43 percent) standards. Excessive iron and manganese are also encountered in the Brunswick and Stockton formations.

Sodium

Sodium occurs in many minerals, for example halite (NaCl) and the plagioclase feldspars (sodium-calcium-alumino silicates). High sodium can have an adverse health impact on people with high blood pressure and other sodium sensitive ailments. The Lockatong Formation has the greatest percentage of wells with values above the drinking water standard (13.6), followed by the Brunswick Group (7.4 percent) and Stockton Formation (3.4 percent).

Total Dissolved Solids

Total dissolved solids is a measure of the amount of dissolved material in the water. The concentration can be measured directly or estimated from the conductivity value. It is a general indicator of the overall quality of the water, and high values can reduce the life of hot water heaters. The total dissolved solid content of ground water is mainly a function of the ease with which the minerals in the aquifer skeleton can be dissolved and the residence time of the ground water. The percentage of wells drawing water from the Brunswick Group, Lockatong Formation and Stockton Formation that exceeded the drinking-water standard are 19.1, 4.5 and 3.4 respectively. In the Brunswick Group the elevated total dissolved solid concentrations are related to elevated sulfate concentrations.

Sulfates

Sulfur bearing minerals such as gypsum (CaSO4.2H2O) and pyrite (FeS) can increase the sulfate concentration in ground water when they are dissolved.

High sulfates in water forms scale on boilers and heat exchangers, affects the water's taste and can cause a laxative effect. In this study, only wells drawing water from the Brunswick Group (11.7 percent) have sulfate concentrations exceeding the secondary standard. The Brunswick Group rocks have localized deposits of gypsum, a sulfate mineral.

Comparisons with Ground Water Quality Standards

As discussed in Chapter II of this report; the Ground Water Quality Standards provide the basis for the protection of ambient ground water quality through the establishment of criteria for ground water pollutants. These criteria in turn provide the primary basis for setting limits on discharges to ground water and standards for ground water cleanups. In order to protect its designated uses, ground waters of the state are divided into three classifications, Classes I, II and III. The ground water quality data in table IV-2 were compared with criteria associated with Class II ground waters: waters for potable water supplies.

It must be noted that many of the Ground Water Quality Criteria are for unfiltered, total concentrations, of a particular constituent. The data in table IV-2 present constituent concentrations after samples were filtered through a 0.45 micron filter. The filtered concentration would be less than or equal to, but never greater than, the total (unfiltered) concentration. Therefore, this data may underestimate the true total constituent concentration in ground water.

Of the data presented in table IV-2, only those characteristics and constituents with concentrations violating the Drinking Water Standards, also violated the Ground Water Criteria for Class II ground waters. All other concentrations were within the criteria limits.

Anthropogenic Impacts to Ground Water In the Newark Province

Nitrate levels from wells within the Newark aquifers have been studied by Clawges and Volwinkel (1996). Recorded levels varied from below the detection limit (0.1 mg/l) to a high of 9.5 mg/l. No samples exceeded the USEPA MCL of 10.0 mg/l. Significant differences were found between nitrate levels collected from wells in predominantly undeveloped land and samples collected from wells in predominantly urban-suburban and agricultural regions. The latter two categories had higher nitrate levels due to anthropogenic inputs that exist over and above the natural sources that alone supply the undeveloped regions.

Median nitrate levels were highest from wells from the predominantly urban-residential regions (2.5 mg/l), followed by wells in predominantly agricultural areas (median = 1.8 mg/l), followed again by wells in predominantly urban-nonresidential regions (1.6 mg/l). The lowest median nitrate levels (0.5 mg/l) were recorded from wells in predominantly undeveloped regions.

Editor's note: Sources of ground water pollution are thought of as either **point** or **nonpoint sources**. These terms are defined somewhat differently in this chapter than when the same terms are applied to surface water pollution. When discussing ground water, point sources are regarded as localized discharges, such as leaking underground storage tanks or chemical spills. Nonpoint sources are larger area discharges of regional significance, such as agricultural chemicals from agricultural areas or septic system wastes from areas with a high septic system use. Under surface water terminology, all these sources are regarded as nonpoint.

Please note that the **Ground water quality standards**, a significant aspect of the DEP's ground water quality management effort, are described in Chapter 2 of this report.

Introduction

New Jersey is taking an active and progressive approach to the management of its ground water. Several federal, state, county, and municipal offices are involved in ground water management activities ranging from resource evaluation to the cleanup and restoration of contaminated aquifers. New Jersey considers its efforts in ground water protection and pollution control to be a priority and has made major commitments to managing its ground water. New Jersey's ground water management program has the following major components:

Strategy Development: The Department's Ground Water Strategy for New Jersey coordinates the many ground water programs that have been established by the Legislature. The Strategy outlines the State's fundamental ground water policies, describes the major management issues, and outlines the Department's approach to solving these issues.

Program Planning: Statewide water quality and supply planning is performed by the DEP, which develops the Ground Water Quality Standards, prepares and updates the New Jersey Statewide Water Supply Plan, and plans initiatives proposed by the Ground Water Strategy. Regulatory planning is conducted by regulatory elements as needed.

Resource Evaluation: Resource evaluation involves the monitoring, investigation, and assessment of ground water resource quantity and quality, the collection of basic quantity and quality data, and the development of methodologies to evaluate and model ground water.

Research: Research (as distinct from resource evaluation) provides an understanding of fundamental processes in ground water movement, pollution migration, and physical/chemical interactions between ground water and the subsurface environment.

Program Implementation: Implementation involves all regulatory programs that manage, protect, and restore ground water. These actions are accomplished through various permit and review functions and through remedial programs.

Enforcement: Enforcement includes all actions designed to ensure compliance with the Department's regulations for ground water, including permit compliance monitoring, enforcing against unpermitted or illegal activities, and identifying the party responsible for pollution.

Outreach/Education: The Department provides education and information programs for the general public, local and county governments, and the news media. The Department conducts research aimed at more effective risk communication. Citizens advise the Department on ground water issues through advisory councils and task forces.

Program Planning And A Ground Water Strategy For New Jersey

Coordination of New Jersey's many laws and programs affecting ground water management occurs through A Ground Water Strategy for New Jersey. It establishes major initiatives for protecting the potability of aquifers and enhancing the effectiveness of pollution mitigation programs. The Strategy was approved in 1989. Coordination of programs is necessary for effective management. The most critical initiatives are outlined below.

The Case Management System coordinates case assignments, priorities, and technical standards for pollution cases involving hazardous substances. This system results in faster action to protect public health where wells are polluted, through concurrent analysis of water supply remedies and ground water pollution mitigation options so that the fastest, most effective, and least costly remedies will be implemented.

Also, the Department develops rapid remedies for imminent or existing pollution of drinking water wells or sensitive ecosystems. The lengthy schedules of normal remedial efforts are not acceptable in such situations. After a remedy is in place, any remaining pollution at the site will be addressed through the normal remedial process.

Well Head Protection further protects the quality of water which supplies drinking water for public community, public non-community (diners, hospitals etc.), and domestic wells. In 1986 Congress required that all states develop and implement a Well Head Protection Program. New Jersey's program was approved by EPA in 1991 and regulations will be formally proposed in 1997.

Under New Jersey's program, the State will be delineating well head protection areas in unconfined aquifers using ground-water models such as the EPA endorsed RESSQC. For public non-community supply wells, the well head protection areas will be delineated using a Calculated Fixed Radius (CFR) method. Although the program does not currently delineate well head protection areas for domestic wells, it is the long term goal of the program to develop a methodology to delineate protection areas for clusters of domestic wells.

Aquifer Recharge Area Protection. The Department's Office of Environmental Planning has published (and continues to develop) best management practices (BMPs) for aquifer-recharge areas. Because these BMPs require the identification of aquifer-recharge areas, the N.J. Geological Survey (NJGS) has published a methodology on how to identify, map, and rank recharge areas. The NJGS has prepared a map of aquifer-recharge areas in Middlesex County. As of this writing, it has partially completed Morris County (Whippany Watershed) and is working on Monmouth and Cape May Counties. The basic mapping methodology is available for use (and has been used) by local, county, state and environmental groups.

Nonpoint Sources of Pollution: Certain nonregulated sources are a major concern for ground water quality, as they are for surface water quality. Nonpoint sources of pollution include urban runoff, road runoff, agricultural and lawn care practices, and myriad sources of pollutants (e.g., residential septic systems) which are individually small but so widespread as to pose significant pollution concerns. Nonpoint source management is needed to ensure that ground water quality standards are met to the greatest extent practicable. For example, industrial and municipal stormwater permitting programs requiring the use of Best Management Practices (BMPs) for pollution abatement are currently being developed by the Department to implement these policies.

Resource Evaluation: Monitoring Networks

The State, both alone and in conjunction with other agencies, has been conducting ground water resource investigations for several decades. The scope of the resource investigations has been expanded in recent years. Resource evaluation results in the description of surface and subsurface geology and an analysis of ground water quality and quantity. Both the N.J. and U.S. Geological Surveys help implement resource assessments by conducting field investigations and developing ground water data bases.

New Jersey has two long-term, continuous ground water quality monitoring networks. One is the Saltwater Monitoring Network. It consists of over 400 wells located along the Atlantic Ocean, Delaware Bay, and Raritan Bay, and provides an early warning system for saltwater intrusion. The Saltwater Monitoring Network has been in existence since 1923. A second network, the Ambient Ground Water Quality Network, provides water quality information on 36 common chemical parameters, as well as volatile organic compounds (VOCs), on a regional basis. This baseline information will regionally characterize natural ground water quality, as a function of aquifer and rock type, throughout the state. The Ambient Ground Water Quality Network has been in existence since 1982.

The USGS has a large scale computerized system, WATSTORE, for the storage and retrieval of the nation's water data. The national database is located in Reston, Virginia, and contains ambient ground water quality data for New Jersey. In addition there is a smaller database housed in the USGS branch office in West Trenton, New Jersey. The NJGS currently has ambient ground water quality and aquifer parameter data on ArcView, the

Department's GIS-based database. Ground water quality data is also available on the Internet and can be accessed through the DEP home-page.

Research

Some research on ground water quality issues is conducted through the Department's various Divisions, including the Division of Science & Research. The Department first attempted an overview of ground water quality in a study conducted from 1977-80. More recent research has studied the fate of toxic substances in soil and aquifer systems. Current research is studying the presence of fertilizers and the newer pesticides in ground water, radon levels in drinking water, the effects of acid deposition on the state's ground water resources, new methods of detecting ground water contamination, and ground water related community health problems.

Ground Water Quality Management

Methods to regulate and control sources of ground water pollution are, to a large degree, a function of the variability of the sources themselves. As discussed in the early parts of this chapter, not all sources of ground water pollution are from activities where a discharge is intended. Many activities that cause ground water pollution are due to poor design, operation, or a lack of awareness of potential pollution problems. Further, many causes of ground water pollution are due not to intentional waste disposal but rather to accidental discharges such as leaking underground storage tanks, incidental discharges (for example, leaching of pesticides) or induced contamination such as saltwater intrusion.

State ground water pollution programs focus first on pollution prevention - the control of the sources and causes of ground water pollution - then, secondly, on the correction of pollution. This emphasis acknowledges the difficulty and cost for the restoration of ground water. Current regulatory programs address three categories of ground water quality concerns: regulated discharges, ground water remedial action, and indirect sources of pollutants.

Five programs regulate the actual or potential discharge of pollutants from active facilities: 1) the Resource Conservation and Recovery Act (RCRA); 2) the NJ Pollutant Discharge Elimination System (NJPDES); 3) the Underground Storage Tank (UST) program; 4) the Realty Improvement Act (Chapter 199); and 5) the Solid Waste Management Act. Additional site remedial actions occur under the Federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, also called Superfund), the NJ Spill Compensation and Control Act (Spill Act), and the Industrial Site Recovery Act (ISRA). These programs are described below.

Resource Conservation and Recovery Act (RCRA): This program controls the treatment, storage, and disposal of hazardous wastes. The universe of facilities with regulated activities has dropped from approximately 600 in 1980 to approximately 200 today. RCRA permitting is integrated with the NJPDES program, where there is an existing, planned, or

potential discharge of pollutants to ground water or surface water. Performance, operational, and construction (minimum technology) standards are used. The performance standard is zero discharge for all hazardous constituents. Stringent closure, post-closure and remedial standards include additional ground water protection requirements. Past disposal units on a site may also be evaluated, and cleanup compelled.

New Jersey Pollutant Discharge Elimination System (NJPDES): The NJPDES program, as it is related to the protection of ground water, is divided into two major programs: remedial discharges and operational discharges. Remedial discharges include the reinjection of ground water that has been treated under such remediation programs as ISRA, CERCLA, and other Department remediation programs. Operational discharges include the regulation of major septic systems, as well as land applications that include infiltration/percolation lagoons, surface impoundments, landfills, and resource recovery uses of sludge and compost. Closure and post-closure activities for hazardous waste land disposal units are also regulated under NJPDES.

Underground Storage Tanks -- New Jersey's Underground Storage of Hazardous Substances Act, as passed in 1986, regulates underground storage tanks (UST) containing hazardous substances. In accordance with the act, DEP's Bureau of Underground Storage Tanks is identifying and registering all tanks containing over 2,000 gallons of hazardous substances or petroleum products. Approximately 125,000 USTs at 85,000 facilities are subject to the State law. A subset of 50,000 tanks at 15,000 facilities are also subject to federal law. Facilities regulated under the state law contain heating oil or motor fuel above a certain storage volume, or any underground storage tank used to contain any regulated hazardous substance or waste.

Program components include registration, annual certification, and technical standards. Standards include: new tank design standards, construction permits, closure approvals, retrofitting existing tanks, periodic testing, monitoring systems, corrosion control, inventory control, and financial responsibility. Certain size and use categories of USTs need not comply with all standards. Special Standards apply to USTs near public water supply wells.

Chapter 199, Realty Improvement Sewerage and Facilities Act -- "Chapter 199" refers to P.L. 1954, Chapter 199, the Realty Improvement Sewerage and Facilities Act. Under this act, the local Board of Health approves the construction of individual sewage disposal systems and the construction official monitors compliance. The NJPDES program regulates multiple connections to a single septic system. The State also must review subdivisions with 50 or more dwelling units for adequate water and sewerage and compliance with applicable state standards.

Regulation of Landfills -- The Department regulates the design, construction, operation, closure and post-closure monitoring of all solid waste facilities including landfills. The Department has required a large number of

existing facilities to either close or prepare designs and plans for upgrading to reflect the required level of technical sophistication. Facilities are required to be permitted by the Division of Solid Waste Management. Landfills and other facilities often require both a solid waste facility permit and a NJPDES permit for ground water monitoring.

Under the Sanitary Landfill Facility Closure and Contingency Fund Act, all facilities are required to submit and obtain approval of a Closure Plan, which describes the activities necessary to properly terminate the facility, estimates the closure costs, and ensures sufficient funds for these costs.

Remedial Action -- Remedial action in the Department is implemented on a priority basis. All potentially contaminated sites in the state are included on a Comprehensive Site List and each site is or will be ranked using the Remedial Priority System. (RPS). The RPS is a scoring system used to prioritize sites based on impacts or potential impacts to various media. Responsible Parties can work with the Department through Memoranda of Agreement to investigate and remediate a site at any time. However, when a site becomes a Department priority as determined by the RPS score, the responsible party must enter into an Administrative Consent Order with the Department to investigate and remediate a site.

There are four sets of acts which require that remediation be implemented if there is a discharge above a Department standard or guideline. These statutes include 1) ISRA, 2) the NJ Spill Compensation and Control Act, 3) CERCLA (Superfund), and 4) the Underground Storage Tank Act (UST). In each program, ground water pollution is a major facet of the site investigation and remedial action. These programs also deal with the contamination of soil, surface water, air, and surface disposal.

1. **ISRA** imposes preconditions on the sale, transfer, or closure of industrial establishments involved in the generation, manufacture, refining, transportation, treatment, storage, handling, or disposal of hazardous substances or wastes. The facility owner must provide information on site conditions and demonstrate/prove/confirm that no remedial actions are needed or that proposed remedial actions will meet the criteria set forth by ISRA for approval.

2. **The Spill Act** mandates that responsible parties notify the Department of discharges of hazardous substances. The Department may take emergency remedial action and may implement long term cleanups when the responsible party will not. The Department may seek treble damages against responsible parties where public funds are used.

3. **CERCLA** is federal law, similar in many ways to the NJ Spill Act. Treble damages against responsible parties may be sought when public funds are used for remedial action. CERCLA provides for an assessment and ranking of sites nationally on the National Priority List.

4. New Jersey's **Underground Storage of Hazardous Substances Act** requires maximum expediency to correct ground water contamination. Tank owners must certify that all requirements were met. If ground water

pollution has occurred, additional requirements are imposed which extend beyond the self-certification program.

Ground Water Supply Management (Quantity Protection)

One major purpose for ground water quality management is the protection of potable ground water supplies. The Department is responsible for protecting ground water through the allocation of supplies and regulation of public water supply systems. The Water Supply Management Act of 1981 is the primary authority for these programs. The Department must approve any withdrawals of water, including ground water, which exceeds 100,000 gallons per day on average. Approximately 1,000 water allocation permits exist, many of which are for ground water. The Department also must approve the drilling and construction of any new well, including monitor wells, test holes, and supply wells for potable, industrial, commercial, and agricultural uses. Over 20,000 well drilling permits are approved each year.

The 1981 Water Supply Management Act requires the Department to prepare a New Jersey Statewide Water Supply Plan and to revise and update the plan as necessary. The plan has recently undergone a major revision and is discussed in detail in Chapter Two of this Report. This revised 1996 plan focuses on assuring a proper water supply to the year 2040 by identifying projects, management initiatives and policy changes that will be necessary to meet this water supply goal. The current plan strongly emphasizes ground water as a potential water supply and in turn addresses ground water vulnerability, and proposes strategies to protect and manage aquifers. In addition, the plan examines the integrated use of multiple ground and surface water supplies as a method of increasing total water supply yield.

The 1981 Water Supply Management Act of 1981 also serves as the basis for the General Water Supply Management Regulations (N.J.A.C. 7:19) which, among other provisions, provide for the establishment of Water Supply Critical Areas where severe water supply problems exist. In order to alleviate these supply problems, the State has been empowered to exercise regional water management controls not applicable in other areas of the state. The regulation for the establishment of critical areas allows for the reduction of existing diversion allocations and the development of alternative supplies.

Responding to severe water level declines and increased development in the northern Coastal Plain, New Jersey established Water Supply Critical Area Number 1 in 1985. The four aquifers included in this area are the Englishtown, Mount Laurel-Wenonah, and the Upper and Lower Potomac-Raritan-Magothy formations.

Critical Area Number 2 was originally established in 1986 in order to protect the water supplies in the Potomac-Raritan-Magothy aquifer. Critical Area Number 2 included portions of Camden, Burlington, Gloucester, Salem, Cumberland, Atlantic, Monmouth, and Ocean Counties. Soon afterwards the State's authority to impose water withdrawal limitations in Critical Area 2 was legally challenged by a 1989 court decision refuting the State's authority on the matter. In order to strengthen the State's position to protect water supplies, amendments to the State Water Supply Management Act were

enacted in 1993 providing the DEP with the authority to reduce allocations in water supply critical areas from supply sources that are overdrafted.

In recognition of the importance of New Jersey's ground water for potable water supplies (almost 50 percent of population relies on ground water), the USEPA responded to a petition by the Department in 1985 (and from other parties from 1980 to 1984) and designated most of New Jersey as "sole source aquifers" which provides additional protection of the aquifers from actions by federally-funded programs. This petition recognized the vulnerability of the state's ground water to many known and potential pollution sources in the state. At present, approximately 80 percent of the state, the highest percentage of any state, is located within these designated aquifers.

Enforcement

The Department has enforcement responsibilities under the programs described above. The Department can enforce the statutes and regulations, mitigate immediate hazards, seek permit compliance or require the responsible party to clean up ground water pollution.

The Office of Legal Affairs (OLA) is responsible for ensuring the legal and policy consistency of the Department's programs. OLA advises the programs on general legal issues and the promulgation of rules concerning ground water protection, and helps the divisional enforcement units develop case strategies and resolve legal issues. Through OLA, the Department may also refer cases to the Office of the Attorney General to pursue court action.

Ground Water Programs of Other Agencies

Other agencies and governmental bodies have ground water programs which complement or supplement NJDEP's role in ground water protection through management strategies, monitoring, and legislation. More information is available by contacting the following:

U.S. Geological Survey (Water Resources Division)

The U.S. Geological Survey, Water Resources Division (USGS/WRD), is the Nation's largest water resource investigating agency. The USGS/WRD investigates the occurrence, quantity, quality, distribution, uses, and movement of surface and ground waters to develop and disseminate scientific knowledge and understanding of the nation's water resources, including New Jersey's. The USGS/WRD (NJ) and the State of New Jersey have had a cooperative agreement since 1923 to work on water-related projects. The USGS/WRD conducts various special studies in cooperation with the Department.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency (USEPA) coordinates USEPA funded ground water programs in New Jersey. They provide both monetary and technical support for the implementation of the USEPA's ground water protection goals. USEPA is responsible for implementing the Safe Drinking Water Act, RCRA, CERCLA, and the Clean Water Act which include ground water protection measures. USEPA provides funding to the State under these laws for planning, development of regulations, and program implementation. USEPA provides extensive support for hazardous waste cleanup work. New Jersey administers most of the federal programs on behalf of USEPA. USEPA's Region II office in New York City is New Jersey's liaison with USEPA.

Delaware River Basin Commission

The Delaware River Basin Commission (DRBC) is a regulatory and planning agency for the Delaware River basin, established in 1961 by Congress and the States of Delaware, New Jersey, New York, and Pennsylvania. The Commission's Comprehensive Management Plan provides for consistent management of the water resources of the basin. DRBC issues permits for water resources projects, conducts research and studies, forecasts stream and ground water levels and future water demand, monitors water quality, and enforces its water resource requirements.

Counties

Counties have the authority to implement environmental health programs through the County Environmental Health Act (N.J.S.A. 26:3A2-21), as long as certain overall performance standards are met. Cooperative program agreements are used for monitoring, inspection, and enforcement activities among local agencies, counties, and the State.

Municipalities

Municipalities have the authority to protect ground water on the local level through ordinances. The Municipal Land Use Law empowers the municipality to protect the environment and public health through zoning and subdivision and site plan control. The **Realty Improvement Sewerage and Facilities Act** requires that the Local Board of Health review the sufficiency of any proposed water supply system and sewage treatment facility for proposed realty improvements.

Public/Private Organizations

New Jersey has numerous watershed organizations, over two hundred environmental organizations, and over two hundred municipal environmental commissions and committees. Many of these organizations deal with the protection and enhancement of water resources management, including ground water. Their activities include public education programs, newsletters, research, technical assistance, recycling drives, lobbying, and outdoor recreational activities.

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Chapter V

Surface Water Monitoring, Assessment and Pollution Control Programs

INTRODUCTION

The protection, maintenance and enhancement of water quality and quantity is the central function of the water resource programs within the New Jersey Department of Environmental Protection. Towards this end the Department maintains a wide assortment of programs, the most important of which are described in this chapter.

A guiding process enveloping the principal water management programs maintained by the Department is the National Environmental Performance Partnership System (NEPPS). Because of the overriding significance of this effort, our program discussion begins with an overview of NEPPS. Following this, the chapter discusses the following major subjects:

- Point Source Pollution Control
- Nonpoint Source Pollution Control
- Watershed Management
- New Jersey's Shellfish Program
- Statewide Water Supply Plan
- Lakes Program
- Wetlands Protection
- Surface Water Quality Standards

ENVIRONMENTAL MANAGEMENT THROUGH THE NATIONAL ENVIRONMENTAL PERFORMANCE PARTNERSHIP SYSTEM (NEPPS)

The Government Performance and Results Act (GPRA) of 1993 requires all federal agencies to manage their programs in an accountable manner. In response, the U.S. Environmental Protection Agency (USEPA) and the Environmental Council of States (ECOS) established a mechanism in 1995 to implement the GPRA by allowing states greater flexibility in addressing their priority environmental problems while reducing federal oversight if and where appropriate.

This mechanism is the National Environmental Performance Partnership System (NEPPS), which emphasizes environmental management aimed towards true environmental results using various environmental goals and indicators as measures of progress. The NEPPS process places greater emphasis on scientific assessments of trends in environmental quality and, through the identification of key issues and the setting of priorities, lays the foundation for many aspects of long-term environmental planning. The process also emphasizes governmental - stakeholder partnerships. In 1996, New Jersey was one of five states in the nation to pilot the NEPPS process. As of this writing, approximately 30 states are expected to be participating in this new environmental management system.

Self Assessment

NEPPS focuses on what are termed "Key Environmental Issues," meaning that states initially identify important (or key) environmental issues and then evaluate the strengths and limitations of the various state agency programs in dealing with

these identified issues. The results of this self-evaluation are published in an appropriately termed "Self Assessment" document. Specific examples of "key issues" would be the extent and severity of nutrient enrichment/eutrophication in state waters, pathogens in surface waters and in shellfish, etc. An example of program strengths might be the extensive treatment plant upgrades that have resulted in documented improvements in water quality. A corresponding program weakness is the continued poor sanitary quality in state surface waters as indicated by observed fecal bacterial levels.

These key issues are used to form the basis of environmental "goals" and measurable "milestones." Environmental indicators are employed to measure the progress toward meeting these environmental goals and milestones, and this progress is in turn reported in subsequent Self Assessment documents.

Performance Partnership Agreement

Based upon the results of the Self Assessment, a second component (document) to the NEPPS process is developed - the Performance Partnership Agreement (PPA), which represents an agreement between the State and the corresponding EPA Regional Office. This agreement delineates broad environmental goals, measurable milestones and activities that the State and EPA will perform to make progress towards the goals and milestones. Progress is measured and reported using environmental indicators mentioned above.

These concepts of goals and indicators are best illustrated by the following examples. Proposed **environmental goals** for surface water are " that our surface waters will support human and ecosystem health and applicable uses such as recreation, fishing, drinking water supply, agricultural and industrial use." Environmental goals for ground water are to protect and enhance the quality of ground water and assure that adequate quantities of ground water will be available for domestic, municipal, industrial and other purposes as well as to provide water of good quality in providing base flow to receiving waters. Examples of **environmental indicators** identified in the PPA are the status and trends of water quality parameters, pollutant loadings and progress in watershed management implementation.

The goal of this document is to delineate activities that the State and EPA will perform to achieve the goals in the Self Assessment, i.e. maintain program strengths and address program limitations. The agreement includes <u>all</u> major DEP activities regardless of program funding source and replaces individual program workplans. It's important to note that all existing federal and state laws, regulations and program delegation agreements remain fully in effect under this system.

Grant Flexibility

The **third component** of the NEPPS process is the **Performance Partnership Grant** (PPG), which combines numerous former program and media-specific EPA grants into one single grant. The PPG is intended to encourage improved environmental performance by providing states with the flexibility to allocate EPA grant funds to significant environmental problems, implement ecosystem or community-based strategies, and address multi-media problems on a more as-

needed basis. Also, the PPG is designed to reduce administrative burdens by combining numerous grants into a single grant. Grants eligible for the PPG include those designed for the management of air pollution, radon, pesticides, water pollution, and waste-disposal. Currently, certain grants are as yet not eligible for participation in the PPG. These include the State Revolving Fund, Superfund, Underground Storage Tank Trust and the Estuary Programs. Grant programs that are ineligible for the PPG can and will fully participate in other aspects of NEPPS.

Enhanced Public Participation

A key component of NEPPS is enhanced public participation. In the past, activity-oriented workplans were negotiated by programs within DEP directly with EPA, with only limited cross discussion with other related programs, and with no discussion with outside stakeholders. By contrast, NEPPS is conducted in a public forum to obtain stakeholder input on key environmental issues, program evaluations, goals, milestones and indicators.

In order to solicit public comment on the NEPPS process, DEP and EPA hosted a series of workshops beginning in the spring, summer and early fall of 1996. Focus groups included sessions for Air and Radiation, Water Resources, Drinking Water, Land and Natural Resources, and Waste/Site Remediation. The results of these workshops are used to guide development of the PPA, and the selection and reporting of indicators. Additional workshops and focus group sessions will be conducted as NEPPS is implemented.

Implementation of NEPPS

In August, 1995, NJDEP completed a pilot Self Assessment for air, freshwater watersheds, ground water and drinking water. In March, 1996, DEP Commissioner Robert C. Shinn, Jr. and EPA Regional Administrator Jeanne Fox signed New Jersey's first Performance Partnership Agreement which included air, freshwater watersheds and drinking water. The first Department-wide Self Assessment, which includes Air and Radiation, Water Resources, Land and Natural Resources (freshwater, marine, ground water and drinking water), Pesticides, Waste/Site Remediation, and Pollution Prevention, was completed in August, 1996. In January 1997, New Jersey Governor Christine Todd Whitman, NJDEP Commissioner Robert Shinn and EPA Regional Administrator Jeanne Fox signed New Jersey's first comprehensive Performance Partnership Agreement.

In summary, the Self Assessment, PPA and PPG together provide the foundation for a goal-oriented environmental plan developed in conjunction with stakeholders, which the Department can use to address the most significant environmental challenges facing New Jersey. However, changes will not occur overnight. Through incremental changes in program management, data collection and indicator evaluation, risk assessment and the prioritization of issues, the Department hopes to improve its overall environmental management program. Workshops and focus groups will continue as DEP and EPA develop and implement NEPPS.

Available Documents

The 1996 and 1997 Self Assessment of New Jersey Environment and NJDEP Programs; the 1996 Performance Partnership Agreement; and the workshop report entitled Management for Environmental Results in New Jersey are available from NJDEP's Division of Science and Research (609-984-6071). These documents are also available via the Department's electronic bulletin board (609-292-2006). Comments or questions may be forwarded to Leslie McGeorge, Director, Division of Science and Research, at (609) 984-6071, or Bryan Ianni, Assistant Commissioner Office, Environmental Regulation at (609) 292-2795.

POINT SOURCE CONTROL PROGRAMS

The protection of water quality through the provision of proper wastewater treatment has long been a program priority in New Jersey. Since 1972, more than $3.4 billion in federal and state funds have been obligated in the state for the construction of wastewater treatment works. The 1992 National Needs Survey (US Environmental Protection Agency, 1993), however, reports that approximately $4.75 billion of new investment in wastewater treatment projects is required to meet current needs in the state.

For the purpose of discussion, New Jersey's point source-related programs are divided into the following major subject areas: the New Jersey Municipal Wastewater Assistance Program, the New Jersey Pollutant Discharge Elimination System Program, the Treatment Works Approval Program for domestic sewage facilities, the industrial pretreatment program, and enforcement-related activities.

New Jersey Municipal Finance and Construction Program

The NJDEP, through its Municipal **Finance and Construction Element** (MF&CE), administers various financial assistance programs which offer low-cost funding for the construction of wastewater treatment facilities, including stormwater and nonpoint source management projects, throughout New Jersey. The three main financing programs are as follows: 1) the traditional federal Construction Grants Program administered by the State on behalf of the USEPA, 2) the N.J. Wastewater Treatment Financing Program, and 3) the Pinelands Infrastructure Trust Program. The MF&CE also administers two aspects of the Sewage Infrastructure Improvement Act program, namely the combined overflow abatement section of the Act (N.J.S.A. 58:25-28), and the planning and design grants for interconnection and cross-connection abatement under N.J.S.A. 58:25-29(b).

The N.J. Wastewater Treatment Financing Program, the most active program, consists of the Wastewater Treatment Fund and the New Jersey Wastewater Treatment Trust. The Wastewater Treatment Trust derives its monies from revenue bonds and it operates under the jurisdiction of an "independent financing authority." The Wastewater Treatment Fund is a state program administered by the NJDEP and is capitalized with federal and state funds. Together, these programs provide for loans at approximately 50% of the market interest rate. Terms of the loans are 20 years. The N.J. Wastewater Treatment Financing Program has issued 141 loans totaling almost $1.23 billion in its nine years, that have been as follows:

1988: $240 million	1989: $190 million	1990: $147 million
1991: $170 million	1992: $131 million	1993: $ 78 million
1994: $120 million.	1995: $ 86 million	1996: $ 68 million

New Jersey Pollutant Discharge Elimination System

The NJDEP administers the New Jersey Pollutant Discharge Elimination System (NJPDES permit program) as prescribed under the Water Pollution Control Act (N.J.S.A. 58:10A-1 et seq.) and other statutes. The NJPDES program regulates

facilities and activities discharging or releasing pollutants into the surface waters or ground waters of the state.

Of the permitted municipal wastewater facilities, 351 discharge to surface water, and 211 to ground water. Of the industrial facilities, 844 discharge to surface water, and 262 to ground water. There are also 95 indirect industrial dischargers - industries that discharge pretreated wastewater to municipal wastewater facilities. There are approximately 45 landfills with NJPDES permits.

The NJDEP is undertaking a major initiative to update and improve the NJPDES program, including the first comprehensive revision to the program regulations since the program was delegated to the State by the Environmental Protection Agency in 1982. The central focus of this program improvement is to move to a watershed approach for the issuance of discharge-to-surface-water-permits. The watershed approach will be a comprehensive program of public outreach, planning, monitoring, modeling, total maximum daily load development and permitting, integrating both point and non-point source controls. Work on the first pilot watershed project (Whippany River) is currently underway; a detailed discussion of this is presented later within this chapter along with a description of the Department's overall plans for watershed-based management.

The NJPDES regulations are being revised to provide provisions for smaller scale, numerous, but primarily innocuous discharges (e.g., beauty salons on septic systems, stormwater basins at certain facilities, etc.). The regulations will provide for permit-by-rule or general permits for specifically identified discharges, allowing the Department to concentrate its efforts on the larger, more potentially polluting facilities.

Treatment Works Approval Program For Domestic And Industrial Treatment Facilities

The Treatment Works Approval (TWA) program protects the integrity of state waters by preventing their pollution from inadequately functioning sewage treatment facilities. The Department reviews TWA applications to assure proper conveyance to and adequate treatment at receiving treatment facilities. The applications are also reviewed for consistency with area-wide water quality management plans, and conformance with the State design standards and regulations. In more technical terms, the Department issues TWAs which authorize the construction and operation of domestic and industrial treatment works, which include sewage treatment plants, collection and conveyance systems, pumping stations, sewer-outfalls, holding tanks, equalization tanks, and certain septic systems.

Major revisions to the TWA regulations were adopted in June, 1994 in N.J.A.C. 7:14A-22 (administrative requirements) and N.J.A.C. 7:14A-23 (technical requirements). The new regulations reduce the scope of projects which require a state level review by approximately 30 percent. These rules continue the sewer connection ban program, although they are reduced in scope (see N.J.A.C. 7:14A-22.17). A sewer connection ban is imposed upon a treatment facility for violations of its NJPDES permit over a period of three consecutive months. The new rules allow exceptions to the ban for facilities which can meet their discharge limits for conventional pollutants, and have entered into an administrative consent order designed to bring the plant into compliance with the non-conventional pollutants

within a specified time frame. A sewer connection ban is also imposed upon collection systems which do not have adequate conveyance capacity and experience unpermitted discharges. The sewer ban prohibits the connection of additional sewage generating structures to the affected system (or plant). Exemptions are allowed, however, in accordance with N.J.A.C. 7:14A-22.22, for certain hardship situations and failed subsurface disposal systems. At the end of calendar year 1994, portions of approximately 63 municipalities were affected by a sewer connection ban (mostly small systems for schools, etc.).

Industrial Pretreatment Program

New Jersey is currently implementing an industrial pretreatment program to help control discharges of industrial pollutants into municipal sewer systems. The discharge of such pollutants can result in water pollution and related problems at the local wastewater treatment plant. As such, the goal of the pretreatment program is to protect municipal treatment plants and the environment from the adverse impact that may occur when hazardous or toxic wastes are discharged into a sewer system. The objectives of the pretreatment program are to:

-prevent the introduction of pollutants into the publicly owned treatment works (POTWs) which will interfere with the treatment operations and/or the use or disposal of the municipal sludge;

-prevent the introduction of pollutants into the POTWs which will pass through the treatment works;

-improve the feasibility of recycling and reclaiming the municipal sludge; and

-reduce the health and environmental risks of pollution caused by discharges to POTWs.

In 1981, New Jersey was delegated authority from the USEPA to oversee pretreatment implementation within the state. As part of this program, NJDEP is responsible for approving the pretreatment programs developed by publicly owned treatment facilities, and for implementing a pretreatment program for the remaining wastewater facilities in the state. Presently, there are twenty-three (23) local agencies which have a State approved industrial pretreatment program (i.e., "delegated local agencies"). Approximately 90 percent of the state's industrial indirect dischargers are located within the service area of a delegated local agency.

As previously noted, one objective of the pretreatment program is to improve and/or protect POTW sludge quality. Based on 50 CFR Part 403 annual reports submitted by delegated local agencies, the quality of sludge produced by these authorities, based on the combined annual averages of calendar year 1987 versus calendar year 1992, shows reductions of heavy metals ranging from 29 to 75 percent. These improvements in sludge quality are the result of decreases in heavy metal loading to the POTWs and the subsequent decrease of heavy metal loadings to the POTWs' receiving waters.

Enforcement-Related Activities

The Water Compliance and Enforcement Program monitors compliance with, and enforces as necessary, all permits issued under the NJPDES permit program for surface water, ground water, landfill, and indirect discharges to publicly owned treatment works (POTWs). In addition to the self monitoring reports submitted by the permittee, periodic on-site compliance evaluation inspections are carried out by enforcement staff as a means to evaluate the facility's compliance with all conditions of their permit. The compliance sampling inspections serve as a means of checking the validity of the self-monitoring data submitted by the permittee.

The Clean Water Enforcement Act (CWEA), was adopted in 1990 and thereby amended the N.J. Water Pollution Control Act (NJDEP, 1984). The CWEA requires the Department to perform additional inspections, discharge compliance sampling, and follow-up inspections for permittees that incur "Significant Non-Compliance" (SNC) status. "Significant noncompliers" are permit holders having serious violations of the same pollutants within any two months during a six month period, or an exceedence by any percentage for a pollutant in four months of a six-month period. Significant noncompliers also include permittees who have failed to submit a complete Discharge Monitoring Report (self-monitoring report) in any two of six months.

The Department is also required to inspect every facility having a NJPDES permit within six months of a permit issuance. The Clean Water Enforcement Act requires the Department to impose mandatory minimum penalties against a permittee that is guilty of a serious violation or found to be in SNC. A serious violation means that an effluent limitation in a NJPDES permit has been exceeded by 20 percent for a hazardous pollutant or a non-hazardous pollutant has been exceeded by 40 percent or more. The Enforcement Act also requires the Department to prepare an annual report on the implementation and enforcement actions taken by the Department and delegated to local agencies during the preceding year. The report describes the types of enforcement actions issued against each violator, the type of violations, penalties assessed, and the status of the penalty collection process.

The Act has been very effective at significantly reducing the number of facilities in noncompliance. Since 1992 the total number of significant noncompliers has decreased from 81 to 38 in 1995 and 18 in 1996. This should result in notable water quality improvements on a local basis.

NONPOINT SOURCE POLLUTION PROGRAMS

Nonpoint source (NPS) pollution is a contributing factor as to why fishable and swimmable goals have not been met in many of New Jersey's waters. Seasonal monitoring of coastal swimming beaches reveals that contaminated stormwater has been the principal cause of beach closings in New Jersey. Nonpoint sources, including contaminated stormwater, are also the principal causes of shellfish harvesting closures and restrictions along our coastal waters. The Clean Lakes Program has found that most of the public lakes investigated are either threatened with or are actively undergoing deterioration, largely because of NPS pollution. Current evidence, although limited, has suggested that nonpoint sources can be a major source of pollution loading in our state's freshwater rivers and streams.

Clearly, nonpoint source pollution threatens the water resources of the state as well as our economy and quality of life.

Rainwater flowing overland or through stormwater sewer systems conveys most of the nonpoint source pollution directly affecting New Jersey's waterways. Because New Jersey is a very densely populated state, the Department's management program must focus on urban and suburban nonpoint source pollution categories in addition to the more traditional focus on agricultural sources. Urban/suburban pollution source categories include residential, industrial, and commercial properties; construction sites; and roadways. These sources have all been identified as significant contributors to nonpoint source pollution.

Since 1990, the Department has embarked on several nonpoint source control initiatives that are funded under section 319(h) of the Federal Clean Water Act (CWA). Additional NPS planning activities have also been developed, funded under other federal grants such as sections 205(j), 604(b), and 402(p) of the CWA. An additional federal mandate comes from Section 6217 of the Federal Coastal Zone Management Act. This Act requires the development of a nonpoint source control plan for waters affecting the designated coastal zone boundary of New Jersey. The following is a summary of all significant ongoing NPS control activities.

Activities Funded under Section 319(h) of the CWA

Since approval by EPA of New Jersey's NPS Assessment and Management Program (October 1989), the Department has been pursuing various NPS initiatives utilizing 319(h) funding, consistent with the direction EPA has set for the program. As a result of these initiatives, the Department has developed new insights into the management of NPS and has modified its approach accordingly.

In general, the focus of the Department's 319(h) grant is on regional initiatives based on integration and coordination. The Department's primary concern is to integrate ground and surface water concerns wherever possible. The Department's initiatives consist of identification of pollution sources and implementation of best management practices for the protection of surface and ground water within defined geographic regions. An essential part of these watershed initiatives will be the involvement of other federal, state, county and local agencies in designing and implementing components of a management plan for the watershed so as to provide strong participation and a long term commitment to the projects.

Current watershed project initiatives include the Musconetcong, the Barnegat Bay, and the Whippany River. In addition, a successful project in the Navesink River watershed has been recently implemented. The first two initiatives are discussed in detail below; the Whippany project is discussed within a separate section later in this chapter. The choice of future watersheds will be based on priorities established by the Department and will begin on an annual basis. It is anticipated that these watershed initiatives will provide a needed link between surface and ground water concerns and point and nonpoint source pollution control.

Other projects to which the Department has committed will support regional and local activities, in particular watershed project initiatives. These activities are geared to provide tools for the diagnosis of NPS problems, as in the Barnegat Bay intensive monitoring project, and implementation of management controls for NPS pollution sources, as in the aspects of the stormwater management program and

public outreach initiatives. The primary activities funded under 319(h) are summarized below.

Revised Nonpoint Source Assessment and Management Program: The Department is preparing a detailed nonpoint source pollution control approach that identifies specific tasks necessary for nonpoint source pollution control. Called the "Nonpoint Source Assessment and Management Program Plan," this strategy will formulate a consistent, comprehensive, and coordinated approach to NPS policy implementation within the Department. The Plan will be incorporating the Nine Key Elements as outlined in EPA's Nonpoint Source Program and Grants Guidance for Fiscal Year 1997 and Future Years (US Environmental Protection Agency, 1996). The policy approach identifies all NPS management offices within the Department and assigns roles to be coordinated in an intra-Departmental effort. The Department will provide opportunities for public review and comment on the draft Plan that is currently being developed.

Stormwater and Nonpoint Source Best Management Practices (BMP) Manual: The BMP manual serves as guidance for nonpoint source and stormwater management. This manual shows how to integrate NPS and stormwater best management (control) practices into the development planning process. The Manual promotes practical applications of pollution prevention techniques in the development of site designs. The manual presents guidance procedures primarily directed towards new development and redevelopment, but the procedures can also be applied in certain instances to existing development. The manual will expand eventually to include retrofitting solutions for existing development as new techniques for controlling stormwater and NPS pollution are discovered.

Stormwater Permitting Program

It has long been recognized that stormwater coming into contact with industrial activities and materials is a major contributor to water pollution. The Stormwater Permitting Program addresses aspects of this problem by addressing stormwater discharges associated with certain, federally designated, industrial activities. The major emphasis of the program is pollution prevention through the elimination of exposure of stormwater to these industrial activities and materials. In order to attain this goal, each facility receiving a permit under this program is required, at a minimum, to prepare and implement a "stormwater pollution prevention plan" (SPPP) which, when implemented, will eliminate all exposure between industrial materials/activities and stormwater.

NJDEP will accomplish this objective through a progressive system of general and industry-specific permits. Two basic or general permits have been adopted by the Department that apply to most regulated industries, construction activities, as well as certain mining activities. These permits require the preparation of stormwater pollution prevention plans. These plans are intended to identify potential sources of pollutants and to develop strategies for implementing best management practices designed to prevent contact between stormwater and on-site potential pollution sources. Potential pollution sources include raw materials, final products, and/or process sites themselves that can come into contact with rainwater. These general permits are followed by a separate series of industry-specific permits developed in coordination with the industrial community, which require specialized control

strategies for pollution sources that are specific to certain industries. The overall goal of these permits is to encourage industries to eliminate pollutant contact with stormwater to the maximum extent practicable.

Individual permits are for facilities not eligible for general permits or for which industry-specific general permits are not available. Approximately 350 facilities have an individual permit. New applicants are usually issued an Interim Individual Permit which is a 3-year permit during which time a SPPP is prepared for controlling discharges to surface water where exposure can be eliminated, and at the same time, identifying areas where exposure cannot be eliminated and recommending appropriate BMPs to minimize pollution. Semi-annual monitoring is required and based on this and the recommended BMPs, the Department, in consultation with the permittee, will draft a five-year individual permit. There are approximately 75 facilities which have been authorized under an Interim Individual Permit.

Outreach and education are an important component of this program. A quarterly newsletter, *The Rain Gauge*, is sent to all permittees. Facilities potentially requiring a permit are sent informational mailings providing information to allow the facility to determine whether or not a permit is required; 38,700 individual pieces of mail have been sent. A stormwater permitting seminar is presented annually in conjunction with Rutgers University. As part of a Technology Transfer effort, the program has stormwater manufacturing vendors present the latest state-of-the-art technology to permittees at this seminar. Over 80 presentations have been made to over 6,000 individuals and various groups including trade organizations.

Sewage Infrastructure Improvement Act (SIIA) (N.J.S.A. 58:25-23 et seq.)

The SIIA Program developed by NJDEP pursuant to the adoption of this state legislation has two main components: (1) to address discharges from combined sanitary and stormwater sewer systems throughout the state and (2) to map and investigate stormwater sewer systems in Atlantic, Cape May, Monmouth and Ocean counties. The SIIA and the existing rules establish various requirements for municipalities and public entities to address combined sewer overflows and stormwater discharges. The stormwater aspects are being implemented in a phased approach consisting of the following four phases:

Phase I - Preliminary Mapping and Inventory

Under Phase I, the Department made available $1.045 million in state grant funds to 94 municipalities in the four southern coastal counties to prepare preliminary maps and inventories of their stormwater and sanitary sewer systems. Eighty-eight municipalities participated in this phase, which is now complete. The Department has assembled the mapping and inventory information and compiled it into a status report for submission to the State Legislature (The Sewage Infrastructure Improvement Act: A Status Report to the New Jersey State Legislature, September 1992).

Phase II - Final Mapping and Monitoring

Each municipality will develop a final map of all stormwater and sanitary sewer lines within the geographical boundary of their municipality. The final maps shall also identify all cross-connections and interconnections found within that municipality. The final map shall include the entire stormwater system including stormwater lines, outfalls, management basins, manholes, and other appurtenances. Rules containing the final mapping requirements were adopted on June 17, 1991. These rules appropriate $5.535 million in state grant money, and $677,000 in federal funds, for the 94 affected municipalities. Grant applications have been received by the Department from all 94 municipalities.

Phase III - Nonpoint Source Pollution Abatement

Based on the information being gathered in Phases I and II, the Department is encouraging the 94 coastal communities to develop nonpoint source abatement plans and begin implementing abatement measures where problems are identified. These measures could include the establishment of:

- municipal ordinances for long term NPS control,
- implementation schedules for BMP operation and maintenance,
- ongoing NPS education programs,
- a long term monitoring program to evaluate BMP effectiveness.

However, funding for this phase (originally appropriated in 1988 and continued through June 30, 1994) has been removed. Therefore, the Department intends to address these issues through its watershed management process (see below) rather than as a separate component of the SIIA program.

Phase IV - Interconnection/Cross-Connection Abatement Planning and Design

Upon completion of the final maps, any of the 94 communities which identify interconnections and/or cross-connections (I/C) of sanitary and stormwater sewer systems are eligible to apply for grants of up to 90 percent of planning and design costs to address the problems. These I/C abatement monies will be awarded in two phases:

(1) the 94 affected municipalities are eligible to apply for an initial planning grant of $15,000, $30,000, or $50,000, based on the number of stormwater outfalls; and

(2) a second round grants will be awarded on a priority basis, the highest priority given to ocean, then back bay, stormwater discharges in municipalities in which beach closures occurred, then to those where no beach closures occurred, and then to projects with discharges to shellfish growing waters.

With the loss of the original SIIA funds, appropriations from the 1989 Stormwater and CSO Bond Fund would be required for implementation.

Barnegat Bay Management Plan (BBMP)

The BBMP is a comprehensive land use and environmental management plan for the Barnegat Bay watershed, developed in cooperation with local governments. The plan identifies standards, controls, and institutional alternatives for effectively controlling NPS pollution within the Bay watershed. The Plan is used by the Department to provide specific recommendations to the Legislature, other state agencies, county, and municipal agencies, with regard to NPS pollution control and protection of the unique nature of the Bay.

After several years of cooperative effort with a citizens advisory committee, the NJDEP released A Watershed Management Plan for Barnegat Bay in July 1993. The Plan presents 133 management recommendations designed to deal with issues such as land use/nonpoint source pollution, regulatory streamlining, the protection of environmentally sensitive area, recreational use of the water, fisheries management, waterfront public access, public participation and education, research and monitoring. Implementation of the plan will be a long term effort involving the cooperation of a variety of governmental agencies, nonprofit groups, and private citizens.

In July 1995, USEPA Administrator Carol Browner designated the Barnegat Bay/Little Egg Harbor estuarine system to become part of USEPA's National Estuary Program. The emphasis of activities in this program will be on using the existing body of knowledge to further support successful management of the Bay and watershed. Specifically, there will be an opportunity to do further consensus building on Bay issues, conduct more coordinated management of Bay-related programs, and increase Federal participation in the planning process. There will also be an opportunity to coordinate effective means of funding action items.

Musconetcong Watershed Project

The focus of the Musconetcong Project is to develop and implement a pilot project in the Musconetcong River watershed that comprehensively manages nonpoint sources of ground and surface water pollution, through the combining of all relevant institutions, programs and management tools. Efforts in general will be watershed-wide but some concentration will occur on priority sub-watersheds, selected to represent the diversity of NPS loadings from various land uses.

The overall goals of the project can be subdivided into two categories: Substantive Goals and Programmatic Goals. Substantive Goals include the demonstration of the reduction of nonpoint source pollutant loadings to ground and surface waters in select, priority sub-watersheds. Achievement of these goals will result in the achievement of both surface water quality standards and ground water quality standards. The project will integrate technical, social and institutional considerations to establish a national demonstration of effective management.

Programmatic Goals include the implementation of a comprehensive management framework and management practices for the control of nonpoint pollution sources in a cost-effective, readily implemented, and measurable manner.

Educational Efforts

Nonpoint source education is one of the most important aspects of NJDEP's NPS Management Program. Effective public education aimed at describing the NPS problems in the state and the resulting heightening of public awareness regarding NPS issues are essential to the success of the Program. Components of the nonpoint source education effort include the following:

- New Jersey Water Watch. The Department has organized Water Watch as an outreach and citizen involvement initiative. Water Watch provides a channel for citizen involvement to assist the Department with water resource management, and has a strong focus on nonpoint source pollution control. Participants in the program are encouraged to play a role in maintaining or improving the quality of their local waterways. Activities undertaken by the program include organizing litter clean-ups, water quality monitoring, canoe trips, nature trail development, wildlife surveys, and providing community education.

- Other Education Efforts. Over the past several years the Department has either conducted or participated in numerous NPS seminars, workshops, and conferences. The Department also has, either alone or in cooperation with other agencies, developed various NPS educational and informational materials. "Beneath The Shell," a popular teacher's guide to NPS pollution and its effects upon shellfish, is one example of some of the excellent educational materials produced by the Department.

COMPREHENSIVE WATERSHED MANAGEMENT

There is an increasing recognition by both federal and state governments of the need to move water resource management towards more coordinated and comprehensive methods that stress environmental planning and site specific management of all water pollution sources. While traditional regulatory approaches that focus on broad-based point source control have produced acceptable results, to address the heightened expectations of current environmental concerns requires a renewed emphasis on more detailed and watershed-specific problem assessment and more comprehensive pollution management. This will not only address point and nonpoint source discharges to ground and surface waters, but also increase attention toward pollution prevention and source reduction.

Also at issue are instances where the combination of federal and state legislative mandates and directives designed to address dissimilar concerns has led to overlapping and contradictory regulations. Water resource management programs such as water supply, water quality, wellhead protection, stormwater management, stream encroachment, wetlands and habitat protection have previously operated somewhat autonomously, resulting at times in limited coordination between programs.

The watershed-based approach represents an effort to more carefully shape, integrate and coordinate water resource management. Rather than being an entirely new concept, the watershed-based approach is a resurrection and expansion of a planning process instituted within the Department back in the mid 1970s and then termed the "continuous planning process." What has changed is a shift away

from politically defined planning regions to regions defined on a hydraulic basis as watersheds.

The watershed-based approach forces water management programs to focus on the resource. It presumes that the impacts from human activities and land uses within and adjacent to its riparian zones are likely to be as important as the more easily measured effects of point source discharges. Moreover, its resource focus ties together water management programs that may have, as stated previously, operated somewhat autonomously. Programmatic coordination is at least partially achieved by providing a discernible and unified regional geographic focus.

How New Jersey Will Institute Comprehensive Watershed-Based Management

Comprehensive Watershed Management begins with a characterization of the watershed. The characterization establishes a baseline of information pertinent to the watershed including natural resources, infrastructure and demographics. Through the development of that characterization, the sources of environmental stress, including pollutants, their sources, and the activities producing them are identified. An assessment of the resource value of the watershed is produced with an eye toward providing additional protection to areas of exceptional resource value and/or ecological sensitivity. This characterization requires a review of existing data as well as the collection of new information when needed in order to make clarifications, or fill data gaps.

After the characterization is developed, the second step is to devise a series of watershed management goals. The goals will be established through a series of cooperative processes involving public participation and a technical evaluation overseen by governmental agencies. This approach employs both public and technical advisory groups designed to both build consensus and to draw upon external (non-governmental) expertise. It is hoped that the participation by regional stakeholders will help to build a consensus, thereby ensuring sensitivity to regional needs, while at the same time facilitating the eventual program implementation.

Once a set of goals is agreed upon, a set of implementation measures will be developed to meet those goals. Those measures will be organized into a workplan that will coordinate and concentrate existing program activities. Concurrently, work schedules will be developed establishing environmental milestones and time frames to meet those goals. When and if gaps are detected in the state's management capabilities or resources, new program initiatives (legislative recommendations, rule changes and/or program amendments) can be initiated in order to strengthen the management effort.

Towards these ends, the DEP has developed a Draft Statewide Watershed Management Framework Document for New Jersey which lays out the elements of a statewide watershed management process. It includes a delineation of watershed boundaries and proposes a phased, prioritized schedule for implementing watershed management activities throughout the state.

In summary, New Jersey perceives the benefits of the Comprehensive Watershed Management approach to be as follows:

- Policies and programs can make better use of sound technical information when evaluating resource status as well as in defining management goals.

- Adversarial relationships with either the environmental or the regulated communities are avoided by building an environmental evaluation and management process that operates on consensus. In addition, it is hoped that a merging of "publicly perceived" problems with "technically defined" problems can be achieved, thereby allowing government to be more effective in allocating limited resources to environmental degradation and public health.

- Program integration is improved. Monitoring, modeling, planning, permitting, and enforcement are all brought together through a common regional focus that will serve to streamline and better coordinate the process through a reduction of bureaucratic duplication and inter-program conflict.

Whippany River Watershed Project: Theory Put to Practice

In order to begin instituting a watershed approach into the DEP's water managing process, the Department is currently conducting a watershed protection pilot project in the Whippany River watershed. The project will help the DEP develop a workable watershed protection approach to water resource management and is being conducted in cooperation with local governments, permittees, regional interest groups and private citizens. The project will also demonstrate how the integration of planning, permitting, monitoring, modeling, financing and enforcement can better protect water resources.

The pilot project involves ten municipalities: East Hanover, Florham Park, Hanover, Madison, Mendham Township, Morris Plains, Morris Township, Morristown, Mountain Lakes and Parsippany-Troy Hills. It also includes small portions of Boonton, Boonton Township, Denville, Harding, Mendham Borough, Montville and Randolph. The watershed management strategy developed for the Whippany River by this project will reflect the regional and local needs as expressed through public involvement in the watershed management planning process.

The Whippany Project began in the fall of 1993 when a public meeting was held to solicit public involvement in the process. A public advisory group and technical advisory committee have been meeting on a regular basis since then. Watershed planning and public outreach efforts are also ongoing and will continue throughout the development and implementation of a watershed management plan for the Whippany River.

The pilot project will culminate in a **Whippany River Watershed Management Plan** which will contain management strategies for the watershed. The goals and objectives of the Watershed Management Plan would also be reflected in changes to the Department's New Jersey Pollutant Discharge Elimination System and the Northeast Water Quality Management Plan through changes in pollutant discharge allocations established for the watershed. The Watershed Management Plan would be regularly updated and fine tuned as the effectiveness of the strategies is monitored and evaluated by the Department and by regional and local entities.

Whippany River Project and Associated TMDL

An extensive technical effort has grown out of the Whippany Project intended to identify, prioritize and analyze water quality in the watershed and provide an understanding of the cause and effect relationships associated with all significant pollution sources, both point and nonpoint. A total maximum daily load (TMDL) analysis represents a significant portion of this technical effort.

An integrated water quality computer model to assess waste load allocations (WLA) and load allocations (LA) has been developed by the Department. In order to provide data for the model, monitoring under both low flow and high flow conditions was planned, including monitoring of major municipal discharges. As of this writing, four sampling efforts employing 17 in-stream stations have been completed. Additional sampling will include storm events (runoff sampling) which when accomplished, will complete the initial stage of what is termed the non-steady state or wet-weather monitoring. Using this data, a preliminary modeling analysis will be performed for the various sub-watersheds.

Low-flow sampling in the Whippany River employing "clean" field and laboratory methods has revealed no violations of heavy metals in the water column (dissolved form). In response the Technical Advisory Committee of the Whippany project has recommended that cadmium, copper and lead be removed from the list of pollutants of concern in the Whippany River. In 1997, the DEP will begin negotiations with USEPA on setting up procedures for delisting pollutants of concern from this State's 303(d) list (list of water quality limited waters).

NEW JERSEY'S SHELLFISH MONITORING AND REGULATION PROGRAM

The Bureau of Marine Water Classification and Analysis (BMWC&A) within the Department monitors the sanitary quality of estuarine and ocean waters for the suitability of shellfish harvesting. Its criteria for determining shellfish growing water status are based on the presence of real or potential sources of contamination from both point and nonpoint discharges. These are determined through actual measurements of coliform concentrations in the water column, hydrographic (tracing), and shoreline surveys.

The BMWC&A has classified coastal waters into five categories of shellfish harvesting areas. These categories are as follows:

- **Approved** - Waters meeting the sanitary standards for approved shellfish harvesting as recommended by the National Shellfish Sanitation Program. Waters not classified as Prohibited, Special Restricted, or Seasonal shall be considered Approved for the harvest of shellfish.

- **Seasonal** - Waters which are Special Restricted and opened for the harvest of oysters, clams and mussels each year but open by operation of regulations according to the schedule of 7:12-4.1: seasonal areas Approved November 1 through April 30, Condemned May 1 through October 31; and 7:12-4.2: Seasonal areas Approved January 1 through April 30, Condemned May 1 through December 31 yearly.

- **Seasonal Special Restricted** - Waters Condemned for the harvest of oysters, clams and mussels. However, harvesting for further processing may be done under special permit from the Department of Environmental Protection between May 1 and September 30th yearly.

- **Special Restricted Area** - Waters Condemned for the harvest of oysters, clams and mussels. However, harvesting for further processing may be done under special permit from the Department of Environmental Protection.

- **Prohibited** - Waters where the harvesting of shellfish is prohibited for any purpose except depletion and the bait harvesting of sea clams under special permit. Prohibited shellfish growing areas are closed for the harvesting of shellfish at all times.

- **Condemned** - Water not meeting the established sanitary standards as recommended by the National Shellfish Sanitation Program of the Interstate Shellfish Sanitation Conference as administered by the Federal Food and Drug Administration. Applications for removal of shellfish to be used for human consumption from areas classified as Condemned will be considered for resource recovery programs promulgated by the Department of Environmental Protection. Condemned areas are further divided into the following subclassifications: Prohibited, Special Restricted, Seasonal Special Restricted, and Seasonal.

The Department is responsible for delineating the distribution of the shellfish resources and implementing various management programs to provide for the best utilization of these resources. Some of the management programs that exist today that control the harvesting of shellfish, such as relay and depuration, are jointly managed by the Bureau of Shellfisheries and Bureau of Law Enforcement (Division of Fish, Game and Wildlife), the Bureau of Marine Water Classification and Analysis, and Department of Health and Senior Services.

Relay Program

The ability of shellfish to purify themselves of bacterial contamination when relayed to clean water was discovered early in the 1900s. New Jersey's Department of Environmental Protection currently administers a program which allows the relaying of shellfish from its Special Restricted areas into Approved growing areas for a minimum of thirty days. This enables shellfish to cleanse themselves of contaminating bacteria and/or viruses. Following the purification period, a sample of clams is analyzed for bacterial quality prior to being released for reharvesting and marketing. An additional benefit of the program is that by reducing the quantity of the shellfish resource contained within restricted waters, illegal clamming operations are discouraged, thus contributing to the protection of consumer health.

The program is under the supervision of the New Jersey Bureau of Marine Water Classification and Analysis (BMWC&A) and Bureau of Shellfisheries. Day to day patrol is provided by the Division of Fish, Game and Wildlife, Bureau of Law Enforcement. All clams harvested on any one day by clammers involved in the program are bagged, tagged and transported under secured conditions to specified Approved growing areas. Transportation of clams by secured means insures the public that none of the clams will be marketed before being relayed. After arriving at the Approved growing waters, the clams are deposited on the privately leased

plots by the clammers. The Bureau of Law Enforcement patrols the area until the clammers are notified that the clams are safe to harvest and market. The BMWC&A monitors the relay waters to insure proper water conditions are being met and thus verify the physiological requirements of the clams are such to permit pumping/purging to occur. Clams relayed during the winter are required to stay on the relay beds until early spring because lower water temperatures (minimum 50 degrees F) inhibit the rate of cleansing action (purging) by the shellfish.

The relay program is now centered in Monmouth County. The Navesink and Shrewsbury Rivers have been the mainstay of the clammers for several years now. Portions of Raritan and Sandy Hook Bays are also used and, to a less frequent extent, the Manasquan and Shark Rivers. In 1991, 1992, and 1993, 25 to 30 percent of the total landing of hard clams for New Jersey were from the relay.

Depuration Program

New Jersey's depuration program, like the relay program, relies on the natural ability of shellfish to purge themselves of bacterial contamination when placed in a clean environment. The program, under provision of a special permit issued by the Bureau of Marine Water Classification and Analysis (BMWC&A), allows the harvesting of hard and soft shell clams from areas classified as Special Restricted and requires the clams to be subjected to a 48 hour depuration period. At the depuration plant, the shellfish are placed in a water environment closely controlled to provide optimal conditions for efficient purification. Salinity and water temperatures are controlled to maintain maximum pumping/purging rates in the shellfish. The recirculated water in the depuration tanks is also disinfected with ultraviolet light to maintain high sanitary water quality. Following the depuration process, laboratory analyses are performed to verify that the shellfish meet appropriate standards. The depurated shellfish are then released for marketing. Specially marked boats are used for harvesting under the direction of the Division of Fish, Game and Wildlife (Bureau of Law Enforcement). At the end of the daily harvest, shellfish are transported to the depuration plant. All aspects of harvesting and transportation of these shellfish are closely monitored by the Division of Fish, Game and Wildlife (Bureau of Law Enforcement) to insure complete compliance with program procedures. The depuration plant itself is licensed by the N.J. Department of Health and Senior Services and is monitored by video camera.

NEW JERSEY'S STATEWIDE WATER SUPPLY PLAN

New Jersey receives more than 40 inches of annual precipitation, which provides on average, water for recreation, a large population, one of the nation's largest industrial concentrations, and aquatic life that requires a regular flow of clean water. However, even plentiful precipitation does not guarantee that droughts will not cause major water supply disruptions or that aquifers cannot be depleted. To ensure that New Jersey could cope with all foreseeable water needs and droughts, the Water Supply Management Act and the Water Supply Bond Act (Bond Fund) were approved in 1981, establishing a management framework and a source of public funding - $350 million - to help fulfill it. The Department of Environmental Protection (NJDEP) was entrusted with primary responsibility for both Acts.

NJDEP in 1982 adopted the first New Jersey Statewide Water Supply Master Plan, as required by the Water Supply Management Act. The 1982 Plan included major recommendations to improve surface water supply capacity (primarily in northeastern and central New Jersey), ensure proper maintenance of aging water supply infrastructure, investigate the status of major aquifers and plan for future water supply needs. As required by the Water Supply Bond Act, the 1982 Plan also determined which public water supply efforts were eligible for funding from the Bond Fund.

New Jersey has taken great strides to improve its water supplies based on the 1982 Plan. The Wanaque South Project/Monksville Reservoir and the rehabilitation of the Delaware & Raritan Canal provided major supply increases. The Manasquan Reservoir in Monmouth County, three major pipelines in the Central Passaic River Basin and Middlesex County, and the Tri-County Project near Camden provide surface waters to replace stressed aquifer supplies, based on research and feasibility studies funded by the Bond Fund. Scores of water supply systems have been upgraded using low-interest loans from the Bond Fund. Much more is now known about New Jersey's aquifers and significant efforts are in progress to protect these supplies, again supported by the Bond Fund. In short, the 1982 Plan has been a major success for New Jersey.

Based on successes of the 1982 Plan and recognizing that available supplies, projected needs for water supplies, development trends and knowledge regarding ecological water needs and water management concepts were changing, NJDEP began to develop a new plan. This New Jersey Statewide Water Supply Plan (NJSWSP) was developed by the NJDEP with the invaluable assistance of three consulting firms, the Water Supply Advisory Council (WSAC) and its Public Advisory Committee (PAC). The NJSWSP constitutes a complete revision and replacement of the 1982 Plan. Significant aspects of the new Water Supply Plan are the comparisons between water supply availability (both surface and ground) and water demand based on recent demand (1990), as well as projects of demand through the planning period of 1990 to 2040.

Statewide Water Supply Initiatives

The report makes recommendations for water supply management. Some are management initiatives that prevent or delay deficits, while others are capital project initiatives that will provide additional supplies. Statewide management initiatives include the following:

- Water Resources Protection -- A major conclusion of the Plan is that protection of existing supplies is fundamental to New Jersey's ability to provide sufficient water in the future. To this end the Plan emphases watershed-based pollution control and aquifer recharge protection.

- Water Supply Management -- Balancing allocations among water users, proper accounting for water used, and improving coordination among water users to stretch supplies during droughts.

- Water Conservation -- Conservation during drought as well as improved, long-term conservation designed to reduce stress on aquifers, aquatic ecosystems and water supplies.

- Water Delivery Management -- While the major water suppliers are generally capable of providing reliable service on a regular basis, small systems have a history of operational and public health problems. Efforts are needed to reduce the number of poorly-managed systems, both new and existing. Continued assistance for the improvement of existing systems (both treatment and delivery) is necessary.

Beyond the statewide management initiatives, the Plan also delineates regional management measures in a number of regions to address acute or long-term projected deficits and other management concerns.

The NJDEP intends to periodically update the NJSWSP as needed through minor changes. An extensive revision of the NJSWSP is planned within the next five to seven years. The revision will reflect new population and demand projections, improved understanding of regional water supply issues, progress made in implementing this NJSWSP and new recommendations for future action.

The Water Supply Element and the Municipal Finance and Construction Element are working together to develop a drinking water State Revolving Fund program to finance projects intended to assist suppliers in achieving or maintaining compliance with drinking water standards. The program will be financed by state and federal funds and will be structured like the State's wastewater treatment financing program.

CLEAN LAKES PROGRAM

The Clean Lakes program has traditionally been designed to help communities restore and maintain the recreational value of their local public lakes through the use of state and/or federally funded grant projects. The program is implemented by the Department under the guidance of USEPA. The restoration projects have been administered in two distinct phases: a diagnostic/feasibility study (Phase I), and an implementation phase (Phase II). Restoration projects must conform to N.J.A.C. 7:9-15 et seq., and 40 CFR Part 35, State and Federal Clean Lakes Regulations respectively.

Clean Lakes grants are awarded, as funds allow, according to a ranking list that is developed using the methodology developed for the N.J. Lake Classification Study Priority Ranking System. In order to be considered for a grant award, a "Phase I Project Proposal" is submitted to the Department. Project proposals are reviewed by the Department's Bureau of Water Monitoring, and forwarded to USEPA to await federal funding. If federal funding is not available, or if the project is not approved for federal funding, the proposal will be evaluated for state funding.

The objectives of Phase I are to acquire water quality data for the lake and watershed, determine the lake trophic status, determine the sources and causes of impairment, and to develop a lake restoration/management plan. In the process of developing a management plan, the Phase I process will identify governmental agencies that can assist in the process such as local environmental commissions, park and recreation departments, planning boards, and National Resource Conservation Service (NRCS) Districts.

Trophic assessments performed within Phase I are based on Trophic State Criteria, as described in USEPA's Clean Lakes Program Guidance Manual. These criteria are total phosphorus, chlorophyll a, and Secchi disk transparency. Trophic status may also be determined by documented impairments caused by other factors such as excessive macrophyte populations, bacterial contamination, or sedimentation. Over the years the program has amassed a useful body of information regarding the sources and causes of lake impairments across the state.

Phase II focuses upon methods and programs to control pollutant sources. Phase II lake restoration activities include land use planning, stormwater management, septic management, dredging, weed harvesting, lake aeration, and fisheries management.

As stated in Chapter III, the focus of the Lakes Program has now shifted from lake use restoration to resident fish-tissue analysis for toxic contamination. The effort is designed to detect the introduction of contaminants into lakes and to establish a baseline for future investigations into the bioaccmulation of toxic compounds within lake ecosystems.

WETLANDS PROTECTION

Over the past two decades, the public perception of wetlands has changed significantly. Once commonly regarded as waste areas with little or no value, wetlands are now recognized by many as a vital link in our ecological system. Wetlands can provide many important benefits including flood control, pollution filtration, aquatic and wildlife habitat, soil erosion and sedimentation control, ground water recharge, water supply, recreation, aesthetics, and research.

Wetlands have become increasingly threatened by development, as suitable land for building is rapidly diminishing. Since wetlands are scattered throughout the state, this impact is widespread. Table 5-1 shows the spatial distribution of wetlands by county. As indicated, while the central and southern counties contain much of the wetlands in the state, there is significant acreage in all of New Jersey's counties. It is estimated that New Jersey may have lost at least 20 percent of its wetlands since the mid-1900s. While some of the early losses were due to agriculture, for the last 30-40 years, filling of wetlands for residential, commercial, and industrial development has predominated.

In New Jersey the chemical, physical, and biological integrity of wetlands are protected under both federal and state laws. Federal protection is provided under sections 303, 401 and 404 of the Federal Clean Water Act. Section 401 is designed to allow the State to control any discharges to its waters which may result from the issuance of a federal permit or license, through a certification process. Section 404 addresses and regulates the discharge of dredge and/or fill material into wetlands and other waters of the state. In 1994, New Jersey began implementing its State program in place of the Section 404 program after being granted the authority by the EPA pursuant to Section 404(g). Section 303 provides protection through the antidegradation provisions of the Surface Water Quality Standards. The State includes wetlands in the definition of "surface waters" and is proceeding to establish water quality standards for wetlands, thereby expanding the role of section 303 in the protection of these waters (see SURFACE WATER QUALITY STANDARDS PROGRAM, at the end of this chapter).

Several New Jersey statutes provide various levels of protection to wetlands including the New Jersey Water Quality Planning Act (N.J.S.A. 58:11A-1), the Flood Hazard Area Control Act (N.J.S.A. 58:16A-50 et seq.) and the New Jersey Water Pollution Control Act (N.J.S.A. 58:10A-1). Specific protection is provided for New Jersey tidal wetlands through the Wetlands Act of 1970. In addition, since July 1, 1988, the State has protected its "inland" wetlands through the Freshwater Wetlands Protection Act (FWPA) (N.J.S.A. 13:9B-1 et seq.). Prior to enactment of the FWPA, several different state laws afforded various levels of protection to "inland" wetlands. One of the goals of the Act was to consolidate the protection of wetlands into one program. It should be noted, however, that the FWPA does not affect wetlands previously regulated under the Wetlands Act of 1970. In addition, the FWPA exempted areas under the jurisdiction of the Hackensack Meadowlands Development Commission and therefore, activities in this area do not require a State freshwater wetlands permit nor are they subject to transition area requirements. In the areas under the regulation of the Pinelands Commission, freshwater wetland requirements are implemented, but applicants must also comply with the Pinelands Comprehensive Management Plan.

TABLE 5-1: WETLANDS ACREAGE (APPROXIMATE) IN NEW JERSEY

County	Land Area (sq. mile)	Wetland Area* (acres)	% of County Represented by Wetlands
Atlantic	569	148,149	40.7
Bergen	234	10,084	6.7
Burlington	819	136,297	26.0
Camden	221	20,922	14.8
Cape May	267	89,581	52.4
Cumberland	500	98,950	30.9
Essex	130	6,833	8.2
Gloucester	329	36,844	17.5
Hudson	47	3,897	13.0
Hunterdon	423	5,450	2.0
Mercer	228	11,819	8.1
Middlesex	312	24,022	12.0
Monmouth	476	32,700	10.7
Morris	468	40,264	13.4
Ocean	642	128,531	31.3
Passaic	192	5,042	4.1
Salem	365	58,987	25.3
Somerset	307	11,127	5.7
Sussex	527	30,771	9.1
Union	103	3,053	4.6
Warren	362	12,637	5.5
State Total	7,521	915,960	19.0

Source: Tiner, 1985

* Based upon aerial photography

The FWPA regulates all activities in freshwater wetlands and the discharge of dredge or fill material into state open waters. The FWPA defines a freshwater wetland as an area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly known as hydrophilic vegetation. The State designates wetlands using the three parameter approach: hydrology, soils, and vegetation.

The FWPA authorizes the issuance of statewide general permits for specific activities defined by regulation such as underground utility crossings, minor road crossings, and construction of headwalls, and individual permits for all other activities which do not fall into one of the General permit categories. Since the implementation of the Act in 1988, the State has authorized 5158 statewide general permits and 223 individual permits resulting in the filling of 939.7 acres of wetlands and state open waters. It is estimated that prior to the adoption of the State law, several thousand acres of wetlands were lost on an annual basis as a result of the implementation of the federal 404 program in New Jersey. In fact, in a report prepared by the U.S. Fish and Wildlife Service (U.S.F.W.S.), it was estimated that from 1985 to 1992, the Army Corps of Engineers authorized the filling of 2,551 acres of wetlands. Further, the U.S.F.W.S. observed that this is probably an underestimation of what has legally occurred under this self-regulating program.

The FWPA also authorizes the issuance of waivers by the NJDEP for prohibited activities in transition areas: ecological "buffer" zones adjacent to freshwater wetlands. These prohibited activities include: (1) removal, excavation, or disturbance of the soil; (2) dumping or filling with any materials; (3) erection of structures; (4) placement of pavements; and (5) destruction of plant life which would alter the existing pattern of vegetation.

Under the transition area rules, the size of the transition area is determined by the resource value classification of the freshwater wetland that it encompasses. Exceptional resource value wetlands are those which provide habitat for threatened or endangered species and those which feature high water quality. A transition area of 150 feet is required adjacent to these wetlands. Ordinary resource value wetlands are defined as small, isolated, human-impacted wetlands, drainage ditches or swales. There is no transition area required adjacent to ordinary resource value wetlands. All other wetlands are defined as intermediate resource value wetlands and require a fifty-foot transition area. On July 3, 1989, the rules to implement the transition area provisions of the FWPA were adopted.

With respect to other wetlands-related activities, the State has completed a comprehensive mapping project to identify and classify all wetlands statewide. The addition of this information to the State's Geographic Information System, together with data on permit activity, will allow an evaluation of the cumulative impacts to wetlands resulting from the State permitting program on a county, regional, or watershed basis.

SURFACE WATER QUALITY STANDARDS PROGRAM

Note: Surface Water Quality Standards (SWQS) program is described in detail in Chapter 2 of this report; the discussion here is limited to recent changes to the standards themselves.

Modifications were proposed and formally adopted in 1993 to the New Jersey Surface Water Quality Standards. Among the most significant changes were numeric criteria for toxic and hazardous substances, a definition for wetlands which will act as an initial step toward developing Surface Water Quality Standards for wetlands and modifications to stream classifications based upon newly acquired information on trout streams. Below are listed the highlights of the changes to the SWQS.

- Recodification of the SWQS (formerly N.J.A.C. 7:9-4) to place them in their own chapter of New Jersey Administrative Code (N.J.A.C. 7:9B-1);
- Inclusion of wetlands under surface waters to protect the structure and function of wetlands;
- Aquatic and human health criteria were adopted for a number of toxic substances which includes priority pollutants (e.g., pesticides, volatiles, acid compounds, etc.);
- Human health criteria were adopted for several known human carcinogens with a risk level of one-in-one-million and possible human carcinogens (with limited evidence of carcinogenicity) with a risk level of one-in-one-hundred-thousand;
- Changes to the stream classification listings to make them more descriptive, as well as the addition of classifications and antidegradation categories where they had been accidentally omitted in the previous standards;
- Thermal criteria for saline estuarine bays were added to correct inadvertent omission during the previous adoption;
- Surface water reclassifications (from and to Trout Production and Trout Maintenance) were adopted for several streams based on available trout-fisheries data.
- Provisions to reflect that lakes, ponds, and reservoirs can potentially be classified as FW2-TP and that thermal criteria and heat dissipation areas apply to such waterbodies;
- A series of existing policies were codified into regulation such as the prohibition of mixing zones for bacterial indicators - criteria for bacterial indicators now apply to the end of the discharge pipe; quantities over the criterion levels are not allowed in the stream.

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Appendix

Watershed Specific Surface Water Assessment

INTRODUCTION

Presented here are watershed specific surface water quality assessments based upon water monitoring and assessment methods described in Chapter III of this Report. These individual assessments, in turn, form the basis of the overall statewide use attainment summary information also provided in Chapter III.

The material presented in this Appendix is organized according to the 20 Watershed Management Areas (see map in Chapter II) that function as chapters. Each of these Management Areas (chapters) begins with a summary fact-sheet that describes the Area in general terms and summarizes its swimming and aquatic life support status. This is followed by individual assessments of each of the assessed watersheds (subchapters) that lie within the Management Area. Discussions of each Management Area conclude with a table detailing the macroinvertebrate assessments on a site by site basis.

Each watershed assessment (subchapter) is in turn divided into the following discussions:

- a watershed description;
- a water quality assessment presented in both detailed and summary form;
- a description of point and nonpoint source pollution within the watershed;
- a brief summary of the attainment of designated uses within the watershed.

WATERSHED MANAGEMENT AREA 1
UPPER DELAWARE RIVER

The watershed management area includes watersheds draining the northwestern corner of New Jersey. The Area is comprised of Sussex and Warren Counties and includes the following watersheds:

Flat Brook	Paulins Kill	Pequest River
Pohatcong Creek	Shimmers Brook	Musconetcong River
VanCampens Brook		

Summary of ambient physical/chemical monitoring stations and classifications:

Flat Brook near Flatbrookville	FW-2 Trout Maintenance
Paulins Kill at Balesville	FW-2 Trout Maintenance
Paulins Kill at Blairstown	FW-2 Trout Maintenance
Pequest River at Pequest	FW-2 Non-Trout
Pohatcong Creek at New Village	FW-2 Trout Maintenance
Musconetcong River at Beattystown	FW-2 Trout Maintenance
Musconetcong River Bloomsbury	FW-2 Trout Maintenance
Musconetcong River Riegelsville	FW-2 Trout Maintenance

Note: Musconetcong River monitoring locations at Lake Hopatcong and at Lockwood have been discontinued as of 1991.

OVERALL MANAGEMENT AREA ASSESSMENT

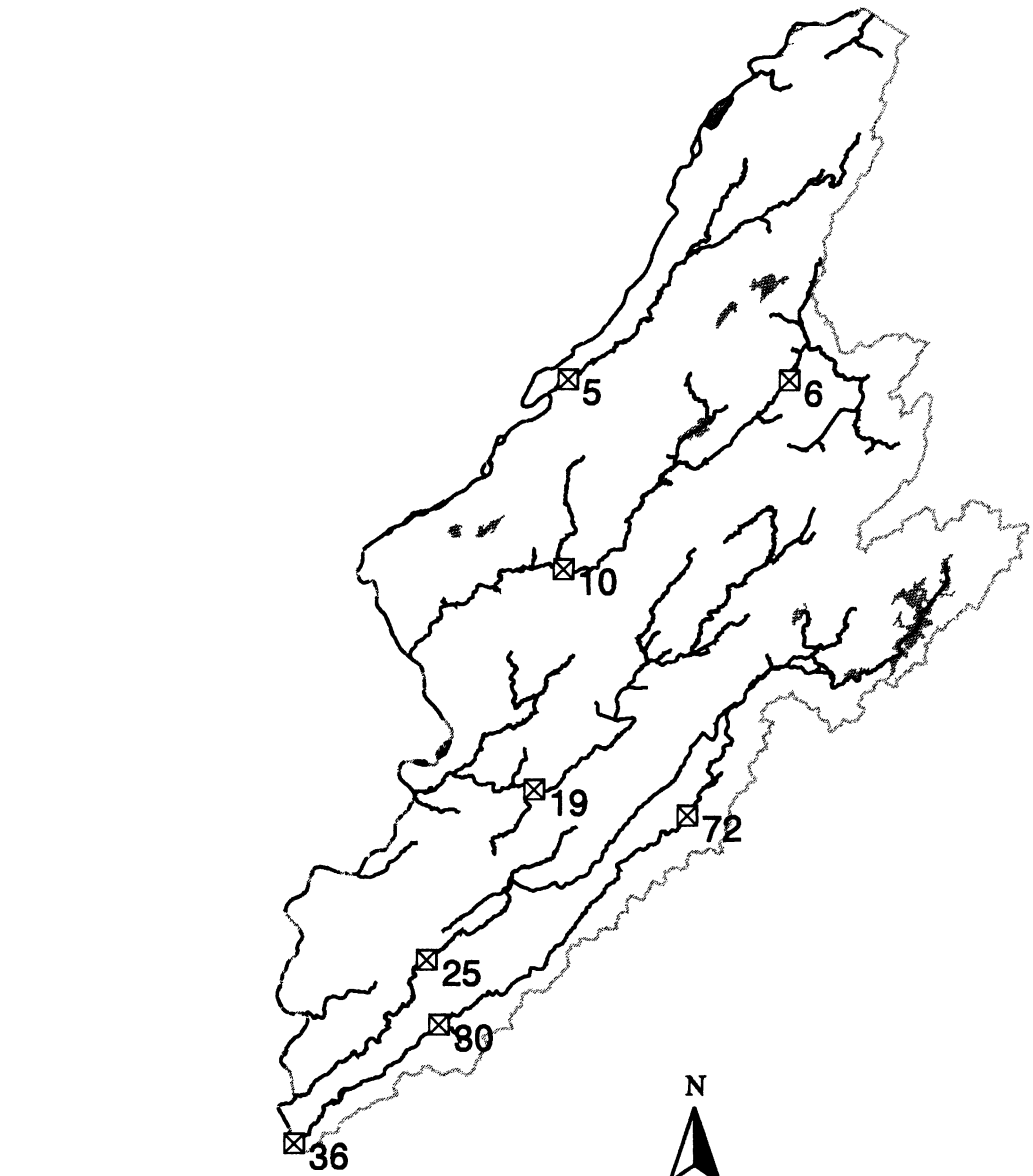
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Flat Brook	near Flatbrookville	Full Support
Paulins Kill	at Balesville	No Support
Paulins Kill	at Blairstown	Partial Support
Pequest River	at Pequest	Partial Support
Pohatcong Creek	at New Village	No Support
Musconetcong River	at Beattystown	Partial Support
Musconetcong River	Bloomsbury	No Support
Musconetcong River	Riegelsville	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 52 Mod. Impairment: 20 Severe Impairment: 1

Upper Delaware River
Watershed Management Area 1

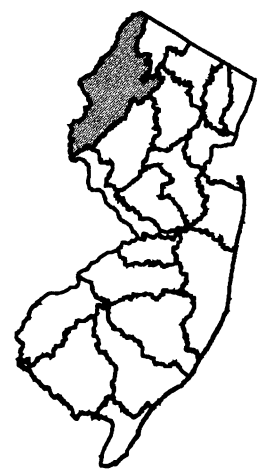


Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary

N

4 0 4 Miles

Location



5. Flatbrook, Flatbrookville, NJ
6. Paulins Kill, Balesville, NJ
10. Paulins Kill, Blairstown, NJ
19. Pequest River, Pequest, NJ
25. Pohatcong Creek, New Village, NJ
30. Musconetcong River, Bloombury, NJ
36. Musconetcong River, Riegelsville, NJ
72. Musconetcong River, Beattystown, NJ

FLAT BROOK

WATERSHED DESCRIPTION

The area drained by the Little Flat Brook, the Big Flat Brook (15 miles long) and the Flat Brook (10 miles long) is 65 square miles. This brook runs along the western boundary of Sussex County into the Delaware River 1.5 miles downstream of Flatbrookville. There are no major population centers, as most of this area is undeveloped mountainous forests contained within state parks, state forests, and the Delaware Water Gap National Recreation Area.

There are many lakes and ponds to accommodate bathing beaches and recreational fishery resources. There are very few point sources in the watershed. The Flat Brook and its tributaries are classified for the most part as FW-1 and FW-2 Trout Maintenance. There are also FW-2 Trout Production and Nontrout waters in the region.

WATER QUALITY ASSESSMENT

The Flat Brook and tributaries continue to contain among the highest quality surface waters in the state. Much of the Flat Brook watershed lies within state park and forest boundaries, thereby affording the streams protection from development. Monitoring is conducted on the Flat Brook near Flatbrookville, which represents most of the 10 mile stretch of the Flat Brook. Because of the relative stability of the water quality at this location, monitoring frequency has been reduced to half the frequency of other locations beginning in 1992; this station is sampled 5 times a year on alternating years. Because of this, the assessment of physical/chemical conditions presented here for the Flat Brook station is based upon a limited number of data points and is therefore presented in a more descriptive fashion than are the other monitoring locations presented in this Management Area.

Monitoring indicates water quality is still good. Periodic summertime problems may still occur because of elevated stream temperature for the protection of cold water fisheries. Dissolved oxygen, fecal coliform and nutrients were all within appropriate State criteria throughout the period of review.

Overall improvements in Flat Brook water quality had been identified between 1977 and 1987. This improvement was reflected in increases in dissolved oxygen as well as decreases in nitrogen-containing compounds and total mercury. The department is currently supporting an assessment of trends within the 1990s in order to evaluate current conditions.

Biomonitoring within the Flatbrook, Little Flatbrook and Big Flatbrook indicates healthy biotic communities. One station, Flatbrook at Walpack Center showed moderate impairment in the most recent assessment (1994). In contrast, earlier biomonitoring assessments in 1993 revealed non-impaired conditions. The reasons behind this change are not yet known. See the

Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

A limited number of point sources are present in the Flat Brook watershed. Some have had impacts to local water quality.

The following wastewater treatment plant permit violation has been mitigated, resulting in water quality improvements:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
NJ Dept. of Corrections Mountainview-Stokes Youth Correctional Facility	Montague Twp., Sussex Co.	trib to Big Flat Brook	Facility had discharged treated sanitary wastewater. Discharges were required to cease in 1988. Since 1992, all wastewater generated at the facility has been hauled offsite. The DEP is currently reviewing the permit renewal application for a discharge to groundwater.

NONPOINT SOURCE ASSESSMENT

The waters of the Flat Brook watershed are among the least polluted in the state. The conversion of summer homes to year-round dwellings has resulted in some local nonpoint source contamination from home and road construction, suburban runoff and septic system leachate. Only Little Flat Brook was noted as receiving some minor agricultural runoff.

DESIGNATED USE ASSESSMENT

The Flat Brook as monitored near Flatbrookville does support primary contact recreation. Almost all monitored waters within the Flat Brook watershed fully support the aquatic life designated use, based upon biological monitoring. One station located by Rt. 615 near the Walpack center indicated partial support when sampled in 1994. Previous sampling in 1993 suggested full support. Two stations on Clove Brook, within the neighboring watershed, were found to be moderately impaired.

PAULINS KILL

WATERSHED DESCRIPTION

The Paulins Kill drains an area of 172 square miles, of which 110 square miles are in Sussex County and 62 square miles are in Warren County. This 39 mile long river runs through western Sussex and northern Warren Counties to the Delaware River at Columbia. Newton and Blairstown are the most developed centers of this rural area, but there is development along Route 15. Major tributaries to the Paulins Kill include Yards Creek, Trout Brook, Blair Creek, Morses Brook, and Culver Brook. Impoundments include Paulins Kill Lake, Swartswood Lake, Little Swartswood Lake, Culvers Lake, and Lake Owassa.

The land use in this watershed is primarily agricultural and forested, but there are increasing amounts of developed suburban and commercial lands. There are approximately 10 NJPDES permitted discharges, of which roughly half are municipal and half are industrial/commercial. The stream classifications for the Paulins Kill and tributaries have been identified as FW-2 Trout Production, FW-2 Trout Maintenance, and FW-2 Nontrout.

The Paulins Kill is monitored for physical/chemical parameters at Blairstown, located in the lower watershed, and at Balesville above Paulins Kill Lake. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Paulins Kill at Balesville and at Blairstown

Nutrients: Water quality of the Paulins Kill remains relatively stable with regard to nutrients. There are more phosphorus violations at Balesville (25%) than at Blairstown (5%) because the presence of an impoundment near the upstream station requires a more restrictive phosphorus criteria at Balesville (0.05 mg/L as compared to 0.10 mg/L at the downstream station). Both locations had similar median values and distributions.

Temperature: Blairstown temperatures exceeded the upper level for trout maintenance waters in 35% of the recorded values. In contrast, 15% of the temperature values recorded at the upstream Balesville station exceeded the upper criterion.

pH: One violation of the upper pH criterion was observed at Blairstown (8.7 in August of 1993).

Paulins Kill at Balesville and at Blairstown continued:

Bacteria: Blairstown exhibits mild elevations of the fecal coliform bacteria. Geometric mean is 96 MPN/100ml, but 15% of samples exceeded the 400 MPN/100 ml criterion. At Balesville, sanitary conditions are unacceptable; the geometric mean of fecal coliform bacteria is 440 MPN/100 ml.

Summary: Water quality in the Paulins Kill ranges from fair quality to good. In general, phosphorus levels are good to marginal. Note that there are more phosphorus violations at Balesville (25%) than at Blairstown (5%) because the presence of an impoundment near the upstream (Balesville) station requires a more restrictive phosphorus criteria (0.05 mg/L as compared to 0.10 mg/L employed at Blairstown). Instream temperatures tend to run warm for trout maintenance waters; elevated water temperatures are more of a problem at Blairstown than upstream at Balesville. At Balesville bacterial counts were notably higher than downstream at Blairstown where sanitary quality runs good to marginal. Other water quality parameters including DO, ammonia, nitrogen and heavy metals are all at acceptable levels.

Current water quality conditions are similar to those encountered during the last assessment using data from 1986 through 1990. The one exception lies in an apparent reduction in phosphorus which seems to have occurred at the Balesville monitoring location.

Biological Monitoring

Biological monitoring in the Paulins Kill itself indicated overall healthy biological conditions. Two locations, however, at Warbasse and below Paulins Kill Lake, indicated moderately impaired conditions. All other remaining locations on the mainstem of the stream were nonimpaired (see the Biological Assessment Table located at the end of this section). Biological impairment was evident in other streams within this watershed. Several unnamed tributaries to the Paulins Kill, as well as Culvers Creek, portions of Troy Brook, Blair Creek and Yards Creek, exhibited moderately to severely impaired macroinvertebrate communities.

POINT SOURCE ASSESSMENT

The Upper Paulins Kill, from Newton to Paulins Kill Lake, had in the past been significantly impacted by the Newton sewage treatment facility which had been discharging inadequately treated effluent into Moores Brook. Previous modeling analyses had estimated that up to 95 percent of the nutrient loading in the Upper Paulins Kill was from this facility. Under an ACO, the facility has upgraded in the early 1990s and no longer impairs water quality as it once did.

NONPOINT SOURCE ASSESSMENT

The Paulins Kill watershed has been assessed and found to be experiencing runoff associated with rapid suburban land development. Housing construction site runoff, suburban surface runoff, as well as heavy winter road salting, are all suspected to be a problem. This is coupled with a decline

in agricultural runoff from crop production. Nonpoint sources have caused eutrophication in many of the lakes in this watershed, including Swartswood Lake.

DESIGNATED USE ASSESSMENT

The Paulins Kill does not support primary contact recreation at the upstream site at Balesville. The stream partially supports the use downstream at Blairstown.

Portions of the Paulins Kill appear to be supporting the "aquatic life support" designated use, while some limited portions partially support the use. Some stress to cold water fishlife (trout and smallmouth bass populations) from high water temperature in summer months may be occurring. Increased residential and commercial development forecasted for the watershed will most likely impact water quality.

PEQUEST RIVER

WATERSHED DESCRIPTION

The Pequest River drainage basin is 158 square miles. The river itself is 32 miles long and flows from southern Sussex County southwest through Warren County to the Delaware River, downstream of Belvidere. The major tributaries to the Pequest include Trout Brook, Beaver Brook, Furnace Brook, and Bear Creek. While there are many small lakes and ponds in the watershed, there are no major impoundments on the Pequest River.

The Pequest River watershed contains many recreational areas, with land use being heavily forested and agricultural. As with the other watersheds in the northwestern section of the State, residential and commercial development is intensifying. There are approximately 9 NJPDES permitted discharges here, of which about one-third are municipal and two-thirds are commercial/industrial. The water quality classifications are FW-2 Trout Maintenance and FW-2 Nontrout, except for the waterways within the Whittingham Tract, which are classified FW-2 Trout Production.

The Pequest River is monitored for physical/chemical parameters at the town of Pequest, located in the lower watershed. See the Biological Assessment Table located at the end of this section for locations of macroinvertebrate assessments within the watershed.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Pequest River at Pequest

Nutrients: Excessive total phosphorus is observed; one third of all samples exceeded the criteria of 0.10 mg/L. Nitrate plus nitrite, although at acceptable levels, are somewhat elevated, with a median value of 1.24 mg/l.

Bacteria: Fecal coliform levels are marginal; the geometric mean is 198 MPN/100 ml, with 22% of samples exceeding 400 MPN/100 ml.

pH: One violation of the upper criterion occurred in August of 1992.

Other: Chloride levels are somewhat elevated at the Pequest monitoring station; median value for the period assessed was 29 mg/l.

Summary: Overall water quality of the Pequest at Pequest is good. The Pequest River in the lower watershed is a cool, fast moving stream with numerous riffles. Therefore, oxygen reaeration results in sufficient in-stream dissolved oxygen levels during critical periods. Moderately elevated nutrients and bacteria are problematic. Current conditions closely resemble those observed during the last review period when data from 1986 through 1990 were assessed.

Biological Monitoring

Macroinvertebrate assessments indicate the Pequest mainstem to be nonimpaired throughout much of its length. The one exception is at Springdale off Rt. 206 where the community was observed to be moderately impaired. Most tributary stations are also nonimpaired, however, Trout Brook at Rt. 612 appears to undergo periodic moderate impairment, and Mountain Lake Brook below Mountain Lake is also moderately impaired. Furnace Brook at Oxford is severely impaired.

POINT SOURCE ASSESSMENT

Point sources to the Pequest River watershed are thought to be limited, however, some have in the past caused water quality impairment.

The following wastewater treatment plant has been upgraded and/or expanded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Oxford Textiles, Inc.	Oxford Twp., Warren Co.	Furnace Brook via Cat Swamp	Discharge of process wastewater contained BOD and acute toxicity violations. Facility has implemented production and disinfection changes to achieve permit compliance.

NONPOINT SOURCE ASSESSMENT

The Pequest has been reported to be impacted by the suburban development occurring throughout the watershed. Back in the late 1980s, the Natural Resource Conservation Service had identified the Pequest system as having serious sheet and soil erosion rates. In the upper half, pollution from agricultural activities such as runoff from crop lands and animal holdings was believed to be on the decline, being replaced with increasing effects of housing construction, suburban runoff, and heavy winter road salting. The overall result has been a combination of nutrient enrichment, pesticide and sediment loading, flooding, and elevated chloride levels in the stream. Nonpoint source pollution in the lower half of the Pequest is known to arise principally from housing construction activities. The most degraded section of the Pequest is reported to be in the Vienna-Great Meadows area where channelization has resulted in complete habitat destruction. Many tributaries in the watershed which support healthy fisheries do receive some minor agricultural runoff; two such streams are Andover Junction Brook and Beaver Brook.

DESIGNATED USE ASSESSMENT

The Lower Pequest is considered partially swimmable. The Pequest River contains both Trout Maintenance and Nontrout waters. Large portions of the watershed appear to fully support the aquatic life support designated use. Three locations (see Biological Monitoring above) partially support the use and one location does not support the use.

POHATCONG CREEK

WATERSHED DESCRIPTION

The 28 mile long Pohatcong Creek stretches from Independence Township to the Delaware River south of Phillipsburg. It drains a 57 square mile area of southwestern Warren County. The population in this area is centered in the Boroughs of Alpha and Washington. Major tributaries include Brass Castle Creek, Shabbecong Creek, and Merrill Creek. The only notable impoundment in the watershed is the Roaring Rock Brook Reservoir, although a reservoir for low-flow augmentation in the Delaware River is being constructed on Merrill Creek.

The land use in this watershed is predominantly agricultural. There are approximately 6 NJPDES permitted discharges here, half of which are municipal and half are commercial/industrial. Pohatcong Creek and its tributaries are classified as FW-2 Trout Production and FW-2 Trout Maintenance. Pohatcong Creek is monitored at New Village for determination of physical/chemical water quality conditions.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Pohatcong Creek at New Village

Dissolved Oxygen: Acceptable.

Temperature: Elevated: 10% exceeded upper limit for Trout Maintenance waters.

Nutrients: Phosphorus is elevated; violations occurred in 33 % of samples taken during the period of assessment. Median is 0.21 mg/l. Nitrate+Nitrite is also somewhat elevated, median being 1.24 mg/l.

pH: One violation of upper criterion.

Bacteria: Elevated: Fecal coliform geometric mean was 427 MPN/100 ml, with 55% of samples over 400 MPN/100 ml. Location fails to support swimming.

Summary: Current monitoring indicates moderate nutrient enrichment, high in-stream temperatures and excessive bacteria. Current conditions are an improvement over what was observed in 1992. Phosphorus violations are more than half of what they were then and although stream temperatures can still be elevated, unionized ammonia levels seem currently to be within acceptable levels.

Biological Assessment

Macroinvertebrate assessments indicate the Pohatcong to have moderately impaired communities in the upper half (with the exception of the uppermost

station that was nonimpaired). The downstream half is nonimpaired. A portion of Merrill Creek in Harmony Township was observed to be moderately impaired. An intensive survey of Pohatcong Creek conducted in 1984 found elevated lead, manganese and nickel in fish tissue. The potential source of the metals was not identified. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Pohatcong Creek and tributaries drain a predominantly agricultural area with one population center, Washington Borough in Warren County. The creek is fairly small and it appears from the water quality data that it cannot assimilate the pollution loads that drain into the stream.

NONPOINT SOURCE ASSESSMENT

Pohatcong Creek is believed to be impacted by agricultural runoff from croplands and chicken farms. In the recent past, the Pohatcong Creek watershed had been known to have among the highest soil erosion rates in the state. Intensive suburban development has occurred, fueled by one acre zoning. Housing construction, urban surface runoff, plus runoff from storm sewers are all suspected to be contributing to local flooding and local declines in water quality.

As in the Pohatcong Creek, Lopatcong Creek has been impacted by suburban development within the watershed, receiving quantities of urban surface runoff and storm sewer outflow. These are suspected to have caused some water quality degradation as well as flooding. New residential and commercial development in many areas of the watershed may contribute additional runoff problems.

DESIGNATED USE ASSESSMENT

The Pohatcong Creek at New Village will not support the primary contact designated use because of high fecal coliform levels. The upper half of the Pohatcong (with the exception of the uppermost station) partially supports the aquatic life support designated use. The downstream half fully supports the use. Portions of Merrill Creek in Harmony township also partially support the use.

MUSCONETCONG RIVER

WATERSHED DESCRIPTION

The Musconetcong River drains an area of about 156 square miles. It is 42 miles long, stretching from its headwaters at Lake Hopatcong to the Delaware River at Riegelsville. Parts of Sussex, Warren, Hunterdon, and Morris Counties are in the Musconetcong drainage basin. The Upper and Lower Musconetcong comprise the entire watershed. The population centers in this watershed are the towns of Hackettstown, Mt. Olive, and Stanhope. There has also been significant development along the shores of Lakes Hopatcong and Musconetcong. The two major tributaries to the Musconetcong River are Lubbers Run and Beaver Brook. Major impoundments include Lake Hopatcong (the largest lake in New Jersey), Lake Shawnee, Lake Musconetcong, and Cranberry Reservoir.

Aside from the aforementioned developed areas, the rest of the watershed is mostly forests or used for agriculture, although significant development pressures are occurring. The waters of the Musconetcong and tributaries are classified, at various locations, as FW-1, FW-2 Trout Production, FW-2 Trout Maintenance, and FW-2 Nontrout. The Musconetcong River is heavily stocked and utilized by fishermen.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Musconetcong at Beattystown, Bloomsbury and Riegelsville.

Dissolved Oxygen: Acceptable at all three stations

Temperature: Elevated at all three locations: 7% exceeded upper limit for Trout Maintenance waters at Beattystown. Downstream at Bloomsbury and Riegelsville, 11% and 10% of temperature recordings were in violation of the limit.

Nutrients; Phosphorus is slightly elevated at Beattystown and Bloomsbury. At Beattystown, violations occurred in 11% of samples taken during the period of assessment (median = 0.055 mg/l). At Bloomsbury, 17% of samples were in violation (median = 0.035 mg/l). No violations were observed at the downstream-most location at Riegelsville.

Nitrate+Nitrite medians increased as one proceeds downstream. Median values were 0.99 mg/l, 1.76 mg/l and 1.86 at Beattystown, Bloomsbury and Riegelsville, respectively.

Musconetcong continued

pH: Twenty-two percent violate upper criterion of 8.5 at Beattystown. Eleven percent were in violation at Bloomsbury. No violations were observed at Riegelsville.

Bacteria: At Beattystown, fecal coliform geometric mean was marginal, with 143 MPN and 33% of samples exceeding the 400 MPN/100ml criterion. Downstream at Bloomsbury, levels increase to unacceptable levels, with a geometric mean of 400 MPN/100ml. At Riegelsville the geometric mean was 209 MPN/100ml, representing marginally unacceptable conditions.

Heavy Metals: At Beattystown, one of four copper samples exceeded the chronic criterion for this metal. No violations were recorded at the other two locations.

Un-ionized Ammonia: At Beattystown, three of twenty samples exceeded the criterion for ammonia toxicity of 20 ug/l. No violations were recorded at the other two locations.

Summary: Elevated summertime temperatures are problematic at all three monitoring locations. Nutrients are somewhat elevated, notably phosphorus in the central portion of the river. Bacterial levels range from marginal (Riegelsville and Beattystown) to unacceptable (Bloomsbury). Of particular concern are the exceedances of copper and unionized ammonia observed at Beattystown.

Biological Assessment:
The Musconetcong River itself has a mix of both nonimpaired and moderately impaired stations in the upper half of the river. The lower half appears to be nonimpaired. The quality the tributaries to the Musconetcong also varied. Wills Brook appeared to be moderately impaired; Trout Brook, and Mine Brook were nonimpaired. Lubbers Run had sections reflecting both moderate as well as non-impairment. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Three permitted facilities are currently on record as being in violation of their discharge permit (see below).

Current status of permitted wastewater discharges within the Watershed that were reported to be in noncompliance with their discharge permits:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Diamond Hill Estates STP	Mansfield Twp., Warren Co.	Hances Brook	Violations of effluent limits for DO, BOD, Suspended Solids, Residual Chlorine, Oil & Grease, and Ammonia.	Effluent limitations are repeatedly violated in spite of escalating enforcement actions.
Mountainview Youth Correctional Institution	Mountainview	Beaver Brook	Violations of effluent limits for BOD5, TKN, total residual chorine, and fecal coliform.	Treatment plant sanitary discharge has frequent effluent violations. An upgraded surface water discharge facility became operational in December 1996 pursuant to an ACO. Compliance with effluent limits has improved, with some ACO issues still pending.
National Auto Truckstops, Inc.	Bloomsbury Borough, Hunterdon Co.	Musconetcong River	Violations of COD and total suspended solids.	Discharge of treated stormwater runoff has shown frequent violations of effluent limits. An ACO was executed in August 1996 to memorialize a compliance schedule.

The following wastewater treatment plant has been upgraded and/or expanded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Mt. Arlington Sanitation Corp.	Morris Co.	Lake Hopatcong	Facility formerly discharged treated sanitary wastewater. Plant ceased discharge on Sept. 1994.

NONPOINT SOURCE ASSESSMENT

The upper reaches of the Musconetcong are believed to be receiving increasing amounts of pollution as a result of areawide suburban development. Moderate to severe urban runoff and runoff from construction activities are suspected as causing a decline in stream water quality and an increase in lake eutrophication in the late 1980s. Heavy winter road salting is also an areawide problem. Increasing runoff from urban surfaces and from storm sewers has been singled out as a problem in the Hackettstown area. In the lower reaches of the Musconetcong, chemical and bacterial contamination from agricultural crop production and pasture land are on the decline. In contrast, siltation and erosion from construction activities, nutrients and bacteria from septic systems, as well as road salt, and oil and grease from highway runoff are all reported to be on the increase.

Willis Brook, in addition to point sources, also suffers from the impacts of construction, urban runoff, road runoff, and channelization. They are all assessed to be at severe and ever growing levels. These have brought about flooding as well as a decline in water quality. Mine Brook likewise suffers from water quality and flooding problems brought about by growing levels of construction, highway maintenance runoff, and channelization. Mine Brook

additionally receives agricultural runoff from animal holdings, crop land, and pasture land, all of which appear to be on the decline. The runoff arising from the increasing amounts of housing construction activity in the areas around Trout Brook is believed to be a significant threat to the Hackettstown fish hatchery, as pointed out by local officials. In addition, this brook has experienced fish kills in the past caused by industrial pollution.

Among the lakes evaluated, Lake Shawnee in Morris County is impacted by increasing housing construction. Lake Musconetcong suffers from advanced eutrophication linked to a wide range of nonpoint pollution sources. Known sources include runoff from housing and road construction, and runoff from road and suburban surfaces. A severe problem with septic system leachate has been singled out by local authorities. Well maintained retention basins is a suggested solution made by local authorities. Lake Hopatcong is also reported to receive local fuel spills and leaks which have been suspected in fish kills.

DESIGNATED USE ASSESSMENT

Based upon bacterial data, the Musconetcong partially supports primary contact recreation at Beattystown but will not support the use at either Riegelsville or Bloomsbury. Portions of the upper half of the river both fully support and partially support the aquatic life designated use, while the lower half of the river fully supports this use.

BIOLOGICAL ASSESSMENT TABLE: AREA 1

Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
1	AN0001	Clove Bk	off Rt 23	Montague Twp	Jan 7, 1993	moderately impaired
1	AN0002	Clove Bk	Rt 23	Duttonville	Jan 7, 1993	moderately impaired
1	AN0003	Shimers Bk	Rt 521	Millville	Jan 6, 1993	non-impaired
4	AN0004	Ltl Flat Bk	Deckertown Tnpk (Rt 650)	Four Cors	Jan 7, 1993	non-impaired
4	AN0004	Ltl Flat Bk	Deckertown Tnpk (Rt 650)	Four Cors	Jul 13, 1993	non-impaired
4	AN0004	Ltl Flat Bk	Deckertown Tnpk (Rt 650)	Four Cors	Oct 26, 1993	non-impaired
4	AN0004	Ltl Flat Bk	Deckertown Tnpk (Rt 650)	Four Cors	Apr 19, 1994	non-impaired
4	AN0005	Ltl Flat Bk	Degroat Rd	Hainesville	Jan 6, 1993	non-impaired
4	AN005A	Ltl Flat Bk	Rt 615	Sandyston Twp	Jul 13, 1993	non-impaired
4	AN005A	Ltl Flat Bk	Rt 615	Sandyston Twp	Oct 26, 1993	non-impaired
4	AN005A	Ltl Flat Bk	Rt 615	Sandyston Twp	Feb 2, 1994	non-impaired
4	AN005A	Ltl Flat Bk	Rt 615	Sandyston Twp	Apr 20, 1994	non-impaired
4	AN0006	Bg Flat Bk	Rt 521	Tuttles Cor	Jan 6, 1993	non-impaired
4	AN0006	Bg Flat Bk	Rt 521	Tuttles Cor	Jul 13, 1993	non-impaired
4	AN0006	Bg Flat Bk	Rt 521	Tuttles Cor	Oct 26, 1993	non-impaired
4	AN0006	Bg Flat Bk	Rt 521	Tuttles Cor	Apr 19, 1994	non-impaired
4	AN0007	Flat Bk	Rt 615	Walpack Center	Jan 6, 1993	non-impaired
4	AN0007	Flat Bk	Rt 615	Walpack Center	Jul 13, 1993	non-impaired
4	AN0007	Flat Bk	Rt 615	Walpack Center	Oct 26, 1993	non-impaired
4	AN0007	Flat Bk	Rt 615	Walpack Center	Apr 20, 1994	moderately impaired
4	AN0008	Flat Bk	Rt 615	Flatbrookville	Nov 16, 1992	non-impaired
4	AN0008	Flat Bk	Rt 615	Flatbrookville	Jul 13, 1993	non-impaired
4	AN0008	Flat Bk	Rt 615	Flatbrookville	Oct 26, 1993	non-impaired
4	AN0008	Flat Bk	Rt 615	Flatbrookville	Apr 20, 1994	non-impaired
4	AN0008	Flat Bk	Rt 615	Flatbrookville	Jan 13, 1995	non-impaired

BIOLOGICAL ASSESSMENT TABLE: AREA 1 contin.

Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
10	AN0009	Van Campens Bk	Flatbrookville - Middleville Rd	Walpack Twp	Nov 16, 1992	non-impaired
10	AN0011	Van Campens Bk	Old Mine Rd	Pahaquarry Twp	Nov 16, 1992	non-impaired
10	AN0012	Dunfield Ck	River Rd (off Rt 80)	Pahaquarry Twp	Nov 16, 1992	non-impaired
6	AN0014	Paulins Kill trib	Rt 623	W of Sparta Jnct	Oct 14, 1992	moderately impaired
6	AN0015	Paulins Kill	Rt 663	Warbasse	Oct 14, 1992	moderately impaired
6	AN0016	Paulins Kill trib	Lafayette Meadows Rd	Lafayette Twp	Aug 8, 1984	moderately impaired
6	AN0016	Paulins Kill trib	Lafayette Meadows Rd	Lafayette Twp	Oct 14, 1992	non-impaired
6	AN016A	Paulins Kill trib	Rt 94 & Old Beaver Run Rd	Lafayette Twp	Aug 7, 1984	moderately impaired
6	AN0017	Culvers Ck	Rt 206	Frankford Twp	Oct 13, 1992	moderately impaired
6	AN0018	Culvers Ck	Long Bridge Rd	Frankford Twp	Oct 13, 1992	moderately impaired
6	AN0019	Dry Bk	Rt 519	Frankford Twp	Oct 13, 1992	non-impaired
6	AN0020	Dry Bk	Mill Rd	Branchville	Oct 13, 1992	non-impaired
6	AN0021	Paulins Kill	Rt 626	Balesville	Oct 14, 1992	non-impaired
6	AN021A	Paulins Kill trib	Van Sickle Rd	Lafayette Twp	Aug 8, 1984	moderately impaired
6	AN021B	Paulins Kill	behind Municipal Bldg	Lafayette	Aug 7, 1984	non-impaired
6	AN021C	Paulins Kill	Rt 661	Lafayette Twp	Aug 8, 1984	non-impaired
6	AN0022	Paulins Kill	blw Paulins Kill Lk	Stillwater Twp	Oct 30, 1992	moderately impaired
6	AN0023	Troy Bk	blw Swartswood Lk	Stillwater Twp	Aug 3, 1988	non-impaired
6	AN0023	Troy Bk	blw Swartswood Lk	Stillwater Twp	Oct 30, 1992	moderately impaired
6	AN0024	Trout Bk	Pond Bk Rd (Rt 612)	Middleville	Oct 30, 1992	non-impaired
6	AN0025	Paulins Kill	USGS gage	Blairstown	Nov 9, 1992	non-impaired
6	AN025A	Blair Ck	blw Fairview Lk	Hardwick Twp	Aug 7, 1991	non-impaired
6	AN025A	Blair Ck	blw Fairview Lk	Hardwick Twp	Oct 22, 1991	non-impaired
6	AN025A	Blair Ck	blw Fairview Lk	Hardwick Twp	Jan 13, 1992	moderately impaired
6	AN025A	Blair Ck	blw Fairview Lk	Hardwick Twp	Apr 7, 1992	severely impaired
6	AN0026	Blair Ck	Shannon Rd	Hardwick Twp	Oct 30, 1992	non-impaired
6	AN0027	Blair Ck	Rt 94	Blairstown	Nov 9, 1992	moderately impaired

BIOLOGICAL ASSESSMENT TABLE: AREA 1 contin.

Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	AN0028	Jacksonburg Ck	Rt 602	Hardwick Twp	Nov 9, 1992	non-impaired
6	AN0029	Jacksonburg Ck	Rt 94	Jacksonburg	Nov 9, 1992	non-impaired
6	AN0030	Yards Ck	Mt Vernon Rd	Mt Vernon	Oct 11, 1992	moderately impaired
6	AN0031	Yards Ck	Rt 94	Hainesburg	Nov 10, 1992	non-impaired
6	AN0032	Paulins Kill	Rt 46	Columbia	Nov 10, 1992	non-impaired
20	AN0033	Delawanna Ck	Rt 46	Delaware	Nov 10, 1992	non-impaired
20	AN0034	Ramseysburg Ck	Rt 46	Ramseysburg	Nov 10, 1992	non-impaired
15	AN0035	Pequest R	Rt 206	Springdale	Sep 15, 1992	moderately impaired
15	AN0036	Pequest R trib	Brighton Rd	Brighton	Sep 15, 1992	non-impaired
15	AN0037	Pequest R	Pequest Rd	Huntsville	Sep 15, 1992	non-impaired
15	AN0038	Trout Bk	Rt 612	Allamuchy	Sep 15, 1992	moderately impaired
15	AN0038	Trout Bk	Rt 612	Allamuchy	Dec 7, 1992	non-impaired
15	AN0038	Trout Bk	Rt 612	Allamuchy	Mar 25, 1993	non-impaired
15	AN0038	Trout Bk	Rt 612	Allamuchy	Jun 2, 1993	moderately impaired
15	AN0039	Pequest R	Rt 615	Long Bridge	Sep 15, 1992	non-impaired
15	AN0040	Bear Ck	nr Alphano	Independence Twp	Sep 16, 1992	non-impaired
15	AN0041	Pequest R	Cemetery Rd	Vienna	Sep 16, 1992	non-impaired
15	AN0042	Furnace Bk	Pequest Rd	Oxford	Oct 8, 1992	severely impaired
15	AN0043	Pequest R	Pequest Rd	Pequest	Oct 8, 1992	non-impaired
15	AN0044	Mtn Lk Bk	blw Mtn Lk	Liberty Twp	Oct 8, 1992	moderately impaired
15	AN0045	Beaver Bk	abv Silver Lk	N of Hope	Sep 16, 1992	non-impaired
15	AN0046	Honey Run	Rt 519	Hope Twp	Sep 16, 1992	non-impaired
15	AN0047	Beaver Bk	Sarepta Rd	Sarepta	Oct 8, 1992	non-impaired
15	AN0048	Pequest R	Water St	Belvidere	Oct 8, 1992	non-impaired
26	AN0049	Pophandusing Bk	off Rt 519	Belvidere	Oct 8, 1992	non-impaired
26	AN0050	Buckhorn Ck	Hutchinson Sta Rd	Hutchinson	Oct 8, 1992	non-impaired
26	AN0051	Lopatcong Ck	Montana Mt Rd	Allens Mills	Sep 1, 1992	non-impaired

BIOLOGICAL ASSESSMENT TABLE: AREA 1 contin.

Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
26	AN051A	Lopatcong Ck	Hartman Dr nr Fiddlers Elbow Rd	Harmony Twp	Jul 31, 1984	non-impaired
26	AN0052	Lopatcong Ck	Rt 57	Port Warren	Sep 1, 1992	non-impaired
26	AN052A	Lopatcong Ck	Belview Rd	Harmony Twp	Jul 31, 1984	non-impaired
26	AN0053	Lopatcong Ck	Old Rt 22	Alpha	Jul 31, 1984	non-impaired
26	AN0053	Lopatcong Ck	Old Rt 22	Alpha	Sep 1, 1992	moderately impaired
25	AN0054	Pohatcong Ck	Janes Chapel Rd	nr Mt Bethel	Aug 31, 1992	non-impaired
25	AN054A	Pohatcong Ck	O'Brian Rd	Mansfield Twp	Aug 1, 1984	moderately impaired
25	AN0055	Pohatcong Ck	Tunnel Hill Rd	Washington Twp	Aug 31, 1992	moderately impaired
25	AN0056	Brass Castle Ck	Brass Castle Rd	Washington	Sep 1, 1992	non-impaired
25	AN0057	Pohatcong Ck	Buttermilk Bridge Rd	Pleasant Valley	Aug 31, 1992	moderately impaired
25	AN057A	Pohatcong Ck	Rt 31	Washington Twp	Aug 1, 1984	non-impaired
25	AN0058	Pohatcong Ck	Edison Rd	New Village	Aug 31, 1992	non-impaired
25	AN0059	Merrill Ck	Merrill Ck Rd (abv res)	Harmony Twp	Aug 31, 1992	moderately impaired
25	AN0060	Merrill Ck	Farm Rd	blw Stewartsville	Aug 31, 1992	non-impaired
25	AN0061	Pohatcong Ck	Carpentersville Rd	Carpentersville	Sep 1, 1992	non-impaired
25	AN061A	Pohatcong Ck	Ck Rd	Pohatcong Twp	Aug 2, 1984	non-impaired
25	AN061B	Pohatcong Ck	Still Valley Rd	Pohatcong Twp	Aug 2, 1984	non-impaired
25	AN061C	Pohatcong Ck	Willow Grove Rd	Franklin Twp	Aug 1, 1984	non-impaired
16	AN0062	Musconetcong R	blw Lk Hopatcong	Roxbury Twp	Jun 2, 1980	moderately impaired
16	AN0062	Musconetcong R	blw Lk Hopatcong	Roxbury Twp	Jun 17, 1980	moderately impaired
16	AN0062	Musconetcong R	blw Lk Hopatcong	Roxbury Twp	Jul 7, 1980	moderately impaired
16	AN0062	Musconetcong R	blw Lk Hopatcong	Roxbury Twp	Aug 4, 1992	moderately impaired
16	AN0063	Musconetcong R	blw Lk Musconetcong	Stanhope	Aug 4, 1992	moderately impaired
16	AN063A	Musconetcong R	Rt 206	Netcong	Jun 2, 1980	moderately impaired
16	AN063A	Musconetcong R	Rt 206	Netcong	Jun 17, 1980	moderately impaired
16	AN063A	Musconetcong R	Rt 206	Netcong	Jul 7, 1980	moderately impaired

BIOLOGICAL ASSESSMENT TABLE: AREA 1 contin.

Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
16	AN0064	Musconetcong R	off Rt 604 (abv Lubbers Run)	Lockwood	Aug 4, 1992	non-impaired
16	AN064A	Musconetcong R	Glen Bk St	Mt Olive Twp	Jun 2, 1980	non-impaired
16	AN064A	Musconetcong R	Glen Bk St	Mt Olive Twp	Jun 17, 1980	non-impaired
16	AN064A	Musconetcong R	Glen Bk St	Mt Olive Twp	Jul 7, 1980	non-impaired
16	AN064B	Wills Bk	Erie Lackawanna RR Bridge	Mt Olive Twp	Jun 2, 1980	moderately impaired
16	AN064B	Wills Bk	Erie Lackawanna RR Bridge	Mt Olive Twp	Jun 17, 1980	moderately impaired
16	AN064B	Wills Bk	Erie Lackawanna RR Bridge	Mt Olive Twp	Jul 7, 1980	moderately impaired
16	AN064C	Wills Bk	Acorn St	Mt Olive Twp	Jun 2, 1980	moderately impaired
16	AN064C	Wills Bk	Acorn St	Mt Olive Twp	Jun 17, 1980	moderately impaired
16	AN064C	Wills Bk	Acorn St	Mt Olive Twp	Jul 7, 1980	moderately impaired
16	AN0065	Lubbers Run	Rt 607	Hopatcong	Aug 4, 1992	non-impaired
16	AN0066	Lubbers Run	Rt 206	Lockwood	Aug 4, 1992	non-impaired
16	AN0067	Mine Bk	Rt 517	Mansfield Twp	Aug 5, 1992	non-impaired
16	AN0068	Trout Bk	Rt 57	Hackettstown	Aug 5, 1992	non-impaired
16	AN0069	Musconetcong R	Kings Hwy	Beattystown	Aug 5, 1992	non-impaired
16	AN069A	Lubbers Run	Waterloo Rd (N of Rt 604)	Byram Twp	Jun 2, 1980	moderately impaired
16	AN069A	Lubbers Run	Waterloo Rd (N of Rt 604)	Byram Twp	Jun 18, 1980	moderately impaired
16	AN069A	Lubbers Run	Waterloo Rd (N of Rt 604)	Byram Twp	Jul 7, 1980	moderately impaired
16	AN069B	Musconetcong R	off Rt 604 (blw Lubbers Run)	Lockwood	Jun 2, 1980	moderately impaired
16	AN069B	Musconetcong R	off Rt 604 (blw Lubbers Run)	Lockwood	Jun 17, 1980	moderately impaired
16	AN069B	Musconetcong R	off Rt 604 (blw Lubbers Run)	Lockwood	Jul 7, 1980	moderately impaired
16	AN069C	Musconetcong R	blw Waterloo Village lwr dam	Mt Olive Twp	Jun 18, 1980	moderately impaired
16	AN069C	Musconetcong R	blw Waterloo Village lwr dam	Mt Olive Twp	Jul 9, 1980	moderately impaired
16	AN069D	Musconetcong R	S of Rt 604 & Rt 80	Mt Olive Twp	Jun 18, 1980	moderately impaired
16	AN069D	Musconetcong R	S of Rt 604 & Rt 80	Mt Olive Twp	Jul 9, 1980	moderately impaired
16	AN069E	Musconetcong R	Rt 604 (abv Saxton Lk)	Mt Olive Twp	Jun 3, 1980	moderately impaired
16	AN069E	Musconetcong R	Rt 604 (abv Saxton Lk)	Mt Olive Twp	Jun 18, 1980	moderately impaired

BIOLOGICAL ASSESSMENT TABLE: AREA 1 contin.

Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
16	AN069E	Musconetcong R	Rt 604 (abv Saxton Lk)	Mt Olive Twp	Jul 9, 1980	moderately impaired
16	AN069F	Musconetcong R trib	Rt 604 (blw Deer Pk Pd)	Allamuchy Twp	Jun 3, 1980	non-impaired
16	AN069F	Musconetcong R trib	Rt 604 (blw Deer Pk Pd)	Allamuchy Twp	Jun 18, 1980	non-impaired
16	AN069F	Musconetcong R trib	Rt 604 (blw Deer Pk Pd)	Allamuchy Twp	Jul 7, 1980	non-impaired
16	AN069G	Musconetcong R	Rt 604 (blw Saxton Falls)	Allamuchy Twp	Jun 3, 1980	non-impaired
16	AN069G	Musconetcong R	Rt 604 (blw Saxton Falls)	Allamuchy Twp	Jun 18, 1980	non-impaired
16	AN069G	Musconetcong R	Rt 604 (blw Saxton Falls)	Allamuchy Twp	Jul 9, 1980	non-impaired
16	AN0070	Hances Bk	Rt 57	Beattystown	Aug 5, 1992	moderately impaired
16	AN0071	Musconetcong R trib	Rt 57	Penwell	Aug 11, 1992	non-impaired
16	AN0071	Musconetcong R trib	Rt 57	Penwell	Nov 18, 1992	non-impaired
16	AN0071	Musconetcong R trib	Rt 57	Penwell	Feb 22, 1993	non-impaired
16	AN0071	Musconetcong R trib	Rt 57	Penwell	May 12, 1993	non-impaired
16	AN0072	Musconetcong R	New Hampton Rd	New Hampton	Aug 5, 1992	non-impaired
16	AN0073	Musconetcong R	Rt 579	Bloomsbury	Aug 11, 1992	non-impaired
16	AN0073	Musconetcong R	Rt 579	Bloomsbury	Nov 18, 1992	non-impaired
16	AN0073	Musconetcong R	Rt 579	Bloomsbury	Feb 22, 1993	non-impaired
16	AN0073	Musconetcong R	Rt 579	Bloomsbury	May 12, 1993	non-impaired
16	AN0074	Musconetcong R	River Rd	Reigelsville	Aug 11, 1992	non-impaired

WATERSHED MANAGEMENT AREA 2
WALLKILL RIVER DRAINAGE

The watershed management area includes watersheds draining the central northern portion of New Jersey that flow into the Hudson River in New York. The Area is comprised of mostly Sussex and Passaic Counties and includes the following watersheds:

Wallkill River	Papakating Creek	Pochuck Creek
Black Creek	Clove River	Lake Lookout Brook
Beaver Run		

Summary of ambient physical/chemical monitoring stations classifications

Station	Classification
Wallkill River near Sussex, NJ	FW-2 Nontrout,
Wallkill River near Unionville, NY	FW-2 Nontrout
Papakating Creek at Sussex, NJ	FW-2 Nontrout
Black Creek near Vernon, NJ	FW-2 Nontrout

Note: Monitoring on the Wallkill at Franklin NJ (FW-2 Trout Maintenance) has been discontinued as of 1991.

OVERALL MANAGEMENT AREA ASSESSMENT

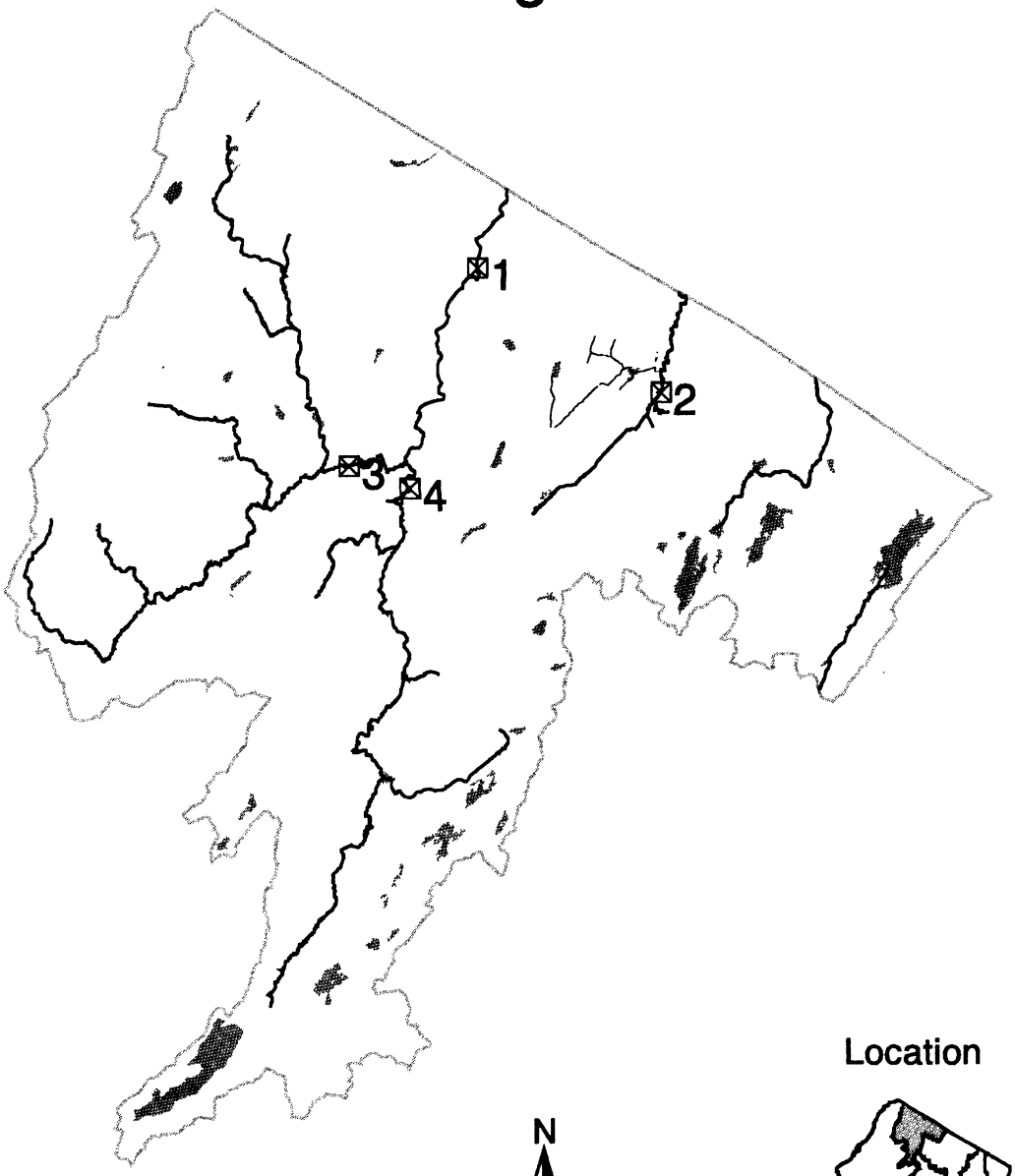
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Wallkill River	near Sussex, NJ	Partial Support
Wallkill River	near Unionville, NY	No Support
Papakating Creek	at Sussex, NJ	No Support
Black Creek	near Vernon, NJ	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: see the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 10 Mod. Impairment: 4 Severe Impairment: 0

Wallkill, Pochuck, Papakating Watershed Management Area 2



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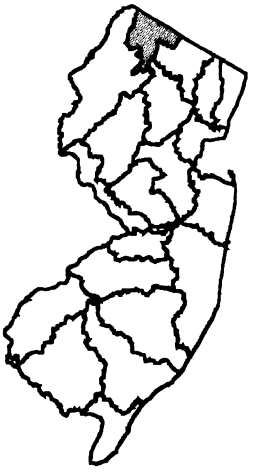


N

0 4 Miles

Rivers and Streams
Monitoring Sites
Water Bodies
Watershed Management Area Boundary

1. Wallkill River, Unionville, NY
2. Black Creek, Vernon, NJ
3. Papakating Creek,Sussex, NJ
4. Wallkill River, Sussex, NJ

WALLKILL RIVER, PAPAKATING AND BLACK CREEK

WATERSHED DESCRIPTION

The Wallkill River drains from New Jersey into New York and has a 203 square mile watershed in New Jersey. The 27 mile length of this river in New Jersey is located in Sussex County. This area is predominantly rural - the largest towns being Vernon, Sparta, Franklin and Sussex. Major tributaries flowing into the Wallkill include the Papakating (15 miles long) and Pochuck (8 miles long) Creeks. Lakes and impoundments in this watershed include Lake Mohawk (at the headwaters), Newton Reservoir, Lake Grinnell, Wawayanda Lake and many others. Four watersheds have been delineated for the Wallkill Watershed Management Area: Upper and Lower Wallkill, Papakating Creek and Black Creek.

The land use in this watershed is primarily forested and agricultural, although the amount of developed land is increasing. Most of the Wallkill River is classified FW-2 Nontrout, except for the stretch from Sparta Glen Brook to the Rt. 23 bridge, which is classified as FW-2 Trout Maintenance. Papakating Creek and Clove Brook contain both FW-2 Trout Maintenance and Nontrout waters.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Wallkill River near Unionville, NY, and near Sussex, NJ

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Phosphorus levels are slightly elevated, with 10% and 11% of samples exceeding the phosphorus criterion at Sussex and Unionville, respectively. Median phosphorus value at Sussex was 0.03 mg/l; at Unionville the median was 0.06 mg/l.

Bacteria: Wallkill River near Sussex indicated marginally acceptable levels of fecal coliform bacteria. Geometric mean was 162 MPN/100ml, with 30% of samples exceeding the 400 MPN/100ml criterion. Wallkill River near Unionville showed higher bacterial levels; a geometric means of 361 MPN/100ml was recorded.

Heavy Metals: Lead levels, although at acceptable levels when compared to criteria, are higher than would be considered normal at the Sussex location.

Summary: Mildly elevated phosphorus and slightly elevated bacterial levels characterize the Wallkill River as monitored near Sussex and Unionville. Elevated lead levels may be a potential problem near Sussex.

Locations: Papakating Creek at Sussex, and Black Creek near Vernon

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: All levels are acceptable in the Black Creek. Papakating Creek at Sussex showed elevated phosphorus, with 30% exceeding the criterion for total phosphorus. Median value at this location was 0.08 mg/l.

Bacteria: Both locations exhibited elevated bacterial levels. In the Black Creek the geometric means of fecal coliform was 321 MPN/100ml. In the Papakating Creek, geometric mean was 448 MPN/100ml.

Heavy Metals: Lead levels, although at acceptable levels when compared to criteria, are higher than would be considered normal at the Papakating Creek location.

Summary: Both the Papakating Creek at Sussex and Black Creek near Vernon showed elevated bacterial levels. Nutrient values in the Black Creek were acceptable; in the Papakating Creek phosphorus was elevated. Elevated lead levels may be a potential problem in the Papakating Creek.

Biological Monitoring

Macroinvertebrate assessments suggest that the Wallkill is biologically healthy throughout its entire length. Papakating Creek exhibits a healthy macroinvertebrate community at all monitoring locations (see the Biological Assessment Table located at the end of this section) except at Pelletown. Other streams such as Clove Brook and Lake Lookout Brook in the management area showed a mix of healthy combined with moderately impaired regions. Black/Pochuck Creek was not assessed in the biological survey.

POINT SOURCE ASSESSMENT

The following is the current status of permitted wastewater discharge within the watershed that was reported to be in noncompliance with its discharge permit:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Sussex Borough STP	Sussex Co.	Clove Brook	Raw sewage overflows, total residual chlorine.	Raw sewage overflows occur during heavy precipitation. The total residual chlorine limit was constantly exceeded. ACO was executed in June 1988 to memorialize a compliance schedule for upgrade of the plant. Dechlorination facilities have been constructed and placed on-line. The ACO has been amended several times. The borough connected into the SCMUA Upper Wallkill STP in Hamburg on December 26, January 1996. Infiltration and inflow (I&I) work to be completed in September 1997.

In the past, the Wallkill River, Papakating Creek, and Black Creek had poorer water quality in the warm weather months, leading to the conclusion that point or continuous sources may be (or have been) significant contributors to stream degradation. One wastewater discharge, Sussex Boro Treatment Plant, continues to be under enforcement action and is suspected of causing water pollution problems (see Point Source Pollution Table above). In the past, Ames Rubber Corporation was reported to be under enforcement action for the release of excess volatile organic compounds. This facility has not been mentioned in the most recent enforcement reports; hence, it may no longer be a problem in the watershed.

NONPOINT SOURCE ASSESSMENT

Evaluated nonpoint pollution in the Wallkill watershed in general shows a shift from agricultural sources to those resulting from increasing urbanization. In the Upper Wallkill River, deleterious effects of both urbanization and agricultural activities are on the rise. Increasing construction and urban surface runoff have resulted in sediment loading and stormwater contamination, respectively. Local officials have stressed the need for stormwater management, such as the use of large detention ponds in the region. In addition, agricultural runoff from crop production, pasture lands, and animal holdings are believed to have contributed to what local officials term as widespread eutrophic conditions in the Upper Wallkill. The Lower Wallkill River is also experiencing the effects of increased urbanization - largely in the form of construction site runoff. Crop production, pasture lands, and a zinc mine at Franklin are all suspected of affecting water quality in the lower segment of the Wallkill.

Clove Brook suffers from excessive nutrient loading which causes low dissolved oxygen levels and excessive algal growth. The known sources are agricultural, including feedlot, pasture land, and crop runoff. Feedlot runoff has been identified as the reason for the closure of bathing beaches in Clove Lake. Increasing agricultural runoff (crop production, pasture land, animal holding) along Papakating Creek is suspected as having contributed to severe eutrophic conditions in this stream and in turn, a degradation of the stream's fishery potential. Black Creek receives some agricultural runoff; however, its principal nonpoint source problem is believed to be suburban/urban in nature. Construction activities coupled with surface runoff are suspected in sediment loading and stormwater contamination. Some tributaries in the Black Creek sub-watershed are so severely impacted that they are described as being devoid of aquatic life. This watershed has been cited by local officials as needing storm water management.

DESIGNATED USE ASSESSMENT

Assessments of the "aquatic life support" designated use in the Wallkill River, Papakating Creek, and tributaries are based upon recent instream macroinvertebrate evaluations. The Wallkill River fully supports the use. Most of the Papakating Creek, including its West Branch, fully supports the use. One location in Pelletown partially supports the use. Parts of Clove Brook and Lake Lookout Brook fully support this use, while other parts only partially support it.

The Wallkill River near Sussex will partially support the primary contact (swimmable) use. The three remaining physical/chemical monitoring locations contain excessive fecal coliform bacteria and, as a result, will not support the primary contact (swimmable) use.

BIOLOGICAL ASSESSMENT TABLE: AREA 2

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
2	5	AN0294	Lk Lookout Bk	Wawayanda St Pk	Wawayanda	Aug 3, 1993	non-impaired
2	5	AN0294	Lk Lookout Bk	Wawayanda St Pk	Wawayanda	Oct 21, 1993	non-impaired
2	5	AN0294	Lk Lookout Bk	Wawayanda St Pk	Wawayanda	Apr 25, 1994	moderately impaired
2	5	AN0294	Lk Lookout Bk	Wawayanda St Pk	Wawayanda	Jan 13, 1995	non-impaired
2	5	AN294A	Lk Lookout Bk trib	Wawayanda St Pk	Wawayanda	Jul 15, 1993	moderately impaired
2	2	AN0297	Wall Kill	Rt 15 (nr municipal bldg)	Sparta	Jun 25, 1990	non-impaired
2	2	AN0298	Wall Kill	Kennedy Ave	Ogdensburg	Jun 25, 1990	non-impaired
2	2	AN0299	Wall Kill	Scott Rd	Franklin	Jun 25, 1990	non-impaired
2	2	AN0300	Wall Kill	Rt 94	Hamburg	Jun 26, 1990	non-impaired
2	2	AN300A	Wall Kill	Rt 94 (abv STP)	Hamburg	May 1, 1991	non-impaired
2	2	AN300B	Wall Kill	Rt 94 (blw STP)	Hamburg	May 1, 1991	non-impaired
2	2	AN0301	Beaver Run	Cemetery Rd	Wantage Twp	Jul 15, 1993	moderately impaired
2	2	AN0302	Wall Kill	Rt 565	Sussex	Jun 26, 1990	non-impaired
2	3	AN0303	Papakating Ck	Rt 619 & Gunn Rd	Frankford Twp	Jun 28, 1990	non-impaired
2	3	AN0303	Papakating Ck	Rt 619 & Gunn Rd	Frankford Twp	Sep 2, 1992	non-impaired
2	3	AN0303	Papakating Ck	Rt 619 & Gunn Rd	Frankford Twp	Dec 7, 1992	non-impaired
2	3	AN0303	Papakating Ck	Rt 619 & Gunn Rd	Frankford Twp	Mar 25, 1993	non-impaired
2	3	AN0304	Papakating Ck	Rt 565	Pellettown	Jun 27, 1990	moderately impaired
2	3	AN0305	Papakating Ck W Br	Rt 519	Plumbsock	Jun 27, 1990	non-impaired
2	3	AN0306	Papakating Ck W Br	Rt 565	McCoy's Cor	Jun 27, 1990	non-impaired
2	3	AN0307	Papakating Ck	Rt 565	McCoy's Cor	Jun 27, 1990	non-impaired
2	3	AN0308	Clove R	Rose Marrow Ave	Wantage Twp	Jun 26, 1990	non-impaired
2	3	AN0309	Clove R	Loomis Ave	Sussex	Jun 26, 1990	moderately impaired

WATERSHED MANAGEMENT AREA 3
POMPTON RIVER DRAINAGE

The watershed management area includes watersheds draining the highlands portion of New Jersey. The Pequannock, Wanaque and Ramapo Rivers all flow into the Pompton, which in turn is a tributary to the upper Passaic River. This management area contains some of the state's major reservoir systems. The Area lies mostly in Passaic County and includes the following watersheds:

Pompton River
Ramapo River
Pequannock River
Wanaque River

Summary of ambient physical/chemical monitoring stations classifications

Station	Classification
Pequannock River at Macopin Intake	FW-2 Trout Maintenance
Ramapo River near Mahwah	FW-2 Nontrout
Pompton River at Packanack Lake	FW-2 Nontrout

Note: The monitoring station Wanaque River at Wanaque (FW-2 Nontrout) has been discontinued.

OVERALL MANAGEMENT AREA ASSESSMENT

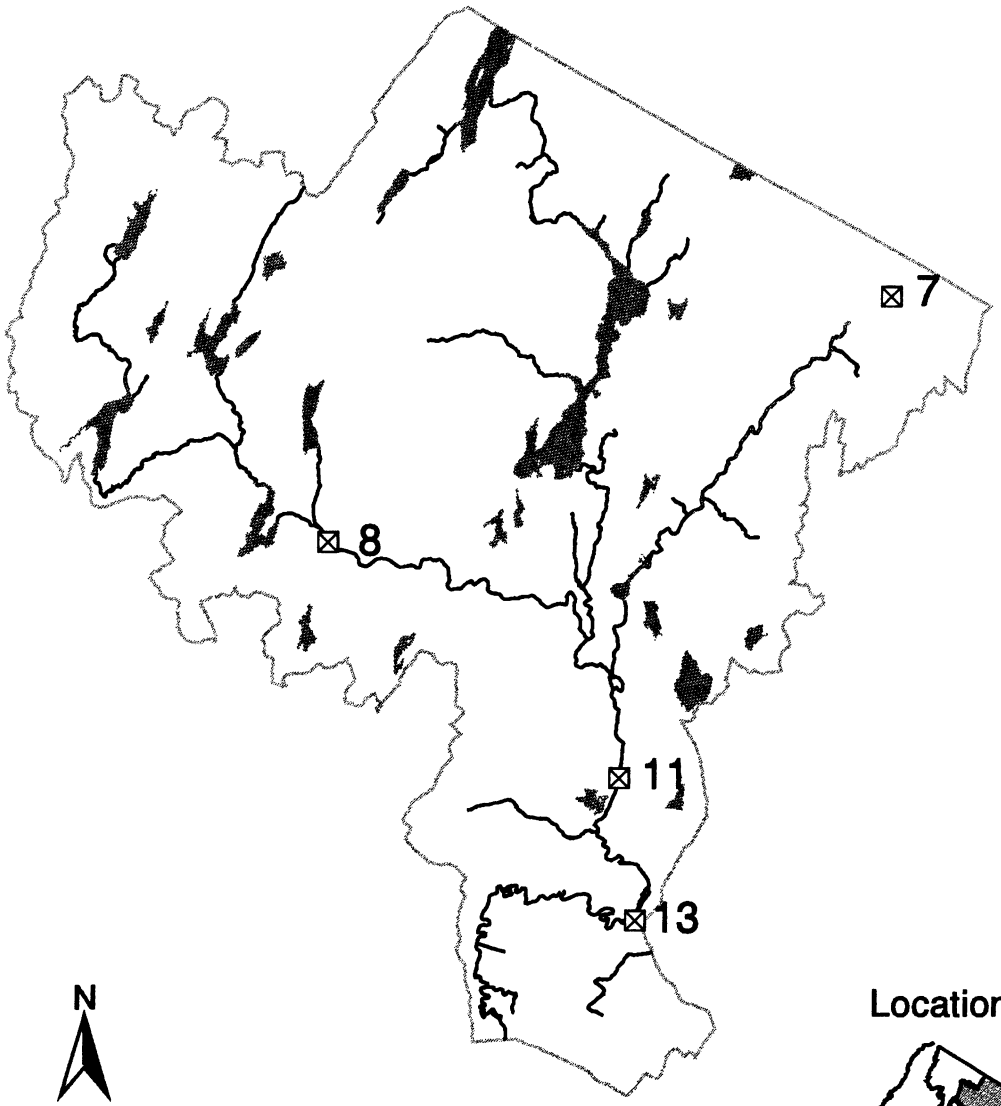
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Pequannock River	at Macopin Intake	Full Support
Ramapo River	near Mahwah	No Support
Pompton River	at Packanack Lake	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 5 Mod. Impairment: 11 Severe Impairment: 1

Pompton, Pequannock, Wanaque, Ramapo Watershed Management Area 3



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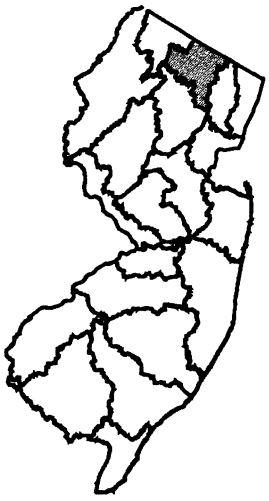


⊠ Monitoring Sites
Water Bodies
River and Streams
Watershed Management Boundary

7. Ramapo River, Mahwah, NJ
8. Pequannock River, Macopin Intake Dam, NJ
11. Pompton River, Packanack Lake, NJ
13. Passaic River, Two Bridges, NJ

PEQUANNOCK RIVER

WATERSHED DESCRIPTION

The Pequannock River is 30 miles long and drains an area of 90 square miles. Its headwaters are in Sussex County and it flows east, delineating the Morris/Passaic County line. It continues flowing east and joins the Wanaque River and flows to the Pompton River in Wayne Township. There are many lakes, ponds and reservoirs in this area; the major impoundments are the Kikeout Reservoir, Lake Kinnelon, Clinton Reservoir, Canistear Reservoir, Charlottsburg Reservoir, Oak Ridge Reservoir and Echo Lake Reservoir. The major tributary is Stonehouse Brook. Population in this watershed is centered in Butler and in Bloomingdale Townships.

The great majority of the land in this watershed is forested and protected for water supply purposes and parklands. The remaining lands are under residential and industrial/commercial use. There are approximately 20 NJPDES permitted discharges; about one-third are municipal and two-thirds are industrial. Waters are classified FW-1 in the Newark water supply area, FW-2 Trout Production, FW-2 Trout Maintenance, and FW-2 Nontrout elsewhere.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location:. Pequannock River at Macopin Intake

Dissolved Oxygen: Acceptable.

Temperature: Twenty-two percent of samples during the period of assessment were in violation of the upper criterion for trout maintenance waters.

Nutrients: Eleven percent of phosphorous samples were in violation of the criterion, indicating slight elevations. The median phosphorous level was 0.035 mg/l. Nitrate+Nitrite levels were low, having a median value of 0.23 mg/l as N.

Bacteria: Sanitary quality at this location is excellent; fecal coliform geometric mean is 10 MPN/100ml.

Heavy Metals: Violations of both copper and lead were recorded. Two of the three copper samples taken during the period of assessment exceeded both the acute and chronic criteria for this metal. One of the three lead samples exceeded the chronic criterion for lead.

Summary: Station is characterized by excessive summertime water temperatures that could be deleterious to aquatic life. Phosphorous was slightly elevated. Nitrate+Nitrite levels and sanitary quality were very

acceptable. Of special concern are violations of copper and lead levels observed at this location.

Biological Monitoring

Macroinvertebrate assessments indicate the Pequannock River to be non-impaired with the exception of its most upstream monitoring site where it is assessed as being moderately impaired. Biological health of the tributaries to the Pequannock varied. Mossmans Brook and Kanouse Brook are assessed as moderately impaired. The Macopin River is non-impaired while Clinton Brook is severely impaired. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

The Pequannock River watershed is primarily forested and located in protected water supply lands. As a result, development and pollution sources are, for the most part, limited.

The following wastewater treatment plant has been upgraded and/or expanded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Frank's Sanitation	Riverdale Borough, Morris Co.	Pequannock River	Facility discharged stormwater runoff and truck washwater with frequent violations of COD, total suspended solids and petroleum hydrocarbons. Facility ceased its permitted outfall and truck washing operations in 1992.

NONPOINT SOURCE ASSESSMENT

The principal source of nonpoint pollution in the Pequannock River watershed from Stockholm to the Pompton River is urban/suburban development. In general, water quality declines as one travels downstream, especially as one passes through the Butler-Bloomingdale area. Reported pollution sources include rising levels of runoff from roads, building construction, urban surfaces, storm sewers and surface mines. Additional problems below Bloomingdale include channelization, streambank modification, and the removal of riparian vegetation. All this is reported by local authorities as having contributed to high water temperatures, silt loads and organic pollution.

DESIGNATED USE ASSESSMENT

The Pequannock River will support the "aquatic life support" designated use in most parts of the river; the uppermost portion partially supports the use. Tributaries vary from full support (Macopin River) to no support (Clinton Brook). Monitoring at the Macopin Intake finds that the river will fully support the swimmable use at this location.

Bluegreen algal blooms were reported in the lower portion of the Pompton in July of 1994. These blooms were dense enough to temporarily impair the use of the water as a potable water source.

RAMAPO AND POMPTON RIVERS

WATERSHED DESCRIPTION

The Ramapo River has a drainage area of about 160 square miles, 110 of which are in New York State. It flows from New York into Bergen County and enters the Pequannock River to form the Pompton River in Wayne Township. The Ramapo River is 15 miles long in New Jersey. The Pompton River is a tributary to the Passaic River and is 7 miles long. Major impoundments include Point View Reservoir #1, Pompton Lake and Pines Lake. The population centers are Mahwah, Pompton Lakes, Pompton Plains, Oakland and Franklin Lakes.

Over one-half of this watershed is undeveloped, with the remainder primarily suburban/commercial/industrial. New development is extensive in many areas of the watershed. There are approximately 25 NJPDES permitted discharges present in the two watersheds, over 15 of which are municipal and the remaining industrial. Waters have been classified FW-2 Trout Production and FW-2 Nontrout.

WATER QUALITY ASSESSMENT

Location: Ramapo River near Mahwah

Dissolved Oxygen: Acceptable.

Nutrients: Phosphorous is somewhat elevated; median value was 0.15 mg/l, with eleven percent of phosphorous samples in violation of the criterion. The median Nitrate+Nitrite level was 1.2 mg/l.

Bacteria: Elevated. Geometric means of fecal coliform is 278 MPN/100 ml.

Sodium: Elevated at this location. Twenty percent of samples exceed the 50 mg/l criterion.

Heavy Metals: Although no violations of criteria were recorded, copper and lead levels are somewhat elevated and should be of concern at this location.

Summary: Phosphorous and sodium are somewhat elevated. Sanitary quality is unacceptable. Copper and lead could be threatening water quality at this location.

Locations: Pompton River at Packanack Lake

Dissolved Oxygen: Acceptable.

Nutrients: Phosphorous is elevated; 20% of samples in violation of the criterion. Median value was 0.06 mg/l. The median Nitrate+Nitrite level was an acceptable 0.81 mg/l.

Bacteria: Elevated. Geometric mean of fecal coliform is 271 MPN/100 ml.

Sodium: Slightly elevated at this location. Three percent of samples exceed the 50 mg/l criterion. Median value was 26 mg/l.

Heavy Metals: Although no violations of criteria were recorded, a copper sample (one of four) was somewhat elevated during the early portion of the assessment period.

Summary: Phosphorous and bacteria are elevated. Sodium and copper may be of concern here and should be watched.

Biological Monitoring

Macroinvertebrate assessments indicate that both the Ramapo and the Pompton Rivers are moderately impaired at all monitoring locations (see the Biological Assessment Table located at the end of this section).

POINT SOURCE ASSESSMENT

The Ramapo has a significant discharge to it in New York State before it flows into New Jersey.

One discharger to the Ramapo River has been eliminated:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Urban Farms Shopping Center	Franklin Lakes	Pond Brook	ACO eliminated Urban Farms wastewater treatment plant and had the flow directed to the Passaic Valley Sewerage Commissioners treatment plant in Newark. Connection was completed in April 1993.

NONPOINT SOURCE ASSESSMENT

Moderate, yet increasing, levels of suburban/urban development along the length of the Ramapo River have resulted in both a loss of habitat for biota and an apparent decline in water quality from siltation and elevated stream temperatures. Runoff from housing and road construction sites, and runoff from urban surfaces and storm sewers, have contributed significantly to pollution in the waterways. The construction of Interstate 287 has had a significant impact upon the Ramapo. Habitat loss in this river has been expanded and intensified by local dredging and channelization. The fisheries in the Ramapo are also considered threatened by agricultural activity in the watershed.

Urban development has resulted in water quality degradation in the Pompton River as reported by local authorities. Increasing levels of runoff from construction activity, urban surfaces, storm sewers, and surface mining, together with dredging and the removal of riparian vegetation, have contributed to silt and nutrient loading, elevated stream temperatures, and flooding. The fish community in the Pompton has been reduced to species that are tolerant of degraded conditions; few game fish are present and species diversity is low in many areas of the river.

DESIGNATED USE ASSESSMENT

The Ramapo and Pompton Rivers will only partially support the "aquatic life support" designated use. Neither river is of swimmable quality due to elevated bacterial levels.

WANAQUE RIVER

WATERSHED DESCRIPTION

The Wanaque River, with its headwaters in New York State, has a total drainage area of 108 square miles. That part which is in New Jersey lies in Passaic County. Its headwaters begin as minor tributaries to Greenwood Lake (which is half in New York and half in New Jersey) before flowing southwesterly to the Wanaque Reservoir, then further south to Lake Inez. It flows from Lake Inez to its confluence with the Pequannock River at Riverdale. The river's total length is 27 miles. Major tributaries include West Brook and Jennings Creek. There are many lakes, reservoirs and ponds, with the larger ones being the Wanaque Reservoir, Greenwood Lake, Arcadia Lake, and Lake Inez. There are no large population centers, but most of the people live in Ringwood and Wanaque Townships.

Most of the land in this watershed is undeveloped, consisting of vacant lands, reservoirs, parks, and farms. For the most part, the remainder is residential with some land being used for industry and commerce. Of the approximately 10 NJPDES permitted discharges here, about one-third are commercial/industrial, and two-thirds are municipal. The waters of this drainage area have been classified FW-1, FW-2 Trout Production, FW-2 Trout Maintenance and FW-2 Nontrout.

WATER QUALITY ASSESSMENT

Prior to 1991, the Wanaque River had one ambient water quality monitoring station located at Wanaque. This is just downstream of the dam at the Wanaque Reservoir, a major water supply source. As such, water quality conditions in the Wanaque River at Wanaque were highly influenced by the impoundment. Prior to being discontinued, routine monitoring found the Wanaque River to be of good quality with little pollution. The water quality of the Wanaque River at Wanaque, however, is probably not indicative of the entire river because of the influence of the impoundment, a principal reason the chemical monitoring was discontinued there. Conditions are thought to degrade somewhat in a downstream direction.

Biological Monitoring

Biological assessments in the Wanaque River indicate the macroinvertebrate community to be healthy above the reservoir but moderately impaired at the two monitoring locations below the impoundment. Morsetown Brook, a tributary to the Wanaque, is assessed as supporting a nonimpaired biological community. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

No facilities were reported to be discharging inadequately treated effluent into the Wanaque River at the present time. One facility has ceased discharging via an ACO:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Marshall Hill School STP	West Milford Twp., Passaic Co.	Belchers Cr.	Facility has ceased discharging.

NONPOINT SOURCE ASSESSMENT

Nonpoint source assessments on the Wanaque River were restricted to the river reaches below the Wanaque Reservoir. In this region, the primary nonpoint pollution sources are those associated with urban/suburban development. These sources have degraded the fishery habitat by contributing to excessive siltation and elevated stream temperatures. West Brook, for example, a unique trout production stream, is threatened by the impact from such development. This stream is special in that it is one of the few streams in our state with a naturally reproducing rainbow trout population.

Other nonpoint pollution sources known to be a problem here include runoff from urban surfaces and roads. In addition, the removal of riparian vegetation along the river has further contributed to stream degradation.

DESIGNATED USE ASSESSMENT

Before 1991 when sanitary sampling was performed in the Wanaque River just below the reservoir, the river was assessed as swimmable based upon fecal coliform testing. It is not known if the river maintained good bacterial quality farther downstream. The Wanaque River will support the "aquatic life" use above the reservoir, but only partially supports the use below the impoundment.

BIOLOGICAL ASSESSMENT TABLE: AREA 3

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
3	7	AN0255	Wanaque R	E Shore Dr	Awosting	Jul 10, 1990	non-impaired
3	7	AN255A	Morsetown Bk	Marshall Hill Rd (abv STP)	W Milford	Apr 30, 1991	non-impaired
3	7	AN255B	Morsetown Bk	Marshall Hill Rd (blw STP)	W Milford	Apr 30, 1991	non-impaired
3	7	AN0256	Wanaque R	Highland Ave (blw STP)	Wanaque	Jul 10, 1990	moderately impaired
3	7	AN0257	Wanaque R	Wanaque Ave	Pompton Lks	Jul 9, 1990	moderately impaired
3	8	AN0258	Pequannock R	Rt 515	N of Stockholm	Aug 3, 1993	moderately impaired
3	8	AN0259	Pequannock R	Rt 23 (abv res)	Stockholm	Jul 22, 1993	non-impaired
3	8	AN0260	Mossmans Bk	Clinton Rd (abv res)	W Milford Twp	Aug 5, 1993	moderately impaired
3	8	AN0261	Clinton Bk	LaRue Rd	W Milford Twp	Jul 27, 1993	severely impaired
3	8	AN0262	Kanouse Bk	Rt 23	Newfoundland	Jul 27, 1993	moderately impaired
3	8	AN0263	Macopin R	blw Echo Lk	W Milford Twp	Jul 27, 1993	non-impaired
3	8	AN0264	Pequannock R	Rt 23 (Macopin Intake)	W Milford Twp	Jul 27, 1993	non-impaired
3	8	AN0265	Pequannock R	Rt 511	Riverdale	Jul 22, 1993	non-impaired
3	9	AN0266	Ramapo R	W Ramapo Ave	Ramsey Twp	Jul 10, 1990	moderately impaired
3	9	AN0267	Ramapo R	Lenape Ln	Oakland	Aug 15, 1985	non-impaired
3	9	AN0267	Ramapo R	Lenape Ln	Oakland	Jul 10, 1990	moderately impaired
3	19	AN0268	Pompton R	Newark Pompton Tnpk	Pequannock Twp	Jul 9, 1990	moderately impaired
3	19	AN268A	Pompton R	Pompton Plains Cross Rd	Pequannock Twp	Jul 9, 1990	moderately impaired
3	19	AN0269	Pompton R trib	Ryerson Rd	Lincoln Pk	Jul 12, 1993	moderately impaired
3	19	AN0270	Packanack Bk	Osbourne Rd	Mountain View	Jul 12, 1993	moderately impaired

WATERSHED MANAGEMENT AREA 4
LOWER PASSAIC RIVER DRAINAGE

This region includes the lower Passaic River (from the Pompton River confluence downstream to Newark Bay) and its tributaries, including the Saddle River. The Area covers portions of Passaic, Essex, Hudson and Bergen Counties and includes the following watersheds:

Lower Passaic River
Saddle River

Summary of ambient physical/chemical monitoring stations and classifications:

Station	Classification
Passaic River at Little Falls	FW-2 Nontrout
Passaic River at Elmwood Park	FW-2 Nontrout
Saddle River at Lodi	FW-2 Nontrout

Note: Chemical monitoring at Passaic River at Singac (FW-2 Nontrout) and Saddle River at Fair Lawn (FW-2 Nontrout) has been discontinued.

OVERALL MANAGEMENT AREA ASSESSMENT

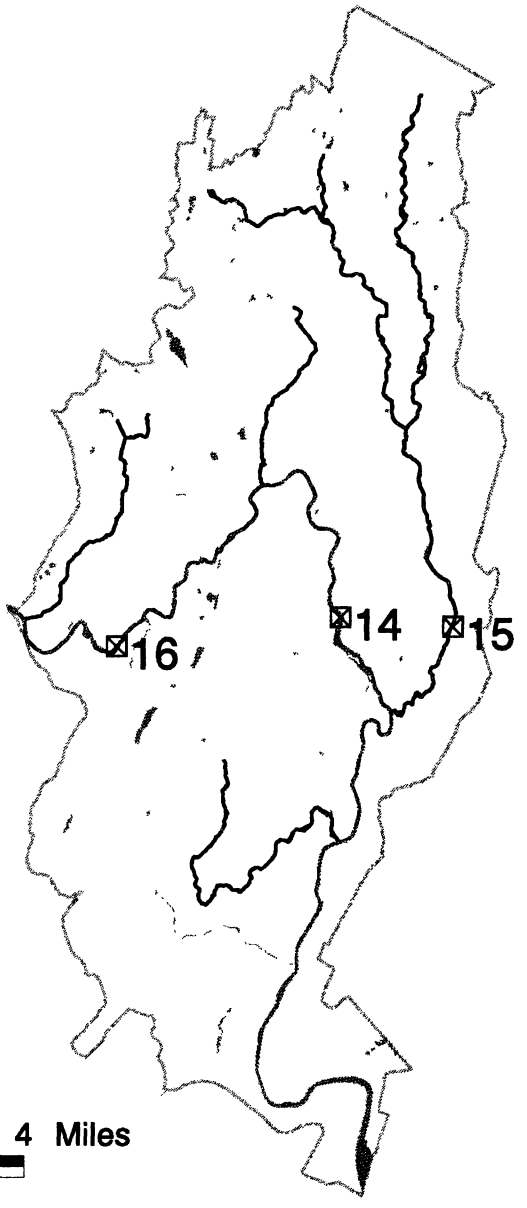
- Swimmable Support Status:

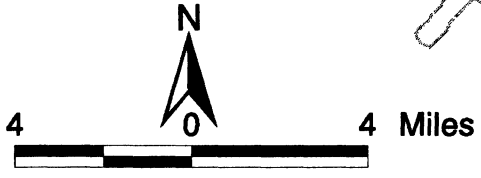
WATERWAY	LOCATION	STATUS
Passaic River	at Little Falls	No Support
Passaic River	at Elmwood Park	No Support
Saddle River	at Lodi	No Support

Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

No Impairment: 6 Mod. Impairment: 12 Severe Impairment: 3

Lower Passaic, Saddle River Watershed Management Area 4





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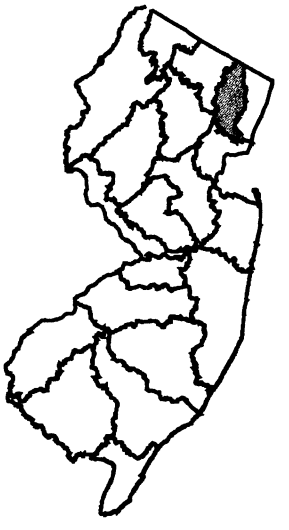


⊠ Monitoring Sites
Water Bodies
Rivers and Streams
Watershed Management Boundary

14. Passaic River, Route46, Elmwood Park, NJ
15. Saddle River, Lodi, NJ
16. Passaic River, Little Falls, NJ

LOWER PASSAIC RIVER

WATERSHED DESCRIPTION

The Lower Passaic River is considered in this report to be that section from the Pompton River confluence downstream to Newark Bay. This 33 mile section includes parts of Bergen, Hudson, Passaic and Essex Counties. Major tributaries include the Saddle River, Preakness Brook, Second River, and the Third River. The Lower Passaic River contains a number of falls, culminating with the Great Falls at Paterson. There is one small dam on the river near Newark named Dundee Dam. This is a densely populated area, including the major cities of Newark, Paterson, Clifton, and East Orange.

Land in this watershed is extensively developed and contains many older cities and industrial centers. There is little open space except in the Upper Saddle River Watershed. Of the approximately 120 NJPDES permitted discharges located in the watershed, about 100 are industrial/commercial and the remaining are municipal.

The Lower Passaic River, including the Saddle River, flows through a densely populated, urbanized and industrialized region. As a result, water quality conditions in the region's surface waters are reflective of numerous point sources, significant nonpoint source contributions, and high sediment oxygen demands.

The waters of the Lower Passaic River and its tributaries are classified FW-2 Trout Production, FW-2 Trout Maintenance (in the Saddle River watershed), FW-2 Nontrout, SE-2, and SE-3.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Passaic River at Little Falls and Elmwood Park

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Phosphorus highly elevated; 93% and 82% of phosphorus records for the period of assessment were in violation of the criterion at Little Falls and Elmwood Park, respectively. Median values were recorded to be 0.46 mg/l at Little Falls, and 0.21 mg/l at Elmwood Park. Nitrate+Nitrite levels were also elevated; median values were 2.9 mg/l at Little Falls, and 2.5 mg/l at Elmwood Park.

Passaic River at Little Falls and Elmwood Park continued:

Bacteria: Elevated at Little Falls, with a geometric mean of 332 MPN/100ml for fecal coliform. Elmwood Park exhibited severely elevated levels, with a geometric mean of fecal coliform being 5165 MPN/100ml.

pH: Both stations had occasional violations of the upper pH limit of 8.5 SU. Little Falls showed exceedances in 11% of samples; Elmwood had exceedances in 3% of recorded values.

Sodium: Elevated sodium is a problem at both locations. Little Falls showed exceedances in 18% of recorded values with a median value of 38.5 mg/l. Elmwood Park had exceedances in 28% of recorded values. There the median was 45 mg/l.

Heavy Metals: Both locations have lead violations of the chronic criterion. At Little Falls, one of three values exceeded the criterion, however, the other two closely approached the chronic limit calculated for this location. At Elmwood Park, all three either equaled or exceeded the criterion. In addition, Elmwood Park showed high copper levels, although no violations were recorded, and mercury may be threatening the station at Little Falls.

Summary: Both locations are characterized by highly elevated phosphorus, poor sanitary quality, elevated sodium and lead. Copper and mercury could also be threatening Elmwood Park and Little Falls, respectively.

Location: Saddle River at Lodi

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Highly elevated nutrient levels. Total phosphorus showed a median of 0.36 mg/l, with 78% of values exceeding the water quality criterion. Median Nitrate+Nitrite level was 3.96 mg/l.

Bacteria: Severely elevated, with a geometric mean of fecal coliform bacteria of 969.6 MPN/100ml.

Sodium: Extremely elevated sodium is a problem at this location. Here, exceedances of the criterion were seen in 45% of recorded values, with a median value of 49 mg/l.

Unionized Ammonia: Although meeting water quality criteria, this parameter is elevated, producing a median value of 12 ug/l. Levels over 40 ug/l have been observed during the period of assessment.

Summary: Poor water quality. Nutrients, bacteria and sodium all highly elevated. Location is threatened with possible ammonia toxicity.

Biological Monitoring

Macroinvertebrate monitoring reveals varying degrees of impairment within the management area. Only one monitoring location is located on the Passaic River itself in the town of Little Falls where the community was assessed as moderately impaired. Of the numerous tributaries to the Lower Passaic, the results were as follows: Preakness Brook, moderately impaired; Peckman River, moderately impaired; Molly Ann Brook, severely impaired; Goffle Brook, moderately impaired; Diamond Brook, moderately impaired; Third River, moderately impaired.

The biological health of the Saddle River based upon the macroinvertebrate community varies from healthy in the upper half, moderately impaired in the lower portions, then further degrading to severely impaired in the lowest end. Hohokus Brook is assessed as moderately impaired upstream, improving to non-impaired near its confluence with Ramsey Brook. Further downstream, Hohokus Brook degrades again to moderately impaired before it joins with the Saddle River. Ramsey Brook is severely impaired as it flows into New Jersey from New York but improves to healthy conditions as it flows into the Hohokus. Valentine Brook, a tributary to the Hohokus, was assessed as moderately impaired.

POINT SOURCE ASSESSMENT

The Lower Passaic River from the Pompton River to the Dundee Dam is severely affected by point sources which overload the assimilative capacity of the river. The Passaic River is highly enriched and suffers from excessive nutrients and oxygen demand. Below Dundee Dam, the Passaic River is tidal and impacted by point and nonpoint sources, and by inputs of polluted waters from further downstream during high-tidal periods. The large number of point sources discharging to the river reflects the complexity of water quality management for the Passaic River.

No dischargers to the Lower Passaic River are reported to be under enforcement actions by the department at the time of this writing. One wastewater discharger is scheduled to be taken off-line (see table below).

The following wastewater treatment plant will be eliminated:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Essex Co. Dept. of Public Works	Cedar Grove	Peckman River	ACO establishes a schedule to eliminate Essex Co.'s wastewater treatment plant discharge to the Peckman River by constructing and operating a pump station directing flow to the Verona Wastewater Treatment Plant. This connection is expected to be completed by the end of 1997 and is expected to significantly improve water quality in the Peckman River.

The Saddle River is suspected of being primarily impacted by urban/suburban runoff, although point sources do exist in the watershed. As in the lower Passaic, no enforcement actions are underway against discharges to the Saddle River that are affecting surface water quality.

The following facility has been upgraded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Borough of Lodi	Lodi	Saddle River	Richmond St. pumping station upgraded to alleviate untreated sewage bypasses to the Saddle River during heavy rain.

A number of hazardous waste sites and contamination problems are found in the Lower Passaic and Saddle River watersheds, including Newark Bay. Those sites that are affecting water quality are chromium disposal sites in Jersey City (to Newark Bay), the Wayne Township Landfill (volatile organics and metals to a small pond), the Ottilio Landfill in Newark (base neutrals, volatile organics and metals) and the Diamond Alkali/Shamrock Corporation site along the Passaic River in Newark. This last site is suspected of contributing dioxin and other chemicals to the waterway, sediments and to aquatic life.

NONPOINT SOURCE ASSESSMENT

The Lower Passaic River suffers water quality degradation and habitat destruction from the consequences of extensive urban/suburban runoff, road and building construction activities, waste storage leaks, riparian vegetation removal, and stream channel modifications. It is suspected by local authorities that a proposed flood control project planned for the Lower Passaic will have additional adverse impacts on the already stressed aquatic life in the river.

In the Passaic River, downstream of Garfield, the degrading impacts of urbanization increase to severe levels. In addition to those urban sources listed in the preceding paragraph, the lower reaches also receive chemical spills and leachate from contaminated soils. Severe degradation from urban runoff, construction, and streambank modification is also evident in many of the tributaries to the Passaic in the lower watershed. Many of these streams are so severely degraded that they are reported to be unable to support any form of aquatic life.

DESIGNATED USE ASSESSMENT

The waters of the Lower Passaic River and Saddle River will not support the primary contact (swimming) designated use. The lower Passaic River partially supports the "aquatic life support" designated use in those portions assessed. Most tributaries to the Passaic in this area also partially support the use. The Saddle River fully supports the "aquatic life support" designated use in its upper half, and partially supports the use along most of its lower region except at its down-stream most end where there is no support.

The tidal Passaic River will not meet water quality criteria for the designated uses assigned to SE-2 and -3 waters. This tidal reach of the Passaic River and Newark Bay are closed to commercial and recreational fishing and shellfishing (crabbing) because the aquatic life is contaminated with chlordane, PCBs and dioxin. As such, the tidal Passaic River will not meet the fish consumption use. Lack of water quality data in the tidal Passaic

River prevents determination of designated use attainment for fish maintenance in SE-3 waters.

BIOLOGICAL ASSESSMENT TABLE: AREA 4

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
4	18	AN0272	Preakness Bk	Paterson - Hamburg Tnpk	Wayne Twp	Jul 12, 1993	moderately impaired
4	18	AN0273	Preakness Bk	French Hill Rd	Wayne Twp	Jul 12, 1993	moderately impaired
4	18	AN273A	Naachtpunkt Bk	Continental Dr (abv outfall)	Wayne Twp	Apr 30, 1991	severely impaired
4	18	AN273B	Naachtpunkt Bk	Continental Dr (blw outfall)	Wayne Twp	Apr 30, 1991	severely impaired
4	18	AN0274	Passaic R	Riverview Rd	Ltl Falls	Jul 7, 1993	moderately impaired
4	18	AN0275	Peckman R	McBride Ave	W Paterson	Jul 7, 1993	moderately impaired
4	18	AN0276	Molly Ann Bk	Totowa Ave	Prospect Pk	Jul 7, 1993	severely impaired
4	18	AN0277	Goffle Bk	Wagaraw Rd	Prospect Pk	Jul 7, 1993	moderately impaired
4	18	AN0278	Diamond Bk	Hemlock St	Fairlawn	Jul 7, 1993	moderately impaired
4	11	AN0279	Saddle R	Old Stone Church Rd	U Saddle R	Jul 17, 1990	non-impaired
4	11	AN0280	Saddle R W Br	Old Stone Church Rd	U Saddle R	Jul 17, 1990	non-impaired
4	11	AN0281	Saddle R	E Allendale Ave	Saddle R	Jul 17, 1990	non-impaired
4	11	AN0282	Saddle R	E Ridgewood Ave	Ridgewood	Jul 17, 1990	non-impaired
4	11	AN0283	Hohokus Bk	Old Mill Rd	Fardale	Jul 16, 1990	moderately impaired
4	11	AN0284	Valentine Bk	Forest Ave	Allendale	Jul 16, 1990	moderately impaired
4	11	AN0285	Hohokus Bk	Park Ave	Allendale	Jul 16, 1990	non-impaired
4	11	AN0286	Ramsey Bk	Grenadier Rd	Mahwah	Jul 16, 1990	severely impaired
4	11	AN0287	Ramsey Bk	Park Ave	Allendale	Jul 16, 1990	non-impaired
4	11	AN0288	Hohokus Bk	Spring St	Ridgewood	Jul 17, 1990	moderately impaired
4	11	AN0289	Saddle R	Dunkerhook Rd	Fairlawn	Jul 17, 1990	moderately impaired
4	11	AN0290	Saddle R	Railroad Ave	Rochelle	Jul 17, 1990	moderately impaired
4	11	AN0291	Saddle R	Marcellus Pl	Garfield	Jul 17, 1990	severely impaired
4	18	AN0292	Third R	Kingland Ave	Nutley	Jul 6, 1993	moderately impaired

WATERSHED MANAGEMENT AREA 5
HACKENSACK RIVER DRAINAGE

The watershed management area represents the Hackensack River drainage system. Waters within this area represent a major water supply to regions of high population density. The area lies mostly in Bergen and Hudson Counties and includes the following watersheds:

Hackensack River

Pascack Creek

Summary of ambient physical/chemical monitoring stations and classifications:

Station	Classification
Hackensack River at River Vale	FW-2 Nontrout

Note: The monitoring station on the Hackensack River at New Milford, directly downstream of the Oradell Reservoir dam (FW-2 Nontrout), has been discontinued as of 1991.

OVERALL MANAGEMENT AREA ASSESSMENT

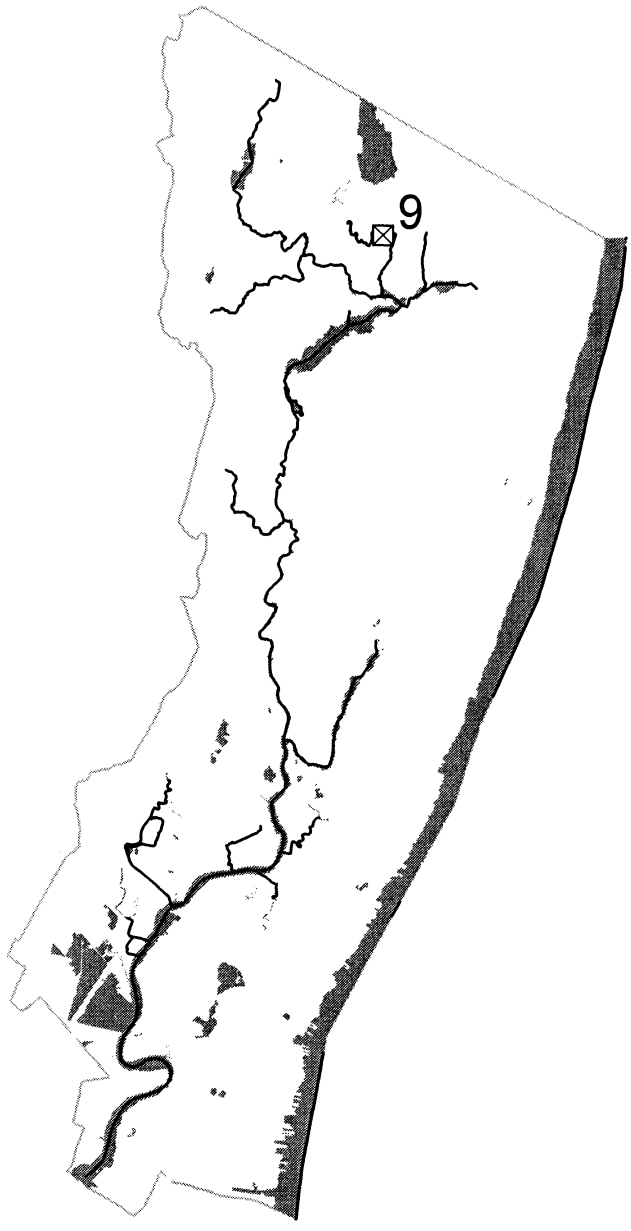
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Hackensack River	at River Vale	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 1 Mod. Impairment: 5 Severe Impairment: 2

Hackensack, Pascack Watershed Management Area 5



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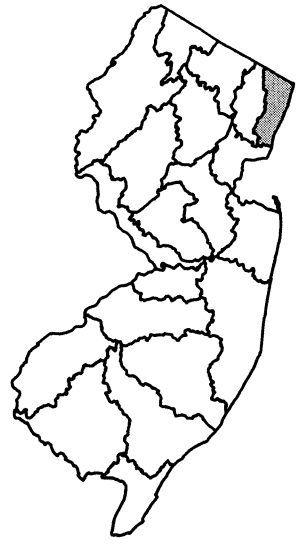
Monitoring Site
Rivers and Streams
Water Bodies
Watershed Management Boundary

Location



9. Hackensack River, Rivervale, NJ

HACKENSACK RIVER

WATERSHED DESCRIPTION

The Hackensack River drains an area of 202 square miles, which includes parts of Hudson and Bergen Counties. The Hackensack originates in New York State and flows south to Newark Bay. The river is 31 miles long in New Jersey. Major tributaries include the Pascack Creek, Berry's Creek, Overpeck Creek and Wolf Creek. The major impoundments on this river are Oradell Reservoir, Lake Tappan and Woodcliff Reservoir. This region of the state is very populated; major cities are Paramus, Bergenfield, Secaucus, Hackensack, Fort Lee, Jersey City and Englewood. Much of the Lower Hackensack watershed is tidal marshes known as the Hackensack Meadowlands.

About 50 percent of the land in this watershed is undeveloped, with more than 30 percent residential. The remainder is commercial/industrial. Of the approximately 80 NJPDES permitted discharges here, about 10 are municipal and the remaining are industrial/commercial. Waters in the Hackensack River and its tributaries have been classified as FW-2 Nontrout, FW-2 Trout Production (Creskill Brook), SE-1, SE-2 and SE-3.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Hackensack River at River Vale

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Mildly elevated phosphorus levels; 20% of samples exceeded the water quality criterion. Nitrate+nitrite levels were acceptable.

Bacteria: Elevated, fecal coliform geometric mean is 219 MPN/100ml, with 35% of samples exceeding 400 MPN/100ml.

Sodium: Elevated with ten percent of values violating the criterion (secondary drinking water). The median value was 37.5 mg/l.

Heavy Metals: This location exhibits very high copper levels. Two of the three recordings exceed both the chronic and the acute copper criteria for the protection of aquatic life at this location.

Summary: Phosphorus and bacteria are mildly elevated. Of concern here are the very high copper values observed. The drinking water quality at this location is threatened by excessive sodium levels.

The Hackensack River from below the Oradell Reservoir to the confluence with Newark Bay is regarded by the Department as an impaired waterway due to toxic discharges emanating from point sources. The contaminants of concern are arsenic, mercury, lead, zinc and nickel. The criteria violated are USEPA's federal aquatic life chronic criteria and USEPA's federal human health criteria for exposure to carcinogens.

The Hackensack Meadowlands Development Commission has conducted annual summer monitoring of the tidal Hackensack River and tributaries since 1971. Results have shown very low dissolved oxygen (less than 1.0 mg/l) in the river during summer months, along with high levels of biochemical oxygen demand, oil and grease and fecal coliform bacteria. Water quality data have shown notable differences between monitoring sites along the river in the past, indicating that impacts do occur locally.

Biological Monitoring

Macroinvertebrate assessments have found impairment to be widespread with this management area. The Hackensack River is assessed only in its more upstream reach at Old Tappan where it was found to be moderately impaired. Most tributaries were assessed as moderately impaired including Musquapsink River, Pascack Brook, Dorotocheys Run and Van Saun Brook. Overpeck Creek and Tena Kill are both severely impaired. Only Dewars Kill was assessed to be non-impaired. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

A large number of industrial and municipal wastewater discharges are present in the lower Hackensack River watershed. The following facilities in the watershed are currently under enforcement action as of this writing.

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Borough of Cliffside Park	Cliffside Park	Wolf Creek	ACO to eliminate untreated sewage discharges to Wolf Cr
Bergen Co. UA	Little Ferry	Hackensack R	ACO to eliminate wet weather sewage discharges.
Twp. of North Bergen	North Bergen	Cromakill Creek	ACO to eliminate sewage discharges.

Seven hazardous waste or Superfund sites which are known or suspected to be contaminating local surface waters are found in the Hackensack watershed. In addition, extensive mercury contamination of Berry's Creek has occurred. Certain fish from the Lower Hackensack River have been found to contain high PCB and chlordane concentrations. As a result, the sale and consumption of striped bass and blue crabs are prohibited. Thermal discharges in this area also impact water quality in the tidal Hackensack by reducing the water's ability to hold dissolved oxygen.

NONPOINT SOURCE ASSESSMENT

Water quality in the Hackensack River above the Oradell Reservoir appears to be primarily affected by nonpoint sources. Oradell Reservoir is highly eutrophic, and the Hackensack Water Company occasionally treats it in order to kill aquatic weed growth. Nonpoint sources within the overall watershed include extensive urban/suburban development and the land disposal of waste materials. The Upper Hackensack is reported to be impacted by runoff from construction activities, urban surfaces, storm and combined sewers, roads and by landfill leachate. These sources have resulted in flooding, habitat destruction, fish community degradation, reduced dissolved oxygen levels, excessive nutrients and accelerated eutrophication. In the Lower Hackensack River, the presence of these sources continues and their impacts become even more severe. Habitat destruction becomes more intense in the lower portions of the river due to riparian vegetation removal and flow regulation efforts. There are also severe impacts from chemical spills, landfills, hazardous waste disposal sites and in-place contaminants.

DESIGNATED USE ASSESSMENT

The Upper Hackensack River (above the Oradell Reservoir) will partially support the "aquatic life" designated use, but will not support the swimmable (primary contact) use. In the tidal Hackensack, both the "aquatic life" use and the primary contact use cannot be met. Based on the Hackensack Meadowlands Development Commission's sampling of the tidal Hackensack and tributaries, this region is not meeting the designated uses for SE-2 and SE-3 waters.

BIOLOGICAL ASSESSMENT TABLE: AREA 5

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
5	14	AN0205	Hackensack R	Old Tappan Rd	Old Tappan	Jul 6, 1993	moderately impaired
5	13	AN0206	Musquapsink R	Harrington Ave	Westwood	Jul 6, 1993	moderately impaired
5	13	AN0207	Pascack Bk	Westwood Ave & Harrington Ave	Westwood/Rivervale	Jul 6, 1993	moderately impaired
5	14	AN0208	Dwars Kill	Ruckman Rd	Closter	Jul 6, 1993	non-impaired
5	14	AN0208	Dwars Kill	Ruckman Rd	Closter	Oct 19, 1993	non-impaired
5	14	AN0208	Dwars Kill	Ruckman Rd	Closter	Apr 5, 1994	moderately impaired
5	14	AN0208	Dwars Kill	Ruckman Rd	Closter	Jan 10, 1995	non-impaired
5	14	AN0209	Tenakill	Cedar Ln	Closter	Jul 6, 1993	severely impaired
5	14	AN0210	Dorotockeys Run	Tappan Rd	Harrington Pk	Jul 6, 1993	moderately impaired
5	14	AN0211	Van Saun Bk	Main St & Rt 4	N Hackensack	Jul 6, 1993	moderately impaired
5	14	AN0212	Overpeck Ck	Dean Dr	Englewood	Jul 6, 1993	severely impaired

WATERSHED MANAGEMENT AREA 6
UPPER PASSAIC RIVER DRAINAGE

The watershed management area represents the area drained by waters from the upper reaches of the Passaic basin including the Passaic River from its source down to just before its confluence with the Pompton River. This region is characterized by extensive suburban development and heavy reliance on ground water sources for water supply. The area lies in portions of Morris, Somerset and Essex Counties and includes the following watersheds:

Upper Passaic River Whippany River Rockaway River

Summary of ambient physical/chemical monitoring stations and classifications:

Station	Classification
Passaic River near Millington	FW-2 Nontrout
Passaic River near Chatham	FW-2 Nontrout
Passaic River at Two Bridges	FW-2 Nontrout
Rockaway River at Boonton	FW-2, Nontrout
Rockaway River at Pine Brook	FW-2 Nontrout
Whippany River at Morristown	FW-2 Nontrout
Whippany River at Pine Brook	FW-2 Nontrout

OVERALL MANAGEMENT AREA ASSESSMENT

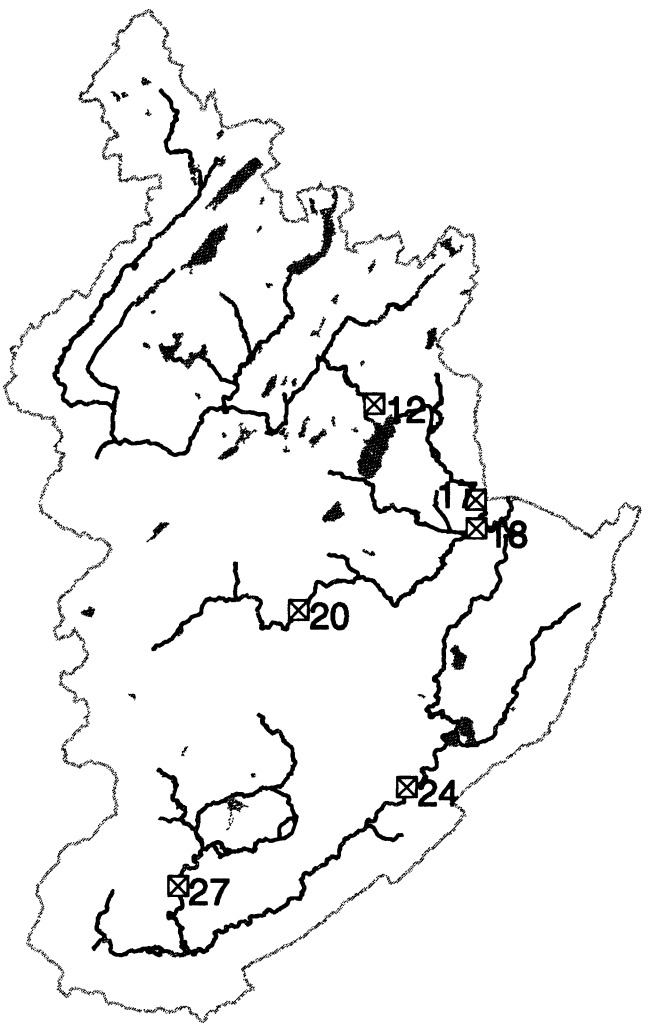
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Passaic River	near Millington	Partial Support
Passaic River	near Chatham	No Support
Passaic River	at Two Bridges	Partial Support
Rockaway River	at Boonton	Partial Support
Rockaway River	at Pine Brook	Partial Support
Whippany River	at Morristown	No Support
Whippany River	at Pine Brook	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 14 Mod. Impairment: 22 Severe Impairment: 7

Upper Passaic, Whippany, Rockaway Watershed Management Area 6



Monitoring Sites
Water Bodies
Rivers and Streams
Watershed Management Boundary

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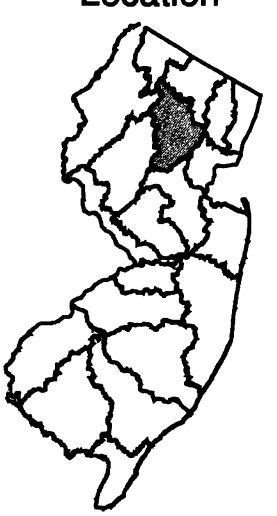
Location



12. Rockaway River Reservoir, Boonton, NJ
17. Rockaway River, Pine Brook, NJ
18. Whippany River, Pine Brook, NJ
20. Whippany River, Morristown, NJ
24. Passaic River, Chatham, NJ
27. Passaic River, Millington, NJ

UPPER PASSAIC RIVER

WATERSHED DESCRIPTION

The Upper Passaic River, from the source to the confluence of the Pompton River, is nearly 50 miles long and drains approximately 200 square miles of eastern Somerset, southern Morris and western Essex Counties. The river represents a significant source of drinking water for a large portion of northeastern New Jersey.

Major tributaries include the Dead River, Rockaway River, Whippany River and the Black Brook. There are no large impoundments, but smaller ones include the Canoe Brook Reservoir, Osborn Pond and Van Dorens Mills Pond. The areas adjacent to the Passaic River are subject to frequent flooding. The population centers are Madison-Chatham, Florham Park, Bernards, Berkeley Heights and New Providence.

Approximately one-half of the land in this watershed is undeveloped or vacant, with the remainder primarily residential and commercial. This Watershed is facing significant development in the vacant areas. There are some 30 NJPDES permitted discharges identified in this watershed, of which slightly more than half are municipal and the rest are industrial/commercial. The streams of the Upper Passaic River Watershed have been classified primarily FW-2 Nontrout, but some FW-2 Trout Production waters are present.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Passaic River near Millington

Dissolved Oxygen: Depressed. Seventeen percent of samples were below the 4.0 mg/l criterion for non-trout waters. Daytime values as low as 2.4 mg/l were recorded and the median value was 5.8 mg/l. These are close to mid-day readings; we expect night-time conditions to be significantly poorer.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen (nitrate+nitrite) at low levels. Total phosphorous is, in contrast, quite elevated, with 60% of samples exceeding the criterion. The median value was 0.12 mg/l.

Passaic River near Millington continued:

Bacteria: Fecal coliform levels are marginally elevated, showing a geometric mean of 136 MPN/100 ml, with 25% of samples exceeding 400 MPN/100 ml.

Heavy Metals: All at acceptable levels, however, one copper sample and one lead sample were elevated during the early portion of the period of review. These metals should be carefully monitored at this location.

Location: Passaic River near Chatham

Dissolved Oxygen: Acceptable for nontrout waters, however, this location is threatened with several recordings that closely approached the 4 mg/l lower limit.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen (nitrate+nitrite) at moderate levels; median value is 0.815 mg/l. Total phosphorous levels are very high, with 90% of samples exceeding the criterion. The median value was 0.29 mg/l.

Bacteria: Highly elevated; geometric mean for fecal coliform is 717 MPN/100ml.

Sodium: Elevated. Forty percent of the samples collected during the assessment period exceeded the 50 mg/l criterion. Median value was 46.5 mg/l. Violations occurred in both mid-winter and mid-summer and fall, indicating that winter road-salting was not the only significant source.

Heavy Metals: Records indicate acceptable levels. One lead value during the early portion of the assessment period, although within standards, did approach the limits of acceptability, suggesting that this metal could be a potential problem at this location and should be monitored.

Location: Passaic River at Two Bridges

Dissolved Oxygen: Acceptable for nontrout waters, but threatened; violations limited to 2% of samples.

Temperature: Violations of the upper criterion for non-trout waters limited to 2% of samples.

Nutrients: Inorganic nitrogen (nitrate+nitrite) at elevated levels; median value is 3.15 mg/l. Total phosphorous levels extremely elevated, with 95% of samples exceeding the criterion. The median value was 0.52 mg/l.

Bacteria: Fecal coliform at marginally unacceptable levels with a geometric mean of 140 MPN/100ml and 25% of samples exceeding 400 MPN/100ml.

Passaic River at Two Bridges continued:

Sodium: Elevated. Thirty-seven percent of the samples collected during the assessment period exceeded the 50 mg/l criterion. Median value was 41 mg/l. Violations were not restricted to winter, indicating that winter road-salting was not the only significant source.

Heavy Metals: Records indicate lead exceedances of chronic criteria to be common; four out of five samples exceeded the criteria.

Summary: Dissolved oxygen level is depressed at Millington but recovers further downstream near Chatham and remains stable through Two Bridges. In regard to nutrients, water quality worsens in a downstream direction. Phosphorus is severely elevated throughout and progressively worse as one proceeds downstream. Inorganic nitrogen is acceptable at Millington but elevated at the two more downstream stations. By the time water flow has reached Two Bridges, the Passaic River has been subjected to numerous municipal wastewater discharges. These discharges severely challenge the limited assimilative capacity of the river. On the positive side, toxic ammonia levels, a significant problem in the past in the Passaic River, were found to be very low.

Sanitary quality is marginal at Millington, poor near Chatham, then again marginal downstream at Two Bridges. Sodium levels are acceptable at Millington, but elevated at the two downstream monitoring sites.

Elevated lead threatens the quality of the Passaic. Levels were elevated but within water quality criteria at Millington and Chatham, but frequently exceeded the chronic criteria at Two Bridges. In the past, portions of the upper Passaic River have been regarded by the Department as impaired due to toxic discharges emanating from point sources; the river is thus listed in the State's 303(d) list. The contaminants of concern were cyanide, arsenic, copper, mercury, cadmium and lead. The criteria violated are USEPA's Federal Aquatic Life chronic criteria and USEPA's Federal human health criteria. The Department will be instituting an intensive review of all current data in order to determine if these concerns are still warranted.

Biological Monitoring

The macroinvertebrate communities within these portions of the Passaic River vary from moderately to severely impaired. Only one location, near Millington, was judged to be non-impaired when assessed in 1993. This fact lies in contrast to the depressed dissolved oxygen levels recorded at the chemical monitoring station near this location. Further downstream, in the Chatham and Hanover areas, the river is assessed as severely impaired. Biological health of the tributaries to the upper Passaic varied from non-impaired (Dead River and some of its tributaries) to severely impaired (Black Brook, portions of Loantaka Brook). See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the Watershed.

POINT SOURCE ASSESSMENT

There are no reported Department enforcement actions currently underway against facilities that are impacting surface water quality. A significant number of plants have been upgraded or eliminated (see table below).

Hazardous waste sites reported in the past to have been contaminating surface waters in this watershed are the Chevron site in Berkeley Heights releasing PCBs and volatiles to the Passaic River, and the Millington Asbestos site, releasing asbestos to the Passaic River. A soon-to-be-scheduled watershed characterization for the Passaic River Watershed will serve to update this information.

The following wastewater treatment plants have been upgraded, expanded or eliminated:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Southeast Morris Co. MUA	Hanover Twp.	Black Brook	Discharge contained violations of residual chlorine, COD and suspended solids. In June 1995 the facility ceased its discharge to the Black Brook and tied into Florham Park SA.
Precision Rolled Products	East Hanover Twp., Morris Co.	Black Brook	Facility discharged treated sanitary and industrial wastewater. Permit limit violations were for DO, suspended solids, ammonia, total residual chlorine. An AO issued in 1990 has resulted in improved industrial housekeeping and closure of their STP. Sanitary wastewater is now hauled off-site; industrial wastewater continues to be discharged at the site.
Warren Twp. Stage IV STP	Warren Twp., Somerset Co.	Dead River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in February 1992.
Chatham Twp. Main STP	Chatham Twp., Morris Co.	Black Brook	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in March 1992.
Long Hill Twp. STP	Long Hill Twp., Morris Co.	Passaic River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in August 1992.
Bernardsville Boro STP	Bernardsville Boro, Somerset Co.	Mine Bk.	Facility has completed an upgrade of its wastewater treatment system via an ACO executed with the Department.
Woodland STP	Morris Twp., Morris Co.	Loantaka Brook	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in November 1993.

NONPOINT SOURCE ASSESSMENT

The Passaic River is impacted by the extensive urban/suburban development which has occurred throughout much of its watershed. In the uppermost stretches (the Great Swamp region), local housing construction and the construction of a gas pipeline are suspected of contributing to localized

stream habitat destruction. As the river flows from the Great Swamp region to Chatham, the degree of development within the watershed becomes greater. Septic seepage, road and building construction and urban surface and road runoff all impact the Upper Passaic River. Florham Park and Chatham are reported to have a highly developed stormwater infrastructure, suggesting that stormwater outfalls may be a significant source of pollution to the river in this area.

The impacts to the river from urbanization increase in severity along the stretch from Chatham to Livingston. Siltation is suspected of being the principal agent of habitat destruction in this portion of the river. It is here that the Division of Fish and Game reports that the fishery begins to noticeably degrade, so that few game species are present. Those species which do survive are largely limited to pollution-tolerant forms such as carp and goldfish. Between Livingston and the Pompton River confluence, habitat destruction continues to rise in severity. This destruction has been brought about largely by dredging, channelization, the removal of riparian vegetation, as well as ever-increasing silt loads. Stream bank erosion and urban runoff appear to be common problems along the Passaic and many of its tributaries.

DESIGNATED USE ASSESSMENT

The Upper Passaic River will fully support the "aquatic life" use only in one portion of the river, namely the region around Valley Road near Millington. The remaining assessed portions varies from partial to non support depending upon the location. Macroinvertebrate assessments have not gone beyond the Passaic River in East Hanover.

The Passaic River sanitary quality as based upon fecal coliform levels at Millington and Two Bridges would partially support primary contact recreation (swimming). Sanitary quality is poor at the Chatham site; hence, this location is not swimmable.

ROCKAWAY RIVER

WATERSHED DESCRIPTION

The Rockaway River has a drainage area of 133 square miles that is mostly within Morris County with a small portion in Sussex County. It flows east to a confluence with the Whippany River at Pine Brook. Major tributaries to this 37 mile long river include Stone Brook, Mill Brook, Beaver Brook and Den Brook. There are many lakes and ponds in this area, but the major impoundments are Mountain Lakes Reservoir, Upper Longwood Lake, Boonton Reservoir, Taylortown Reservoir, Splitrock Reservoir, White Meadow Lake and Lake Denmark. The population centers include Boonton, Randolph, Montville, Kinnelon and Dover.

The land use patterns in this area are complex and include wooded/vacant areas, park lands, and residential development, with some areas having industrial and commercial uses. Development is occurring in much of the vacant area. There are approximately 30 NJPDES permitted dischargers here, of which about two-thirds are industrial/commercial and one-third are municipal. Waters in this drainage basin have been rated FW-2 Trout Production, FW-2 Trout Maintenance, FW-2 Nontrout and FW-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Rockaway River at Boonton and at Pine Brook

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen low at Boonton. Phosphorus also low when compared to Pine Brook, however, the location just upstream of a reservoir requires that Boonton be assessed using the more restrictive phosphorus criterion of 0.05 mg/l. Using this criterion, 29% of the phosphorus recordings exceeded the standard. The median total phosphorus value was 0.03 mg/l.

At Pine Brook conditions degrade noticeably. Inorganic nitrogen is very high, with a median value of 3.13 mg/l, but with individual values as high as 8.93 mg/l. Total phosphorus is also elevated; the median values was 0.145 mg/l, with 72% of samples exceeding the criterion (0.10 mg/l). At Boonton, in contrast, only one phosphorus recording exceeded 0.10 mg/l (6% of the samples).

Bacteria: At Boonton, fecal coliform levels are marginal. Geometric mean is 107 MPN/100ml, with 17% of samples exceeding 400 MPN/100ml. At Pine Brook, again fecal coliform levels are marginal; geometric mean is 171 MPN/100ml, with 35% of samples exceeding 400 MPN/100ml .

Rockaway River continued:

Sodium: Acceptable at Boonton. At Pine Brook, sodium is elevated and just within the water quality criterion. Several records above 40 mg/l were encountered in summer and fall, not in winter.

Heavy Metals: One lead record out of four exceeded the chronic criterion for aquatic life support at Boonton. At Pine Brook one high record (out of five) again exceeded the chronic criterion. Pine Brook, is also threatened by copper, levels of which are within standards, but are somewhat elevated.

Summary: Generally speaking, the Rockaway River is of good quality above the Boonton reservoir, but has fair quality below it as measured at Pine Brook. The later location exhibits elevated nutrients, sodium and lead. Sanitary quality at Boonton and Pine Brook is marginal. Lead is also a problem at Boonton.

Conditions are very similar to the previous physical/chemical assessment presented in the 1992 Inventory Report using records from 1986 through 1990 (inclusive). One notable exception is a reduction of fecal coliform levels (expressed as geometric means) at Pine Brook. In this previous assessment, fecal coliform samples had a geometric mean of 503 MPN/100ml. This is notably higher than the bacterial levels observed in the still earlier 1983-1987 assessment when the geometric mean was determined to be 169 MPN/100ml. Hence, it appears that the geometric mean (in our present assessment) has returned to the levels originally observed in the mid-1980s.

Biological Monitoring

Macroinvertebrate assessments suggest that the upper-most portion of the Rockaway River in Jefferson Township is moderately impaired. Further downstream, in Randolph Township, Denville and Boonton (above the reservoir), the river is assessed as non-impaired. Below the reservoir, the Rockaway is moderately impaired.

Assessment results of tributary streams varied. Russia Brook and Mill Brook were non-impaired. Beaver Brook and Crooked Brook indicated portions of non-impairment and portions of moderate impairment. The only severely impaired location was Den Brook as monitored in Denville.

POINT SOURCE ASSESSMENT

Point source facilities in non-compliance as well as those formerly under enforcement action that have improved their discharges are listed in the point source tables below. Only one facility is under a Department enforcement action.

Two hazardous waste sites located in the Rockaway Watershed were suspected of contaminating surface waters in the past. These were Sharkey Landfill in Parsippany-Troy Hills and L.E. Carpenter in Wharton Borough. A future characterization report will update their status.

A permitted wastewater discharge within the watershed was reported to be in noncompliance with its discharge permits:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
White Rock STP	Jefferson Twp., Morris Co.	tributary to Mitt Pond	Total phosphorus and primary tank overflows	The STP has had frequent effluent violations as well as primary tank overflows. Enforcement action is under way. The plant is undergoing minor modification at this time.

The following wastewater treatment plants have been discontinued:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Randolph High School STP	Morris Co.	Mill Brook	Treated sanitary wastewater contained violations of nitrogenous BOD, DO, ammonia and cBOD. Facility was decommissioned in February 1993.
Berkshire Sand and Stone Co.	Jefferson Twp., Morris Co.	Middle Brook/Rockaway River	Discharge of process and storm water contained violations of total suspended solids. Following seizure by the IRS in 1993, operations and all discharge ceased.

NONPOINT SOURCE ASSESSMENT

The Rockaway River from Dover down to the Passaic River is impacted to varying degrees by urban/suburban development; this impact increases in severity as one travels downstream. Construction activities and urban runoff from storm sewers and urban surfaces have resulted in siltation, high stream temperatures and losses of riparian vegetation - all of which contribute to a general decline in water quality. In the stretch between Dover and the Boonton Reservoir this degradation has led to a reduction in the stream's trout holding capacity. Further downstream of the reservoir, the impacts from these sources become more severe.

Many other streams in this watershed are also impacted by urbanization. Construction and urban runoff (sewers, urban surfaces) have degraded Jackson Brook, where fish kills have been documented in the 1980s. Beaver Brook is reported to be impacted by intensive road and housing construction. Development has been so severe around Den Brook that it has led to complete habitat destruction within the stream.

DESIGNATED USE ASSESSMENT

The Rockaway River will fully support the "aquatic life support" designated use in the segment within Randolph Township, Denville and Boonton (above the reservoir). In Jefferson Township and the segment below the reservoir, the Rockaway River partially supports the use. Various tributaries either fully support (Russia and Mill Brooks), partially support (portions of Beaver and Crooked Brooks), or do not support the "aquatic life" designated use (Den Brook).

The river is regarded as partially supporting primary contact recreation (swimming) because of marginal fecal coliform bacterial levels at Boonton and Pine Brook.

WHIPPANY RIVER

INTRODUCTORY NOTE

Significant portions of the information presented for the Whippany Watershed in this report are drawn from the *Whippany River Watershed Characterization Report*, prepared by the NJDEP's Office of Environmental Planning. As such, the level of information presented for the Whippany region is extensive compared to other watersheds in this report. These detailed assessments will be developed through the department's Watershed Management Program, of which the Whippany serves as a pilot program. Copies of the *Whippany River Watershed Characterization Report* are available from the New Jersey Department of Environmental Protection, Office of Environmental Planning, CN 418, Trenton, NJ, 08625.

WATERSHED DESCRIPTION

The 69.3 square mile Whippany River Watershed is located entirely within Morris County and encompasses 14.3% of the County. The river flows 18 miles to the New River near East Hanover, directly upstream of the confluence with the Passaic River. Two of the larger tributaries to the Whippany are Black Brook and Troy Brook. Major impoundments include Clyde Potts Reservoir, Speedwell Lake and Pocahantas Lake. The population is centered in Morristown, Parsippany-Troy Hills, Hanover Township and East Hanover Township.

The Whippany River Watershed has been divided into three subwatersheds. The Upper Whippany subwatershed constitutes 20 percent of the watershed and is 14 square miles. It includes the headwaters to just above the Butterworth Sewage Treatment Plant in Morris Township. The Middle-Lower subwatershed with inputs from Black and Malapardis Brooks is 39 square miles and comprises 57 percent of the watershed. The Troy Brook subwatershed is located from its headwaters in Mountain Lakes Borough to just prior to the confluence with Smith Ditch/Whippany River. It is 16 square miles and is 23 percent of the Watershed.

Surface Water Quality: Stream Classifications

The following classifications are from the Surface Water Quality Standards (N.J.A.C. 7:9B) of April 1994. The Whippany is composed of the Brookside tributary, which is classified as FW2-TP(C1) from its source to Whitehead Road bridge, and the Morristown tributary, which is classified as FW2-NT extending from the Whitehead Road bridge in Morris Township to the Rockaway River. The tributaries of the Whippany River are classified as follows:

Brookside (entire length)	FW2-TP(C1)
East of Brookside (entire length)	FW2-TM
East of Washington Valley (entire length)	FW2-TM
Gillespie Hill (entire length)	FW2-TP(C1)
Shongum Mountain (entire length)	FW2-NT

FW = fresh water
TM = trout maintenance
TP = trout production
NT = nontrout waters
C1 = category one waters

Land Use In The Subwatersheds

The following information was generated from a GIS coverage from the United States Geological Survey Land Use Land Cover Classification System.

Land Use Per Subwatershed:

Subwatershed	Land Use	Area Square Mile	Percent
Upper Whippany	Agriculture	.50	3.60
	Barren Land	0	0
	Forest	8.51	61.10
	Urban Land	4.68	33.60
	Water	.11	.79
	Wetlands	.12	.86
Middle-Lower Whippany	Agriculture	.50	1.28
	Barren Land	.14	.36
	Forest	11.04	28.16
	Urban Land	25.05	63.9
	Water	.16	.41
	Wetlands	2.31	5.89
Troy Brook	Agriculture	.11	.69
	Barren Land	.03	.19
	Forest	4.18	26.14
	Urban Land	8.94	55.91
	Water	.59	3.69
	Wetlands	2.14	13.38

Land Use Categories are defined as follows:

Urban land is characterized by intensive land use where the landscape has been altered by human activities. It includes residential; commercial and services; industrial; transportation, communication and utilities; mixed urban or built-up land; other urban or built-up land; and recreational land. . Included with each of the above land uses are associated lands, buildings, parking lots, athletic fields, access roads, etc.

Agricultural land includes all lands used primarily for the production of food and fiber and some structures associated with this production. Subcategories

include cropland and pastureland; orchards, vineyards, nurseries and horticulture areas; and confined feeding operations.

Forest delineates any lands covered by woody vegetation other than wetlands.

Water represents all areas within the land mass periodically covered by water. This category includes river channels; lakes or ponds; reservoirs; and bay/estuaries.

The wetlands are those areas that are inundated or saturated by surface or ground waters at a frequency and duration sufficient to support vegetation adapted for life in saturated soil conditions. Coastal and interior wetlands are the two subcategories based on the location relative to a tidal water system.

Barren lands are characterized by thin soil, sand or rocks and a lack of vegetative cover in a non-urban setting. Extractive mining operations, landfills and other disposal sites compose the majority of man-altered barren lands. Barren land such as beaches and rock faces are also included in this category.

The Upper Whippany subwatershed is over 60 percent forest covered, most of which is classified as deciduous forest. Urban land use accounts for another 30 percent of the subwatershed. Residential land use is the majority of this category.

The Middle-Lower Whippany subwatershed is also over 60 percent urban. Forest cover makes up another 30 percent of the subwatershed. Wetlands comprise over 5 percent of the subwatershed and are characterized by non-tidal marshes for the most part. Black Meadows is located in this subwatershed.

Over 50 percent of the Troy Brook subwatershed is urban while wetlands and forest comprise most of the other half of the land use in the subwatershed. Troy Meadows and part of Hatfield Swamp are located in this subwatershed.

Water Supply

Based upon information contained within the August *1996 New Jersey Statewide Water Supply Plan*, the total current average water supply demand (1990) in the watershed is approximately 27.3 MGD. There is only one surface water withdrawal for potable use in the watershed: the Southeast Morris County Municipal Utilities Authority, which diverts water from the Clyde Potts Reservoir (Harmony Brook) in Mendham Borough. This water is utilized by Morristown, Morris Township and Mendham Township. The generated wastewater is sent to the Morristown STP for treatment and subsequent discharge back into the Whippany River in a non-depletive manner. Although the Clyde Potts Reservoir is not frequently used as a water supply source, the Southeast Morris County Municipal Utilities Authority has the capability to divert 4 MGD from it. When water is diverted, water demand does not usually exceed 1.5 MGD.

Ground water is the most common use of the water supply in the Whippany River Watershed. Approximately 23.4 MGD is withdrawn from the aquifers that underlie the watershed. The majority of the withdrawals are for potable supply (20.3 MGD), while the remaining amount is used for industrial (3.0 MGD) and agricultural (0.1 MGD) purposes.

Approximately 7.3 MGD of the 23.4 MGD of ground water that is withdrawn from within the watershed is depletive in nature. Depletive water use is simply the amount of surface or ground water withdrawn from a selected geographic area that is used for water supply and disposed of in such a way that it can no longer be utilized again in that particular geographic area. Current ground water investigations indicate that these depletive ground water withdrawals may cause streamflow reductions within the watershed. The remainder of the watershed's demands (2.4 MGD) is met from sources that are transferred in from outside of the watershed.

WATER QUALITY ASSESSMENT

Water quality assessments of the Whippany Watershed presented here are based upon three principal sources. As the other watersheds assessed in this report, information is gathered from the fixed-station ambient physical/chemical monitoring network and a macroinvertebrate biological monitoring network. The third information source is a supplemental watershed-specific intensive monitoring and assessment process that represents an outcome of the Whippany Watershed pilot program. Many of the final conclusions regarding overall water quality within this watershed are the result of this latter study.

Physical/Chemical Water Quality

Locations: Whippany River at Morristown and Pine Brook

Dissolved Oxygen: Acceptable at both locations. Overall dissolved oxygen levels are lower at Pine Brook than at Morristown.

Temperature: No violations of the upper criterion for non-trout waters at either locations.

Nutrients: Total phosphorus is elevated at both locations. At Morristown, 60% of samples exceeded the criterion and the median value was 0.125 mg/l. At Pine Book, 84% of total phosphorus samples were over the criterion and the median value was 0.28 mg/l. Inorganic nitrogen was slightly elevated at both locations; the medians were 1.5 mg/l and 1.85 mg/l at Morristown and Pine Book, respectively.

Bacteria: Highly elevated at both locations. Geometric means of fecal coliform records were 599 MPN/100 ml and 433 MPN/100 ml at Morristown and Pine Book, respectively.

Sodium: Elevated but within the criterion at Morristown where the median value was 26 mg/l. At Pine Brook, 10% of samples exceeded the criterion and the median value was 34.5 mg/l. High values were not restricted to winter periods but occurred in summer and fall as well.

Whippany River at Morristown and Pine Brook continued:

Heavy Metals: Traditional sampling methods and laboratory analyses of total recoverable metals indicated violations of lead criteria (chronic) at Morristown and both lead and copper (both for chronic) at Pine Brook. However, recent supplemental sampling using "clean" field and laboratory techniques and analyses for the dissolved form of the metals uncovered no violations of either acute or chronic criteria at any of the numerous sampling locations.

Other: Two elevated pH recordings were observed at Morristown. Levels of 8.8 SU and 8.9 SU were recorded in the spring of 1992.

Summary: Based upon current physical/chemical monitoring, the Whippany, as monitored at Morristown and Pine Brook, still experiences elevated total phosphorus and poor sanitary quality as reflected by excessive bacterial levels. The use of the water for drinking is threatened by high sodium levels.

Biological Monitoring

Macroinvertebrate assessments indicate that the upper section of the Whippany mainstem is non-impaired. Beginning at Ridgedale Ave in Morristown down to the river's termination, the river is assessed to be moderately impaired. Conditions in Morristown represent an improvement over conditions observed in 1985 and 1990, when the location was assessed to be severely impaired. Tributaries to the Whippany, Troy Brook and Watnong Brook are assessed to be largely moderately impaired. One station on Watnong Brook (Old Dover Road in Morris Township) was found to be non-impaired.

An Historical Perspective on Water Quality

Comparisons of dissolved oxygen (DO) levels between 1973 and 1995 indicate that DO increased significantly between 1973 and 1980, and then again from 1980 to 1995. These are believed to be the results of the substantial upgrades to the wastewater treatment systems that have occurred within the watershed and the corresponding substantial reductions in the discharge of oxygen demanding materials (see *Point Source Assessment*, below). These reductions are reflected in reductions in in-stream biological oxygen demand (BOD) of some 80% in twenty years in the Whippany River.

Although there has been a general reduction in the loading of phosphorus from point sources, the in-stream concentrations have continued to increase over the past 20 years. It is suspected these additional phosphorus loadings may be emanating from nonpoint sources such as fertilizers, groundwater discharges, wildlife populations (such as pond waterfowl) surface runoff, the re-suspension of bottom material and ineffective stormwater management.

POINT SOURCE ASSESSMENT

Sewage Treatment Plants and Stormwater Systems

Six municipal wastewater treatment plants, 25 institutional sanitary plants and one stormwater facility discharge into the Whippany River or its tributaries. The Parsippany-Troy Hills Sewage Treatment Plants handles the greatest volume while Saint Mary's Abbey has the least maximum flow based upon monthly averages.

Starting in 1988 upgrades began on the four large sewerage facilities in the watershed. By 1992 all four facilities had attained tertiary or advanced status. Currently these advanced facilities employ chlorinating and/or ultra-violet disinfection methods. All four plants use the Parsippany-Troy Hills facility for sludge incineration.

Several sewage treatment plants serve municipalities in the Whippany River Watershed but do not discharge into the Whippany River. Morris Township, which operates the Butterworth STP, also operates the Woodland STP which discharges into Loantaka Brook, a Passaic River tributary. The Florham Park Sewerage Authority serves the entire borough and discharges into the Passaic River. The sanitary waste from both Madison Borough and Chatham Township also flows into the Passaic River after it is processed by the Madison-Chatham Joint Meeting Treatment Plant.

In the late 1980s all six of the larger sewage treatment plants underwent extensive upgrades. The total cost of these upgrades was between $150,000,000 and $200,000,000.

Industrial Permit Holders

For the most part the 32 permit holders in the watershed can be classified as small dischargers. In the Whippany River Watershed processes range from backwashing swimming pool filters to metal plating. Some of the following are notable and salient components of the waste-streams generated in the watershed. Colloid Chemical is permitted to release several metals including copper and chromium. Litton Industries also holds a permit for solvents, vinyl chloride and several toxic substances including arsenic and cyanide.

Pollutant Loading From Point Sources - Historical Perspective.

Comparisons were made of point source loadings during the 1970s and 1994 so as to analyze the changes that have occurred in municipal and industrial discharges as a result of some 20 years of point source management by the Department. Municipal treatment plant discharges were compared in terms of carbonaceous biochemical oxygen demand (CBOD) and nitrogenous biochemical oxygen demand (NBOD). Industrial discharges were analyzed using chemical oxygen demand (COD). Results are tabled below.

Municipal Facilities (Excluding Parsippany-Troy Hills)

Discharge/ Constituent	1970s Loading	1994 Loading	Percent Increase or Reduction
Flow, MGD	5.58	6.22	11.5% Increase
CBOD, lbs/day	1,602	219.3	86.3% Reduction
NBOD, lbs/day	2,774	56.3	98.0% Reduction
Total P, lbs/day	206	127	38.3% Reduction

Parsippany-Troy Hills STP

Discharge/ Constituent	1970s Loading	1994 Loading	Percent Increase or Reduction
Flow, MGD	4.75	12.75	158% Increase
CBOD, lbs/day	2250	282	87.5% Reduction
NBOD, lbs/day	4990	73.8	98.5% Reduction
Total P, lbs/day	186	347	87% Increase **(see note below)**

Note: This STP is located on the far downstream portion of the Whippany River. Its pollutant load is of little significance to the Whippany as a whole but is an issue impacting the Passaic River downstream.

Industrial Facilities (Estimated)

Discharge/ Constituent	1970s Loading	1994 Loading	Percent Increase or Reduction
Flow, MGD	9.5	1.86	80% Reduction
COD, lbs/day	6894	119	98% Reduction
CBOD*, lbs/day	6205	132	98% Reduction

* CBOD = COD x 0.9

The data indicate that for municipal wastewater, pollutant loadings of oxygen-demanding materials and phosphorus have been reduced substantially within the watershed. At the same time total wastewater flow has increased. Note that although phosphorus loadings have increased at the Parsippany-Troy Hills STP, this nutrient burden is more of an issue for the Passaic River due to the extreme downstream location of this treatment plant on the Whippany. Industrial facilities have shown a substantial reduction in both total flow and oxygen-demanding load.

The following is a summary of wastewater treatment plants that have been recently upgraded and/or expanded and have renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Hanover SA	HanoverTwp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in July 1992.

Treatment plants continued:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Morristown STP	Morristown Twp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in June 1992.
ParTroy STP	Parsippanny Twp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in December 1995.
Butterworth STP	Morris Twp., Morris Co.	Whippany River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in July 1992.
N.J. Psychiatric Institution (Greystone)	Parsippany Twp., Morris Co.	Jackqui Pond	Facility has completed an upgrade of its wastewater treatment system via an ACO executed with the Department.

Permit Compliance

Only one facility is under enforcement action for discharging improperly treated wastewater:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
St. Mary's Abbey, Delbarton School	Morris Twp., Morris Co.	un-named trib. to the Whippany River	Ammonia, nitrogenous BOD	Facility was to upgrade in accordance with a 1988 ACO. The ACO was amended in 1994, allowing St. Mary's to tie into the Morris Twp. collection system. Facility is awaiting an amendment to water quality management plan to allow the tie-in.

NONPOINT SOURCE ASSESSMENT

Urban/suburban development is suspected of degrading the water quality of the Whippany River in its upper reaches and is known to have a severe impact in the river's lower section. Upstream of Speedwell Lake, runoff from construction activity, stormwater discharges, urban surfaces, and the loss of riparian vegetation are all suspected of contributing to siltation in the river. This in turn has led to a reduction in the trout holding capacity of the waterway. In the lower end below Speedwell Lake, urban runoff and chemical spills have resulted in severe siltation and an overall degradation of the river's water quality. The lower Whippany River is reported to have had a long history of fish kills caused by industrial and municipal pollution. Few game fish are said to inhabit this portion of the river as reported back in the late 1980s; in their stead pollution-tolerant forms such as carp and pan fish were reported to be inhabiting the river. Speedwell Lake and the wetland areas of the Whippany River Watershed (Black and Troy Meadows) are known to be receiving severe runoff from construction activity and from local storm sewers.

DESIGNATED USE ASSESSMENT

The Whippany River will fully support the "aquatic life" designated use in the portions upstream of Ridgedale Ave. in Morristown. From this point downstream the river only partially supports the use. Troy Brook and Watnong Brook also partially support the use. The river will not achieve swimmable status because of fecal coliform concentrations.

BIOLOGICAL ASSESSMENT TABLE: AREA 6

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	21	AN0213	Passaic R	Tempewick Rd	Mendham Twp	Feb 5, 1992	moderately impaired
6	21	AN0214	Indian Grave Bk	Hardscrabble Rd	nr Bernardsville	Feb 5, 1992	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	Aug 20, 1991	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	Nov 14, 1991	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	Feb 4, 1992	non-impaired
6	21	AN0215	Primrose Bk	Jockey Hollow Nat'l Pk	Jockey Hollow	May 19, 1992	non-impaired
6	21	AN0216	Primrose Bk	Lees Mill Rd	Harding Twp	Feb 6, 1992	moderately impaired
6	21	AN0217	Gr Bk	Blackwells Pl	Harding Twp	Feb 6, 1992	non-impaired
6	21	AN0218	Gr Bk	Blackberry Ln	Harding Twp	Feb 6, 1992	moderately impaired
6	21	AN0219	Gr Bk	Woodland Rd (Gr Swamp WMA)	Harding Twp	Feb 6, 1992	moderately impaired
6	21	AN0220	Loantaka Bk	Bluestone Terr	Morristown Twp	Feb 7, 1992	severely impaired
6	21	AN0221	Loantaka Bk	Green Village Rd	Green Village	Feb 7, 1992	moderately impaired
6	21	AN0222	Black Bk	Southern Blvd	Harding Twp	Feb 7, 1992	severely impaired
6	21	AN0223	Black Bk	New Vernon Rd	Meyersville	Feb 7, 1992	severely impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	Feb 5, 1992	non-impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	May 19, 1992	non-impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	Dec 9, 1992	non-impaired
6	21	AN0224	Passaic R	Valley Rd	nr Millington	Aug 11, 1993	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	Aug 27, 1991	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	Nov 14, 1991	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	Feb 4, 1992	non-impaired
6	21	AN0225	Dead R trib	Somerville Rd (Liberty Cor)	Bernards Twp	May 19, 1992	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	Aug 20, 1991	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	Nov 14, 1991	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	Feb 4, 1992	non-impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	May 19, 1992	moderately impaired
6	21	AN0226	Dead R	Somerville Rd (Liberty Cor)	Bernards Twp	May 5, 1994	moderately impaired
6	21	AN0227	Dead R	King George Rd	nr Mt Bethel	Feb 5, 1992	moderately impaired
6	21	AN0228	Passaic R	S Main Ave	Stirling	Nov 20, 1989	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	21	AN0229	Passaic R	Stanley Ave	Chatham	Jun 11, 1990	severely impaired
6	21	AN229A	Passaic R	Mountain Ave	Gillette	Nov 20, 1989	moderately impaired
6	21	AN229B	Passaic R	Snyder Ave	Berkeley Twp	Nov 17, 1989	moderately impaired
6	21	AN229C	Passaic R	Fairmount Ave	Long Hill	Jun 11, 1990	severely impaired
6	21	AN0230	Passaic R	Summit Ave	Chatham	Jun 12, 1990	severely impaired
6	21	AN230A	Passaic R	Watchung Ave	Chatham	Jun 12, 1990	severely impaired
6	21	AN0231	Passaic R	Eagle Rock Ave	E Hanover Twp	Nov 17, 1989	moderately impaired
6	21	AN231A	Passaic R	Passaic Ave	Florham Pk	Jun 12, 1990	severely impaired
6	21	AN231B	Passaic R	Old Mt Pleasant Ave	E Hanover Twp	Nov 17, 1989	severely impaired
6	23	AN0232	Whippany R	Mt Pleasant Rd	Mendham Twp	Jul 7, 1993	non-impaired
6	23	AN0233	Whippany R	Whitehead Rd	Morris Twp	May 16, 1985	non-impaired
6	23	AN0233	Whippany R	Whitehead Rd	Morris Twp	May 22, 1990	non-impaired
6	23	AN0234	Whippany R	Ridgedale Ave	Morristown	Apr 17, 1985	severely impaired
6	23	AN0234	Whippany R	Ridgedale Ave	Morristown	May 22, 1990	severely impaired
6	23	AN0234	Whippany R	Ridgedale Ave	Morristown	Nov 9, 1993	moderately impaired
6	23	AN234A	Watnong Bk	Lake Rd	Morristown	Nov 9, 1993	moderately impaired
6	23	AN234A	Watnong Bk	Lake Rd	Morristown	Sep 8, 1994	moderately impaired
6	23	AN234B	Watnong Bk	W Hanover Rd	Morris Twp	Sep 8, 1994	moderately impaired
6	23	AN234C	Watnong Bk	Old Dover Rd	Morris Twp	Sep 8, 1994	non-impaired
6	23	AN0235	Whippany R	Jefferson Rd	Hanover Twp	Apr 19, 1985	severely impaired
6	23	AN0235	Whippany R	Jefferson Rd	Hanover Twp	May 22, 1990	moderately impaired
6	23	AN0235	Whippany R	Jefferson Rd	Hanover Twp	Nov 9, 1993	moderately impaired
6	23	AN0236	Troy Bk	Lake Rd	Mtn Lks	Jul 13, 1993	moderately impaired
6	23	AN0237	Troy Bk	Beaverwyck Rd	Troy Hills	Jul 13, 1993	moderately impaired
6	23	AN0238	Whippany R	Edwards Rd	E Hanover Twp	Apr 16, 1985	moderately impaired
6	23	AN0238	Whippany R	Edwards Rd	E Hanover Twp	Jul 7, 1993	moderately impaired
6	12	AN0239	Russia Bk	Milton - Dover Rd	Jefferson Twp	Jul 22, 1993	non-impaired
6	12	AN0240	Rockaway R	blw Longwood Lk	Jefferson Twp	Jul 22, 1993	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
6	12	AN0241	Rockaway R	Berkshire Valley Rd	Jefferson Twp	Jul 20, 1993	moderately impaired
6	12	AN0242	Green Pd Bk	Mt Pleasant Tnpk	Wharton	Jul 20, 1993	moderately impaired
6	12	AN0243	Rockaway R	Blackwell St (Rt 513)	Randolph Twp	Jul 20, 1993	non-impaired
6	12	AN0244	Mill Bk	Palmer Rd	Randolph Twp	Jul 20, 1993	non-impaired
6	12	AN0245	Beaver Bk	Lyonville Rd	Meriden	Jul 15, 1993	non-impaired
6	12	AN0246	Beaver Bk	Morris Ave	Denville	Jul 15, 1993	moderately impaired
6	23	AN0247	Den Bk	Mt Pleasant Tnpk	Denville	Jul 20, 1993	severely impaired
6	12	AN0248	Rockaway R	Pocono Rd	Denville	Jul 15, 1993	non-impaired
6	12	AN0249	Stony Bk	Valley Rd	Boonton Twp	Jul 15, 1993	moderately impaired
6	12	AN0250	Rockaway R	Morris Ave	Boonton	Jul 16, 1993	non-impaired
6	12	AN0251	Rockaway R	River Rd	Boonton	Jul 16, 1993	moderately impaired
6	12	AN0252	Crooked Bk	Hemlock Rd	Montville Twp	Aug 3, 1993	non-impaired
6	12	AN0253	Crooked Bk	Vista Rd	Montville Twp	Jul 13, 1993	moderately impaired
6	12	AN0254	Crooked Bk	River Rd	Montville Twp	Jul 13, 1993	moderately impaired

WATERSHED MANAGEMENT AREA 7
RAHWAY AND ELIZABETH RIVER DRAINAGE

The watershed management area includes watersheds draining into the Arthur Kill and Newark Bay. Portions of this area are highly polluted. The area lies in parts of Middlesex, Union and Essex Counties and includes the following watersheds:

Rahway River

Elizabeth River

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Rahway River near Springfield	FW-2 Nontrout
Rahway River at Rahway	FW-2 Nontrout
Elizabeth River at Ursino Lake	FW-2 Nontrout

Note: Monitoring at the West Branch Rahway River at West Orange (FW-2 Nontrout) has been discontinued.

OVERALL MANAGEMENT AREA ASSESSMENT

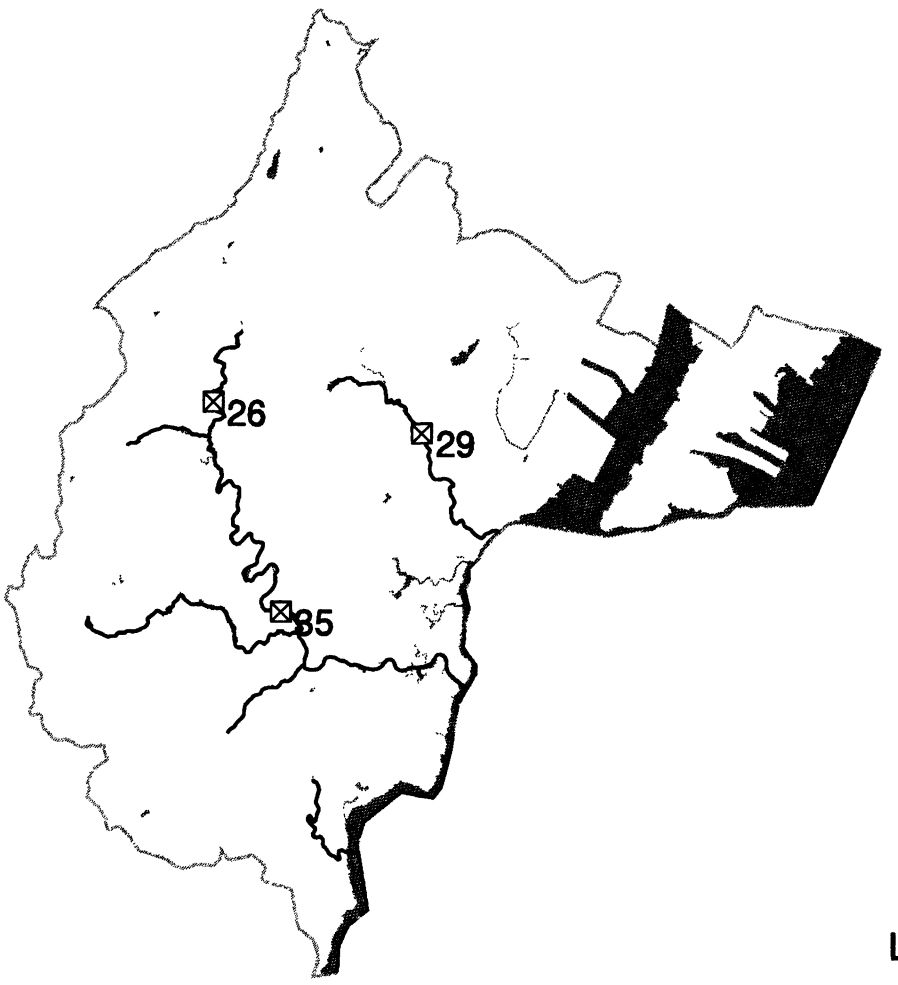
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Rahway River	near Springfield	No Support
Rahway River	at Rahway	No Support
Elizabeth River	at Ursino Lake	No Support

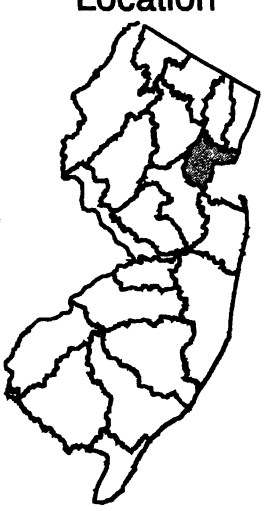
- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: see the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 0 Mod. Impairment: 9 Severe Impairment: 3

Elizabeth, Rahway, Woodbridge Watershed Management Area 7



Location



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Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary

26. Rahway River, Springfeild, NJ
29. Elizabeth River, Unsina Lake, Elizabeth, NJ
35. Rahway River, Rahway, NJ

RAHWAY AND ELIZABETH RIVER

WATERSHED DESCRIPTION

Measured from the headwaters to the City of Rahway, the Rahway River drains an area of 41 square miles, which includes parts of Middlesex, Union and Essex Counties. The mainstem, 24 miles long, flows from Union into the Arthur Kill near Linden and is tidal from the Pennsylvania Railroad bridge at Rahway down to the mouth. This is a densely populated area, with the centers of population being Rahway, Woodbridge, Clark, Springfield, Cranford, Westfield and Kenilworth. Major tributaries to the Rahway River include the East Branch Rahway River, Woodbridge River and Robinsons Branch. The major impoundments are the Middlesex Reservoir, Orange Reservoir, Lower and Upper Echo Lakes and Diamond Mill Pond. The Elizabeth River is 11 miles long, much of it channelized for flood control purposes.

Land uses in these watersheds are principally residential, commercial and industrial. There are over 50 NJPDES permitted discharges identified in the Rahway and Elizabeth watersheds; all except approximately five are industrial/commercial. The waters of the Rahway and Elizabeth Rivers and tributaries have been classified FW-2 Nontrout, SE-2 and SE-3.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Rahway River near Springfield and at Rahway

Dissolved Oxygen: One violation out of 19 recordings of the DO criterion was observed at the station near Springfield. Summer and fall DO recordings tended to be low (around 5 mg/l) as compared to those recorded downstream at Rahway. At Rahway DO was acceptable for nontrout waters.

Temperature: No violations of the upper criterion for non-trout waters at either location.

Nutrients: Phosphorus was elevated at both locations. Near Springfield, phosphorus levels exceeded the criterion in 33% of samples, and the median value was 0.065 mg/l. At Rahway, 35% of samples exceeded the criterion and the median value was 0.075 mg/l. Inorganic nitrogen (nitrate + nitrite) was elevated at both locations, with median values of 1.26 mg/l and 0.885 mg/l, respectively.

Bacteria: Highly elevated at Rahway with a fecal coliform geometric mean of 1201 MPN/100ml; also highly elevated near Springfield where the geometric mean was 852 MPN/100ml.

Rahway River continued:

Sodium: Elevated at both locations. Near Springfield, 25% of records exceeded the criterion and the median value was 37 mg/l. At Rahway, 15% of samples exceeded the criterion and there the median was 30 mg/l.

Heavy Metals:. A lead sample (one out of four) exceeded the chronic criterion for aquatic life support at the monitoring location near Springfield. A recording of 5 ug/l of arsenic was also observed at this location and represents a concern if water in this location or downstream is used for human consumption. Also at this location was an elevated copper sample (again one out of four) that approached but did not exceed the aquatic life support chronic criterion.

At Rahway, one sample of a total of five contained a high lead level (25 ug/l total rec.) that significantly exceeded the chronic criterion. On the same day, a very high copper record was observed (18 ug/l total rec.) which exceeded both acute and chronic criteria for this metal.

Other: The Rahway station showed one exceedance of the upper pH criterion (out of 19 samples).

Summary: Both monitoring locations (near Springfield and at Rahway) on the Rahway exhibited elevated phosphorus, bacteria, sodium and lead. In addition, Springfield DO recordings tended to be low in summer and fall compared to Rahway. Here also, elevated copper as well as lead may be a problem.

The Rahway near Springfield has shown some improvement over conditions observed during the last period of review (1986 through 1990) with regard to sanitary quality. The current fecal coliform geometric mean is about half of that previously observed. Conditions at Rahway more or less mirror the previous assessment.

The monitoring location on the West Branch Rahway River was discontinued in 1991. Previously, during the last period of assessment, this location showed excess levels of fecal coliform bacteria, total phosphorus and total dissolved solids. Fecal coliform counts had a geometric mean of 1,126 MPN/100ml from 1986 through 1990. Total phosphorus has averaged 0.07 mg/l, during which 63 percent of samples exceeded the State criterion. Total dissolved solids have averaged 511 mg/l - among the highest of all freshwater monitoring stations in the state. Dissolved oxygen concentrations have appeared adequate at this location.

Locations: Elizabeth River at Ursino Lake

Dissolved Oxygen: Acceptable for nontrout waters.

Temperature: No violations of the upper criterion for non-trout waters

Nutrients: Phosphorus was elevated; levels exceeded the criterion in 35% of samples, and the median value was 0.07 mg/l. Inorganic nitrogen (nitrate + nitrite) was relatively high, with a median value of 1.66 mg/l.

Bacteria: Highly elevated, with a geometric mean of 1167 MPN.

Sodium: Elevated with 50% of records exceeding the criterion and a median value of 51.5 mg/l.

Heavy Metals:. A recording of 2 ug/l of arsenic was also observed at this location during the early part of the review period.

Other: The Elizabeth River showed two exceedances of the upper pH criterion (out of 20 samples). This could suggest eutrophic conditions with very active photosynthesis.

Summary: The Elizabeth River drains highly developed urban lands adjacent to the Rahway watershed. The river, as monitored at Ursino Lake, contains excessive nutrients (phosphorus), bacteria and sodium. Water quality in the Elizabeth River may have undergone a slight improvement as compared to the last period of review (1986 through 1990). During the earlier assessment, 66 percent of the samples exceeded the phosphorus criterion. The current analysis found 35 percent in exceedance.

Biological Monitoring

The Rahway mainstem is assessed as moderately impaired throughout its entire length. The South Branch of the Rahway is moderately impaired at its upper portion and severely impaired in the lower half. The upper portion of Robinsons Branch in Scotch Plains is assessed to be severely impaired while the lower portion in Rahway is moderately impaired. The Elizabeth River is determined to be moderately impaired in the upper portion in Union; the lower portion in Elizabeth is severely impaired. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Water quality of the Rahway and Elizabeth Rivers are reflective of urbanized streams. The presence of high levels of nutrients, dissolved solids and fecal coliform bacteria are thought to be from both nonpoint sources and municipal/industrial point sources. Both the Lower Elizabeth and Rahway Rivers have combined sewer overflows discharging during storm events; however, the impacts are believed to be most severe in the Elizabeth River. Only one Department enforcement action against an unpermitted discharge in these watersheds is reported, see table below. Hazardous waste sites are

present in these watersheds, however, their status in contaminating surface waters is unclear (see Nonpoint Source Assessment below).

Current status of an unpermitted waste water discharge within the Rahway Watershed that is reported to be in noncompliance with its discharge permit:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Polychrome Corp.	Clark	Robinsons Branch of Rahway River	alcohols (COD>5000 mg/l)	Facility possesses an unpermitted discharge of highly contaminated sump water. Temporary holding tanks have been installed to contain the discharge for proper disposal. A Notice of Violation has been issued and negotiations are now in progress to settle the matter. Discharge ceased within 24 hours of DEP issuing the Notice, which resulted in significant improvements in the water quality in Robinsons Br.

NONPOINT SOURCE ASSESSMENT

The Rahway River watershed is highly urbanized and its waterways are severely degraded by nonpoint source pollution and by the physical alterations of the stream channel which extensive urbanization has brought about. In addition to pollution and habitat destruction, flood control has been a major problem in this watershed. Known sources of nonpoint pollution in the Rahway River include construction activities, storm sewers, urban surfaces, roads, and combined sewer overflows; all of these have contributed to high stream temperatures, sediment and nutrient loadings, periodic low dissolved oxygen levels and fishkills. Another problem in this watershed may be landfill leachate which in the past was believed to have contributed to the degradation of the tidal Rahway River, as well as to the adjacent Arthur Kill, Marshes Creek and Kings Creek.

Morses Creek and the Elizabeth River, draining almost totally developed watersheds, have been extensively channelized. Both in the past were judged to support minimal fish life due to the combined effects of habitat loss and severe water pollution levels coming from numerous nonpoint and point sources. The Elizabeth River has been described as chronically polluted over its entire length.

DESIGNATED USE ASSESSMENT

The Rahway and Elizabeth Rivers do not support primary contact recreation based upon sanitary conditions at their respective monitoring sites. The aquatic life support designated use is moderately supported in the Rahway River, as well as in portions of the South Branch of the Rahway, Robinsons Branch and the Elizabeth River. The use is not supported in the upper portion of Robinsons Branch and the lower reach of the Elizabeth River.

BIOLOGICAL ASSESSMENT TABLE: AREA 7

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
7	27	AN0192	Rahway R	Northfield Ave	W Orange	Feb 20, 1992	moderately impaired
7	27	AN0193	Rahway R	Washington Ave (Rt 82)	Springfield	Feb 20, 1992	moderately impaired
7	27	AN0194	Rahway R	Kenilworth Blvd	Springfield	Feb 20, 1992	moderately impaired
7	27	AN0195	Rahway R	River Rd & Church St	Rahway	Feb 19, 1992	moderately impaired
7	27	AN0196	Robinsons Br	Goodmans Crossing	Scotch Plains	Feb 19, 1992	severely impaired
7	27	AN0197	Robinsons Br trib	Raritan (Terrell) Rd	Scotch Plains	Feb 19, 1992	moderately impaired
7	27	AN0198	Robinsons Br trib	Lamberts Mill Rd	Westfield Twp	Feb 19, 1992	moderately impaired
7	27	AN0199	Robinsons Br	Rt 27	Rahway	Feb 19, 1992	moderately impaired
7	27	AN0200	Rahway R S Br	Parsonnage Rd	Menlo Pk	Feb 19, 1992	moderately impaired
7	27	AN0201	Rahway R S Br	Maplewood Ave	Colonia	Feb 19, 1992	severely impaired
7	28	AN0202	Elizabeth R	Lakeview Rd & Maple Terr	Union	Jul 6, 1993	moderately impaired
7	28	AN0204	Elizabeth R	Summer St	Elizabeth	Jul 6, 1993	severely impaired

WATERSHED MANAGEMENT AREA 8
NORTH AND SOUTH BRANCH RARITAN RIVER DRAINAGE

The watershed management area includes watersheds draining portions of the highlands of New Jersey. The area lies within portions of Morris, Hunterdon and Somerset Counties and includes the following watersheds:

South Branch Raritan River North Branch Raritan River

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
South Branch Raritan River at Middle Valley	FW-2 Trout Maintenance
South Branch Raritan River at High Bridge	FW-2 Trout Maintenance
Spruce Run near Glen Gardner	FW-2 Trout Production
Mulhockaway Creek at Van Syckel	FW-2 Trout Production
South Branch Raritan River at Stanton Station	FW-2 Trout Maintenance
South Branch Raritan River at Three Bridges	FW-2 Nontrout
Neshanic River at Reaville	FW-2 Nontrout
Lamington River near Pottersville	FW-2 Trout Production
Rockaway Creek at Whitehouse	FW-2 Nontrout
Lamington River at Burnt Mills	FW-2 Nontrout
North Branch Raritan near Chester	FW-2 Trout Production
North Branch Raritan River at Burnt Mills	FW-2 Nontrout

Note: Monitoring at the following locations has been discontinued as of 1991:

Spruce Run at Clinton (FW-2 Trout Maintenance)
Lamington River near Ironia (FW-2 Nontrout)
North Branch Raritan River at North Branch (FW-2 Nontrout)

OVERALL MANAGEMENT AREA ASSESSMENT

- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
South Branch Raritan R	at Middle Valley	Partial Support
South Branch Raritan R	at High Bridge	Partial Support
Spruce Run	near Glen Gardner	Partial Support
South Branch Raritan R	at Stanton Station	Partial Support
South Branch Raritan R	at Three Bridges	Partial Support

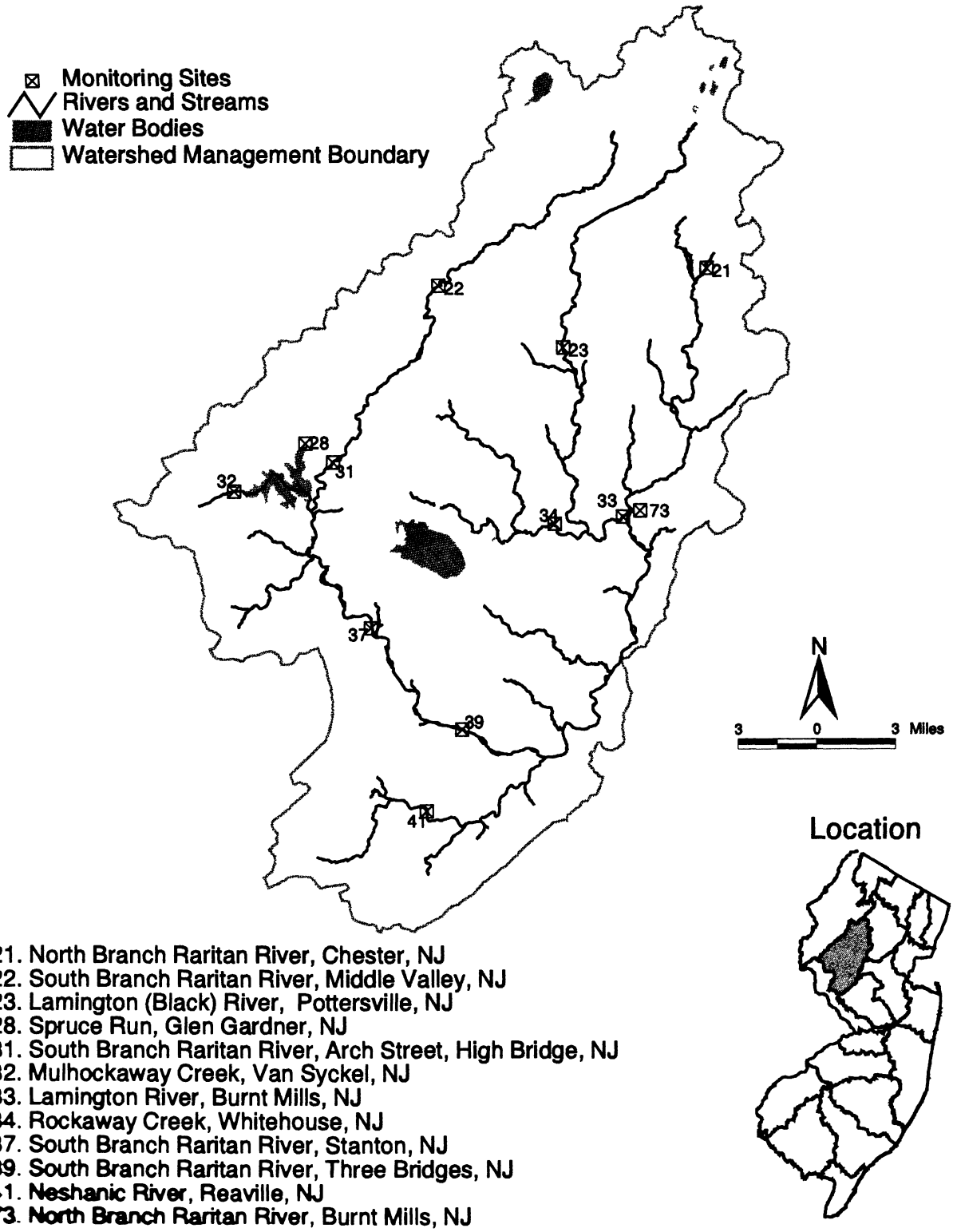
Swimmable Support Status continued:

WATERWAY	LOCATION	STATUS
Neshanic River	at Reaville	No Support
Mulhockaway Creek	*at Van Syckel*	*Partial Support*
Lamington River	near Pottersville	Full Support
Rockaway Creek	at Whitehouse	No Support
Lamington River	at Burnt Mills	Partial Support
North Branch Raritan R	near Chester	Partial Support
North Branch Raritan R	at Burnt Mills	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: see the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 47 Mod. Impairment: 18 Severe Impairment: 0

North and South Branch Raritan Watershed Management Area 8



21. North Branch Raritan River, Chester, NJ
22. South Branch Raritan River, Middle Valley, NJ
23. Lamington (Black) River, Pottersville, NJ
28. Spruce Run, Glen Gardner, NJ
31. South Branch Raritan River, Arch Street, High Bridge, NJ
32. Mulhockaway Creek, Van Syckel, NJ
33. Lamington River, Burnt Mills, NJ
34. Rockaway Creek, Whitehouse, NJ
37. South Branch Raritan River, Stanton, NJ
39. South Branch Raritan River, Three Bridges, NJ
41. Neshanic River, Reaville, NJ
73. North Branch Raritan River, Burnt Mills, NJ

SOUTH BRANCH RARITAN RIVER

WATERSHED DESCRIPTION

The South Branch of the Raritan River drains an area of 279 square miles and flows from western Morris County through central Hunterdon County and into western Somerset County before joining the North Branch. The South Branch is 51 miles long. Population centers include Flemington, Washington Township, Mt. Olive, Clinton and High Bridge. Major tributaries to the South Branch are the Neshanic River (11 miles long), Spruce Run Creek (6 miles), Mulhockaway Creek (8 miles) and Cakepoulin Creek. The major impoundments located in the watershed are Spruce Run Reservoir and Round Valley Reservoir.

The land use in this watershed is mostly agricultural, but suburban-industrial development is increasing at a rapid rate. Of the approximately 23 NJPDES permitted discharges here, half are municipal and half are industrial/commercial. The streams in this watershed are classified as FW-2 Trout Production, FW-2 Trout Maintenance and FW-2 Nontrout.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: South Branch Raritan River at Middle Valley

Dissolved Oxygen: Acceptable.

Temperature: One violation of the upper criterion for trout maintenance waters.

Nutrients: Inorganic nitrogen is slightly elevated, with a median value of 1.66 mg/l. Phosphorus is elevated, with 26% of samples exceeding the phosphorus criterion.

Bacteria: Sanitary quality at this location is marginally acceptable. The geometric mean is 146.9 MPN/100 ml, with 35% of samples exceeding 400 MPN/100ml criterion.

Heavy Metals: One lead sample of the four for this sampling period was equal to the aquatic life chronic lead criterion.

Other: Four of the 20 pH records exceeded the upper limit of 8.5 SU. One sodium record exceeded the drinking water criterion in January of 1994. Otherwise, sodium levels are low (median is 14 mg/l).

Location:. South Branch Raritan River at High Bridge

Dissolved Oxygen: Acceptable.

Temperature: Three violations (out of 20 measurements) of the upper criterion for trout maintenance waters.

Nutrients: Inorganic nitrogen is slightly elevated, with a median value of 1.52 mg/l. Phosphorus is acceptable, with 5% of samples exceeding the phosphorus criterion and a median value of 0.05 mg/l.

Bacteria: Sanitary quality at this location is marginally acceptable. The geometric mean is 171.9 MPN/100 ml, with 35% of samples exceeding 400 MPN/100ml criterion.

Heavy Metals: One lead sample of the five for this sampling period was equal to the aquatic life chronic lead criterion.

Other: One out of the 20 unionized ammonia records exceeded the upper limit of 20 ug/l. This value (85 ug/l) occurred in August of 1991, but no other elevated records were observed otherwise.

Location: South Branch Raritan River at Stanton Station

Dissolved Oxygen: Acceptable.

Temperature: Two violations of the upper criterion for trout maintenance waters.

Nutrients: Inorganic nitrogen is marginally elevated, with a median value of 1.2 mg/l. Phosphorus is slightly elevated, with 44% of samples exceeding the applicable phosphorus criterion of 0.05 mg/l. The median value for phosphorus was 0.045 mg/l and only 2 samples exceeded 0.10 mg/l.

Bacteria: Sanitary quality at this location is marginally acceptable. The geometric mean is 104.65 MPN/100 ml, with 22% of samples exceeding 400 MPN/100ml criterion.

Heavy Metals: One lead sample of the six for this sampling period slightly exceeded the aquatic life chronic criterion for lead.

Other: Two of the 17 pH records exceeded the upper limit of 8.5 SU.

Location: South Branch Raritan River at Three Bridges

Dissolved Oxygen: Acceptable for nontrout waters.

Temperature. Acceptable for nontrout waters.

Nutrients: Inorganic nitrogen is slightly elevated, with a median value of 1.53 mg/l. Phosphorus is elevated, with a median value of 0.19 mg/l and 60% of samples exceeding the phosphorus criterion of 0.10 mg/l.

South Branch Raritan River at Three Bridges continued:

Bacteria: Sanitary quality is marginally acceptable. The geometric mean is 139.8 MPN/100 ml, with 20% of samples exceeding 400 MPN/100ml criterion.

Heavy Metals: One lead sample of the five for this sampling period closely approached the aquatic life chronic lead criterion. In addition, one zinc sample equaled the aquatic life chronic criterion for zinc.

Other: One of the 19 pH records exceeded the upper limit of 8.5 SU.

Location: Spruce Run near Glen Gardner

Dissolved Oxygen: Acceptable.

Temperature: One sample (out of 20 records) exceeded 20° C.

Nutrients: Inorganic nitrogen is slightly elevated, with a median value of 1.3 mg/l. Phosphorus is slightly elevated with 33% of samples exceeding the phosphorus criterion here of 0.05 mg/l. The median value is 0.035 mg/l, with 2 (of 18) samples over 0.10 mg/l.

Bacteria: Sanitary quality at this location is marginally acceptable. The geometric mean is 105.2 MPN/100 ml, with 20% of samples exceeding the 400 MPN/100ml criterion.

Heavy Metals: One lead sample of the five for this sampling period slightly exceeded the aquatic life chronic lead criterion. One copper sample also exceeded the aquatic life chronic criterion for copper.

Location: Mulhockaway Creek at Van Syckel

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: Inorganic nitrogen is acceptable, with a median value of 0.96 mg/l. Phosphorus is marginal, with 11% of samples exceeding the phosphorus criterion of 0.05 mg/l. The median phosphorus value was 0.03 mg/l and all records were below 0.10 mg/l.

Bacteria: Sanitary quality at this location is marginally acceptable. The geometric mean is 118.4 MPN/100 ml, with 15% of samples exceeding the 400 MPN criterion.

Location: Neshanic River at Reaville

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Neshanic River at Reaville continued:

Nutrients: Inorganic nitrogen is slightly elevated, with a median value of 1.5 mg/l. Phosphorus is acceptable; the median was 0.05 mg/l, with one of 20 samples exceeding the phosphorus criterion of 0.10 mg/l.

Bacteria: Sanitary quality at this location is poor. The geometric mean is 858 MPN/100 ml, with 75% of samples exceeding the 400 MPN/100ml criterion.

Heavy Metals: One copper sample of the four for this sampling period exceeded the aquatic life chronic criterion.

Other: Four of the 20 pH records exceeded the upper limit of 8.5 SU. One sodium record exceeded the drinking water criterion in June of 1993. Otherwise, sodium levels are acceptable (median is 17 mg/l).

Summary: Overall water quality is good in the South Branch Raritan River, although some problems are evident. Warm summertime temperatures threaten the aquatic life, especially in the trout maintenance (and perhaps the trout production) portions of the river. This has been a problem reported in past Inventory Reports. Phosphorus is slightly elevated and sanitary quality is marginally acceptable. Elevated lead levels may be threatening the aquatic life support use in the river and should be investigated using "clean" sampling techniques.

The tributaries examined in the watershed - Spruce Run, Mulhockaway Creek and the Neshanic River - show good water quality with slight nutrient enrichment. Sanitary quality is marginally acceptable in the first two rivers and relatively poor in the Neshanic. Aquatic life is threatened by copper and lead in the Spruce Run, while copper is a concern in the Neshanic. The Neshanic River appears to have improved with respect to nutrient levels as current total phosphorus violations are significantly lower during this period of review (5% violations) as compared to the past review period of 1986 through 1990 (23% violations).

Biological Monitoring

An extensive amount of macroinvertebrate analysis has been performed in the South Branch Raritan watershed (see the Biological Assessment Table located at the end of this section for detailed assessments). At the source of the river is Budd Lake which exerts a strong influence upon the upstream-most monitoring site in Mt. Olive Township. At its source the South Branch exhibits a moderately impaired biota. Conditions improve, however, downstream as biomonitoring locations from Long Valley downstream to Clinton indicate nonimpaired conditions. At Stanton Station, conditions become variable and assessments can vary between moderately impaired and nonimpaired at the same location depending upon when the assessment was performed. The latest assessment shows the site as moderately impaired. Farther downstream at Three Bridges, conditions remain moderately impaired. At Neshanic Station the community is once again non-impaired until at South Branch where the river is assessed to be moderately impaired.

Tributaries within the watershed vary between non-impaired and moderately impaired. In the upper regions, Drakes Brook is moderately impaired at its

upstream-most location and non-impaired before its confluence with the South Branch. Nearby Stony Brook is assessed as non-impaired. Within the central portions of the watershed, Spruce Run, Mulhockaway Creek, Cakepoulin Creek, Prescott Brook and the upper half of Beaver Brook are all assessed as non-impaired. The lower portion of Beaver Brook is moderately impaired.

Tributaries in the lower watershed vary; Pleasant Run is moderately impaired in the upper-most reach and healthy in the lower-most end. Holland Brook appears to be healthy in both upper and lower ends. The Neshanic River and Black Creek are both moderately impaired.

POINT SOURCE ASSESSMENT

The South Branch Raritan River watershed contains a variety of potential point source pollution problems. No NJDEP enforcement actions are currently reported against any facilities. The table below lists six facilities that were formerly under enforcement action but have upgraded their discharge and are no longer considered to be impairing water quality.

The following wastewater treatment plants have been upgraded and/or expanded and have renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
U.S. Bronze Powders	Raritan Twp. Hunterdon Co.	Mill Creek	Former discharge of treated stormwater runoff and cooling water contained violations of zinc, copper, COD, dissolved solids and acute toxicity limits. The surface water discharge was eliminated in 1994.
Johnson & Johnson	Montgomery Twp., Somerset Co.	Back Brook	Discharge of treated wastewater contained violations of total suspended solids, BOD, ammonia, fecal coliform and pH. Facility completed an upgrade in 1993.
Clinton STP	Clinton, Hunterdon Co.	South Br. Raritan River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in January 1994.
Schooley's Mountain STP	Washington Twp., Morris Co.	South Br. Raritan River	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in August 1991.
NJDHS/Garret W. Hagedorn Center for Geriatrics	Glen Gardner Boro., Hunterdon Co.	Rocky Run	Facility has completed an upgrade of its wastewater treatment system via an ACO executed with the Department.
Clover Hill STP	Mt. Olive Twp., Morris Co.	Drakes Brook	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in December 1991.

NONPOINT SOURCE ASSESSMENT

The South Branch Raritan River exhibits a pattern which appears common throughout the state: a gradual decline in agricultural nonpoint source pollution paralleled by a rapid increase in suburban nonpoint sources. Both housing and road construction are reported to be on the rise in the Upper

South Branch watershed and these are known to be sources of excessive sediment loading. Coupled with these activities are the increasing problems with runoff from suburban sources and storm drains which are known to be contributing additional nutrients and sediments to the river. Septic tanks are a severe problem in this watershed, especially the increasing number of older systems which are failing in the High Bridge and Califon areas.

Agriculture is suspected of contributing nutrient and sediment loads to the South Branch. Local authorities suggest that while runoff from pasture lands may be on the rise, the gradual loss of farmland in this watershed has caused a decline in the severity of cropland runoff. The Natural Resources Conservation Service considers agricultural sheet and rill erosion to be severe in the South Branch watershed. Local timber harvesting is noted to have contributed to siltation but this problem is also believed to be on the decline. Other pollution sources suspected of impacting the South Branch are surface mining activities and general road runoff.

Five large tributary streams were evaluated for NPS impacts in this watershed: Bushkill Creek, Spruce Run Creek, Mulhockaway Creek, the Neshanic River and Pleasant Run. Bushkill Creek is believed to have been impacted by chemical spills and by urban runoff from combined sewers. Spruce Run Creek is known to be impacted by runoff from road maintenance, construction activities, feedlots, surface mines and leaks from waste storage facilities. These in turn have sent excess silt as well as oil and grease into the stream and are reported to have contributed to a general decline in the creek's fishery habitat. The Mulhockaway Creek subwatershed is said to be experiencing significant amounts of housing development, which is causing severe silt problems. The Neshanic River receives what are believed to be excess levels of nutrient and sediment loads from agricultural sources. Of these suspected sources, runoff from local croplands is judged to be on the rise while feedlot and pasture land runoff is believed to be on the decline. Suburban development in the Neshanic sub-watershed has brought about a rise in pollution problems. These problems arise from construction activities, septic systems, suburban surface runoff and road runoff. Additional problems in this sub-watershed have been reported from the improper land disposal of sludge. Pleasant Run is suspected of receiving excessive amounts of nutrient and sediment from croplands, suburban construction sites, storm sewers and roads.

DESIGNATED USE ASSESSMENT

Based upon fecal coliform bacterial data, all four physical/chemical monitoring sites on the South Branch Raritan River will partially support primary contact recreation (swimming). Spruce Run and Mulhockaway Creek also will partially support the use. The Neshanic River will not support primary contact recreation.

Large portions of the South Branch Raritan, especially in the upper and central portions, fully support the "aquatic Life Support" designated use. Sections of the lower portions fully and partially support this use.

The degree of aquatic life support in the tributaries vary. Drakes Brook partially supports the use in the upstream portions and fully support it in its

lower end. Stony Brook fully supports the use. Spruce Run, Mulhockaway Creek, Cakepoulin Creek, Prescott Brook and the upper half of Beaver Brook are assessed as fully supporting the aquatic life designated use. The lower portion of Beaver Brook partially supports the use. Pleasant Run partially supports the use in the upper reach and fully supports the use in the lowermost end. Holland Brook appears to fully support the use while the Neshanic River and Black Creek partially support it.

NORTH BRANCH RARITAN RIVER

WATERSHED DESCRIPTION

The North Branch of the Raritan River, 23 miles long, drains an area of 190 square miles and flows from northwestern Morris County through Somerset County to the confluence with the South Branch between the towns of Branchburg and Raritan. Population centers include Bernardsville, Peapack-Gladstone, Chester, Bedminister, Mendham and Far Hills. Major tributaries to the North Branch are Peapack Brook, Rockaway Creek (16 miles) and the Lamington River (27 miles). The only major impoundment in this drainage area is Ravine Lake.

The land use in this watershed is primarily rural, woodland, agricultural and scattered commercial/residential, but there is intense development along the major road corridors of Rts. 24, 206, and interstate highways 22, 287 and 78. Of the over 20 NJPDES permitted discharges here, roughly half are municipal and half are industrial/commercial. The streams in this watershed have been classified along various stretches as FW-2 Trout Production, FW-2 Trout Maintenance and FW-2 Nontrout.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: North Branch Raritan near Chester and at Burnt Mills

Dissolved Oxygen: Acceptable at both locations.

Temperature: Water temperatures can run high for trout production waters at Chester. Summertime temperatures can approach 20°C. Temperatures run a bit higher at Burnt Mills, but here the waters are classified as nontrout, thereby allowing for higher in-stream temperatures. No violations of the upper criterion for non-trout waters were observed at Burnt Mills.

Nutrients: Chester shows elevated nitrogen elevations in summer and fall. Inorganic nitrogen levels reached over 3 mg/l in 4 of 17 samples, with the median being 2.23 mg/l. Phosphorus is mildly elevated, with sixteen percent of samples exceeding the 0.1 mg/l criterion; the median is 0.07 mg/l.

Downstream at Burnt Mills, inorganic nitrogen levels decrease somewhat. Here the median is 0.94 mg/l and all recordings were well below 2.0 mg/l. Phosphorus here is just slightly less than the levels observed at Chester.

North Branch Raritan near Chester and at Burnt Mills continued

Bacteria: At Chester, fecal coliform levels are marginally acceptable. The geometric mean was 96 MPN/100ml and 20% of samples exceeded the 400 MPN/100ml criterion.

At Burnt Mills, sanitary quality was unacceptable. Geometric mean is 264 MPN/100ml and 40% of samples exceeded the 400 MPN criterion.

Heavy Metals: The only observed metal violation in the North Branch was at Burnt Mills, where one of five copper records exceeded both the acute and chronic criteria for aquatic life.

Other: Three out of 20 pH samples at Burnt Mills exceeded the upper criterion of 8.5 SU.

Locations: Lamington River near Pottersville and at Burnt Mills

Dissolved Oxygen: Acceptable at both locations.

Temperature: Water temperatures can sometimes run high for trout production waters near Pottersville. Spring and summertime temperatures can approach 20°C. Temperatures run about the same at Burnt Mills, but there the waters are classified as nontrout, thereby allowing for higher in-stream temperatures. No violations of the upper criterion for non-trout waters were observed at Burnt Mills.

Nutrients: Pottersville shows acceptable inorganic nitrogen levels. Phosphorus is mildly elevated, with 3 out of the 20 samples exceeding the 0.1 mg/l criterion.

Downstream at Burnt Mills, inorganic nitrogen and total phosphorus levels are roughly the same as those observed near Pottersville.

Bacteria: Near Pottersville, fecal coliform levels are acceptable. The geometric mean was 52 MPN/100ml and 10% of samples exceeded the 400 MPN/100ml criterion.

At Burnt Mills, sanitary quality was marginally acceptable. Geometric mean is 138 MPN/100ml and 25% of samples exceeded the 400 MPN/100ml criterion.

Other: One out of 19 pH samples near **Pottersville** exceeded the upper pH criterion of 8.5 SU; 3 of 20 samples at Burnt Mills exceeded the criterion.

Locations: Rockaway Creek at Whitehouse

Dissolved Oxygen: Acceptable.

Temperature: Acceptable for non-trout waters.

Nutrients: Mild nitrogen elevations. Inorganic nitrogen levels exceeded 1 mg/l in most samples, with the median being 1.3 mg/l. Phosphorus is also elevated, with 65% of samples exceeding the 0.1 mg/l criterion; the median is 0.12 mg/l.

Rockaway Creek at Whitehouse continued

Bacteria: Sanitary quality was unacceptable. Geometric mean is 270 MPN/100ml and 45% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: One of four lead records equaled the chronic criteria for aquatic life support.

Other: One out of the 19 pH samples exceeded the upper criterion of 8.5 SU.

Summary: The North Branch Raritan as monitored at Chester and Burnt Mills shows mild nutrient elevations and slight to moderately elevated fecal coliform levels (at Chester and Burnt Mills, respectively). Warm in-stream water temperatures during the summer may present problems to the trout fisheries within the trout production reaches of the river. Prior to its termination in 1991, the monitoring site at North Branch indicated good conditions with moderate nutrient enrichment but sanitary quality that would not support swimming.

Compared to the previous water quality assessment performed in 1992, water quality has improved in the North Branch at both Chester and Burnt Mills as evidenced by notable reductions in phosphorus and fecal coliform levels.

The Lamington also shows good quality. As in the North Branch, warm stream temperatures may threaten the trout production portions of the river. Rockaway Creek is consistent with the other waters with relatively good water quality but with unacceptable sanitary quality. The aquatic community may be threatened with lead. Monitoring prior to 1991 near Ironia found fair conditions that turned poor during the warmer months of the year, quite unlike the rest of the river. The site had exhibited elevated nutrient levels and poor sanitary quality. Low dissolved oxygen levels during low flow periods had been recorded.

The Lamington has also shown some improvement in water quality at Pottersville and Burnt Mills as compared to conditions recorded near the end of the 1980s. This is especially notable in the improved sanitary quality.

Biological Monitoring

The entire length of the North Branch Raritan, including its upper reaches (India Brook), are assessed as non-impaired. The Lamington is also non-impaired with the exception of the upstream-most biomonitoring site in Chester Township where it was assessed to be moderately impaired.

Assessments of the biological health of Rockaway Creek varied. The entire length of the North Branch as well as the mainstem are assessed to be healthy. The South Branch is non-impaired in the upper reaches and moderately impaired near its confluence with the North Branch Rockaway.

Tributaries within the watershed overall exhibited healthy biota including Dawson's Brook, Burnetts Brook, Peapack Brook and Tanners Brook. Middle Brook was healthy in its upper half but moderately impaired in the lower

portion. Mine Brook showed the reverse; the upper reach was assessed as moderately impaired but the lowest portion appears non-impaired.

POINT SOURCE ASSESSMENT

There are currently no enforcement actions involving facilities impacting stream quality, nor are there any recent upgrades currently reported within the North Branch Raritan watershed.

NONPOINT SOURCE ASSESSMENT

Active suburban development appears to be the primary nonpoint pollution source in the North Branch Raritan River watershed. The Lamington River has been reported to be impacted by increasing amounts of housing construction along its entire length, with many of these developments on former farmlands. These developments are suspected of contributing nutrients and sediments to the river. Other reported problems arising from suburban development are increasing urban runoff from storm sewers, leachate from septic tanks and runoff from land clearing. Agriculture is a suspected problem because of crop production and poorly managed pastures. Rockaway Creek, a tributary to the lower Lamington, is reported to have a severe pollution problem from surface mines. The Rockaway is also suspected to be impacted by horse pasture and septic systems in its north branch and road runoff in its south branch.

The North Branch Raritan River is impacted much the same way as is the Lamington. Active suburban development along much of its length, especially in the Pluckemin and Mendham areas, is reported to contribute to the excessive loading of nutrients and sediments to the waterway. Another suspected suburban pollution source is urban surface runoff, which appears to be a declining problem now due to better stormwater control. Agricultural activities also have an impact in this river, primarily through poorly managed pasture lands and feedlots. Pasture lands are estimated by local authorities to be an increasing nonpoint problem while the feedlots are assessed to be in decline due to an overall decrease in farm activity in the area.

DESIGNATED USE ASSESSMENT

Monitored waters of the North Branch partially support primary contact recreation (swimming) at Chester but do not support the use at Burnt Mills. The upper portion of the Lamington as monitored near Pottersville will fully support the use and will partially support primary contact recreation in the lower end as monitored at Burnt Mills. Rockaway Creek, as monitored at Whitehouse, does not support the use.

This watershed overall contains generally healthy macroinvertebrate and fish communities; recreational fishing for trout and smallmouth bass is heavy in many streams of the watershed. With some limited exceptions, these waters do support the aquatic life support designated use. There are concerns about water quality problems in some sections of the Lamington, the North Branch

Raritan, as well as some of the tributaries, which may threaten the quality of the fisheries (and overall biota) within those reaches.

BIOLOGICAL ASSESSMENT TABLE: AREA 8

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
8	24	AN0310	Raritan R S Br	Smithtown Rd	Mt Olive Twp	Jul 7, 1994	moderately impaired
8	24	AN0311	Drakes Bk	Emans Rd	Cary	Jun 16, 1994	moderately impaired
8	24	AN0312	Drakes Bk	Bartley Long Valley Rd	Four Bridges	Jun 28, 1994	non-impaired
8	24	AN0313	Stony Bk	Fairview Ave	Washington Twp	Jul 7, 1994	non-impaired
8	24	AN0314	Electric Bk	Fairview Ave	Long Valley	Jul 7, 1994	non-impaired
8	24	AN0315	Raritan R S Br	Rt 517	Long Valley	Jul 7, 1994	non-impaired
8	24	AN0316	Raritan R S Br	R Rd (dwnstr of Rt 512)	Califon	May 11, 1994	non-impaired
8	24	AN0316	Raritan R S Br	R Rd (dwnstr of Rt 512)	Califon	Aug 1, 1994	non-impaired
8	24	AN0316	Raritan R S Br	R Rd (dwnstr of Rt 512)	Califon	Nov 2, 1994	non-impaired
8	24	AN0316	Raritan R S Br	R Rd (dwnstr of Rt 512)	Califon	Feb 14, 1995	non-impaired
8	24	AN316A	Raritan R S Br	R Rd (upstr of Rt 512)	Califon	Mar 8, 1995	non-impaired
8	24	AN316B	Frog Hollow Bk	Beaver Rd	Tewksbury Twp	Mar 8, 1995	non-impaired
8	24	AN316C	Frog Hollow Bk	Bank St	Califon	Mar 8, 1995	non-impaired
8	24	AN0317	Raritan R S Br	R Rd (Ken Lockwood Gorge)	Lebanon Twp	May 11, 1994	non-impaired
8	24	AN0318	Spruce Run	Newport Rd	Newport	May 10, 1994	non-impaired
8	24	AN0318	Spruce Run	Newport Rd	Newport	Aug 1, 1994	non-impaired
8	24	AN0318	Spruce Run	Newport Rd	Newport	Nov 2, 1994	non-impaired
8	24	AN0318	Spruce Run	Newport Rd	Newport	Feb 14, 1995	non-impaired
8	24	AN0319	Spruce Run	Rt 31	Glen Gardner	May 10, 1994	non-impaired
8	24	AN0320	Willoughby Bk	Rt 31	Clinton Twp	May 10, 1993	non-impaired
8	24	AN0321	Mulhockaway Ck	Rt 635	Van Syckel	May 10, 1994	non-impaired
8	24	AN321A	Mulhockaway Ck	off Baptist Church Rd	Union	Apr 7, 1995	non-impaired
8	24	AN0322	Raritan R S Br	Rt 173 & Rt 513	Clinton	May 10, 1994	non-impaired
8	24	AN0323	Beaver Bk	Herman Thau Rd	Clinton Twp	May 11, 1994	non-impaired
8	24	AN0324	Beaver Bk	Lehigh St	Clinton	May 10, 1994	moderately impaired
8	24	AN0325	Cakepoulin Ck	L Lansdown Rd	Franklin Twp	May 10, 1994	non-impaired
8	24	AN325A	Cakepoulin Ck	L Kingston Rd	Kingston	Jan 13, 1992	moderately impaired
8	24	AN0326	Raritan R S Br	Station Rd	Stanton Sta	May 5, 1994	non-impaired
8	24	AN0326	Raritan R S Br	Station Rd	Stanton Sta	Aug 1, 1994	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
8	24	AN0326	Raritan R S Br	Station Rd	Stanton Sta	Nov 2, 1994	non-impaired
8	24	AN0326	Raritan R S Br	Station Rd	Stanton Sta	Feb 14, 1995	moderately impaired
8	24	AN0327	Prescott Bk	Station Rd	Stanton Sta	May 5, 1994	non-impaired
8	24	AN0328	Assiscong Ck	R Rd	Bartles Cor	May 5, 1994	non-impaired
8	24	AN0329	Raritan R S Br	Rt 613	Three Bridges	May 5, 1994	moderately impaired
8	24	AN0330	First Neshanic R	Rt 31	Raritan Twp	Apr 14, 1994	moderately impaired
8	24	AN0331	Second Neshanic R	Rt 31	Raritan Twp	Apr 27, 1994	non-impaired
8	24	AN0332	Third Neshanic R	Rt 31	Copper Hill	Apr 27, 1994	non-impaired
8	24	AN0333	Neshanic R	Reaville - Everitt Rd	Reaville	Apr 27, 1994	moderately impaired
8	24	AN0334	Back Bk	Wertsville Rd	E Amwell Twp	Apr 27, 1994	moderately impaired
8	24	AN0335	Back Bk	Rt 609	E Amwell Twp	Apr 27, 1994	moderately impaired
8	24	AN0336	Furmans Bk	Welisewitz Rd	Furmans Cor	Apr 14, 1994	moderately impaired
8	24	AN0336	Furmans Bk	Welisewitz Rd	Furmans Cor	Jul 6, 1994	moderately impaired
8	24	AN0336	Furmans Bk	Welisewitz Rd	Furmans Cor	Oct 11, 1994	non-impaired
8	24	AN0336	Furmans Bk	Welisewitz Rd	Furmans Cor	Jan 12, 1995	non-impaired
8	24	AN0337	Neshanic R	Rt 514	Hillsborough Twp	Apr 27, 1994	moderately impaired
8	24	AN0338	Raritan R S Br	Elm St	Neshanic Sta	May 23, 1994	non-impaired
8	24	AN0339	Pleasant Run	Pleasant Run Rd	Pleasant Run	May 5, 1994	moderately impaired
8	24	AN0340	Pleasant Run	S Br Rd	Neshanic Sta	May 12, 1994	non-impaired
8	24	AN0341	Raritan R S Br	Studdiford Dr	S Br	May 12, 1994	moderately impaired
8	24	AN0342	Holland Bk	Holland Bk Rd	Readington Twp	May 5, 1994	non-impaired
8	24	AN0343	Holland Bk	S Br Rd	Branchburg Twp	May 12, 1994	non-impaired
8	22	AN0344	India Bk	Calais Rd	Randolph Twp	Nov 30, 1993	non-impaired
8	22	AN0345	India Bk	Mountainside Rd	Mendham Twp	Nov 30, 1993	non-impaired
8	22	AN0346	Raritan R N Br	Rt 24	Ralston	Nov 30, 1993	non-impaired
8	22	AN0347	Dawsons Bk	S Rd & Ironia Rd	Mendham Twp	Nov 30, 1993	non-impaired
8	22	AN0348	Burnetts Bk	Old Mill Rd	Mendham Twp	Jun 19, 1990	non-impaired
8	22	AN0348	Burnetts Bk	Old Mill Rd	Mendham Twp	Sep 8, 1992	non-impaired
8	22	AN0348	Burnetts Bk	Old Mill Rd	Mendham Twp	Dec 7, 1992	non-impaired
8	22	AN0348	Burnetts Bk	Old Mill Rd	Mendham Twp	Mar 25, 1993	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
8	22	AN0349	Peapack Bk	Fox Chase Rd	Chester Twp	Jun 16, 1994	non-impaired
8	22	AN0350	Peapack Bk	Old Dutch Rd	Bedminster Twp	Jun 16, 1994	non-impaired
8	22	AN0351	Raritan R N Br	Rt 202	Far Hills	Jun 19, 1990	non-impaired
8	22	AN0351	Raritan R N Br	Rt 202	Far Hills	Sep 8, 1992	non-impaired
8	22	AN0351	Raritan R N Br	Rt 202	Far Hills	Dec 7, 1992	non-impaired
8	22	AN0351	Raritan R N Br	Rt 202	Far Hills	Apr 12, 1993	non-impaired
8	22	AN351A	Raritan R N Br	Roxitucus Rd	Mendham Twp	Jun 19, 1990	moderately impaired
8	22	AN0352	Mine Bk	Bernardsville Rd	Bernardsville	Dec 2, 1993	moderately impaired
8	22	AN0353	Mine Bk	Far Hills Rd (Rt 512)	Far Hills	Dec 2, 1993	non-impaired
8	22	AN0354	Middle Bk	Spook Hollow Rd	Bedminster Twp	Dec 2, 1993	non-impaired
8	22	AN0355	Middle Bk	R Rd	Bedminster Twp	May 5, 1994	moderately impaired
8	22	AN0356	Lamington R	Ironia Rd	Chester Twp	Jun 16, 1994	moderately impaired
8	22	AN0357	Tanners Bk	Tanners Bk Rd	Chester Twp	Jun 28, 1994	moderately impaired
8	22	AN0358	Lamington R	Rt 24	Milltown	Jun 28, 1994	non-impaired
8	22	AN0359	Trout Bk	Hacklebarney Rd	Chester Twp	Jun 28, 1994	non-impaired
8	22	AN0360	Lamington R	Rt 512	Pottersville	May 23, 1994	non-impaired
8	22	AN0361	Lamington R trib	Black R Rd	Pottersville	May 23, 1994	non-impaired
8	22	AN0361	Lamington R trib	Black R Rd	Pottersville	Aug 2, 1994	non-impaired
8	22	AN0361	Lamington R trib	Black R Rd	Pottersville	Nov 3, 1994	non-impaired
8	22	AN0361	Lamington R trib	Black R Rd	Pottersville	Feb 14, 1995	non-impaired
8	22	AN0362	Cold Bk	Vliettown Rd	Oldwick	May 23, 1994	non-impaired
8	22	AN0363	Lamington R	Rt 523	Lamington	May 23, 1994	non-impaired
8	22	AN0363	Lamington R	Rt 523	Lamington	Aug 2, 1994	non-impaired
8	22	AN0363	Lamington R	Rt 523	Lamington	Nov 3, 1994	non-impaired
8	22	AN0363	Lamington R	Rt 523	Lamington	Feb 14, 1995	non-impaired
8	22	AN0364	Rockaway Ck N Br	Rt 512	Fairmount	May 11, 1994	non-impaired
8	22	AN0365	Rockaway Ck N Br	Rockaway Rd	Mountainville	May 11, 1994	non-impaired
8	22	AN0366	Rockaway Ck N Br	Rockaway Rd	McCrea's Mill	May 11, 1994	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
8	22	AN0367	Rockaway Ck S Br	Windy Acres Farm	Lebanon	May 11, 1994	non-impaired
8	22	AN0368	Rockaway Ck S Br	Rt 22	Whitehouse	May 23, 1994	moderately impaired
8	22	AN0369	Rockaway Ck	Island Rd	Readington Twp	Jul 6, 1994	non-impaired
8	22	AN0370	Lamington R	Walsh Rd	Burnt Mills	Jul 6, 1994	non-impaired
8	22	AN0371	Chambers Bk B	Love Rd	Bedminster Twp	Dec 2, 1993	moderately impaired
8	22	AN0372	Chambers Bk A	Coddington Rd	Readington Twp	May 12, 1994	non-impaired
8	22	AN0373	Chambers Bk A	Station Rd	N Br Depot	Jun 14, 1994	non-impaired
8	22	AN0373	Chambers Bk A	Station Rd	N Br Depot	Dec 2, 1993	non-impaired
8	22	AN0373	Chambers Bk A	Station Rd	N Br Depot	Sep 12, 1994	non-impaired
8	22	AN0373	Chambers Bk A	Station Rd	N Br Depot	Mar 22, 1995	moderately impaired
8	22	AN0374	Raritan R N Br	Rt 202	Milltown	Jun 19, 1990	non-impaired
8	22	AN0374	Raritan R N Br	Rt 202	Milltown	Sep 12, 1994	non-impaired
8	22	AN0374	Raritan R N Br	Rt 202	Milltown	Dec 6, 1994	non-impaired
8	22	AN0374	Raritan R N Br	Rt 202	Milltown	Mar 22, 1995	non-impaired
8	22	AN374A	Raritan R N Br	Rt 28	N Branch	Jul 26, 1984	non-impaired

WATERSHED MANAGEMENT AREA 9
LOWER RARITAN RIVER DRAINAGE

The watershed management area includes watersheds draining the lower portion of Raritan River and includes the South River and Lawrence Brook. The Area lies mostly in Middlesex and Somerset and Monmouth Counties and includes the following watersheds:

Mainstem Raritan River	South River	Lawrence Brook
Manalapan River		Matchaponix Brook

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Raritan River at Manville	FW-2 Nontrout
Raritan R. at Queens Bridge (Bound Brook)	FW-2. Nontrout
Manalapan Brook near Manalapan	FW-2 Nontrout
Manalapan Brook at Spotswood	FW-2 Nontrout

Note: Monitoring at Raritan River at Raritan (FW-2 Nontrout) and Matchaponix Brook at Spotswood (FW-2 Nontrout) was discontinued in 1991.

OVERALL MANAGEMENT AREA ASSESSMENT

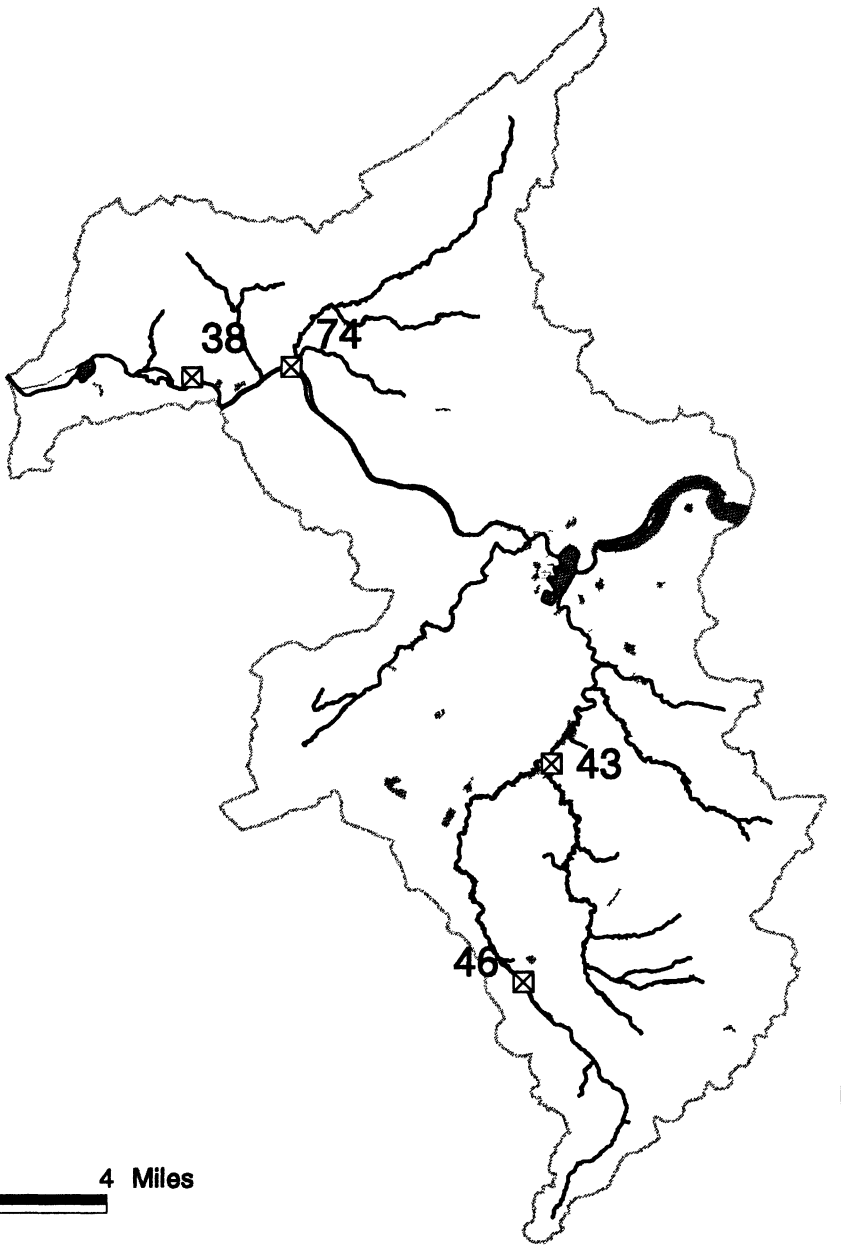
- Swimmable Support Status:

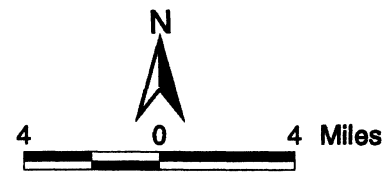
WATERWAY	LOCATION	STATUS
Raritan River	at Manville	Full Support
Raritan R.	Queens Bridge (Bound Brook)	No Support
Manalapan Brook	near Manalapan	Full Support
Matchaponix Brook	at Spotswood	Full Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

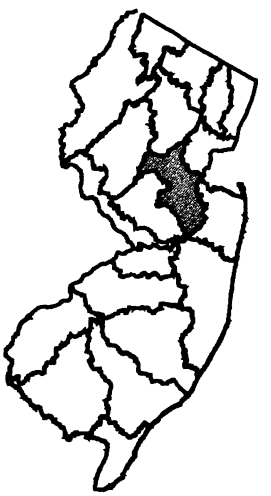
No Impairment: 3	Mod. Impairment: 33	Severe Impairment: 6

Lower Raritan, South River, Lawrence Brook Watershed Management Area 9





Location



Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary

38. Raritan River, Manville, NJ
43. Matchaponix Brook, Mundy Ave, Spotswood, NJ
46. Manalapan Brook, Federal Road, Manalapan, NJ
74. Raritan River, Queens Bridge, Bound Brook, NJ

RARITAN RIVER MAINSTEM

WATERSHED DESCRIPTION

The Raritan River, its tributaries and branches drain an area totaling over 1,100 square miles. The Raritan River basin is the largest river basin located entirely within New Jersey. The mainstem, 31 miles long, drains parts of Somerset, Union, Middlesex and Monmouth Counties before emptying into the Raritan Bay. Tides affect this waterway to the Fieldsville Dam upstream of New Brunswick. The Delaware and Raritan Canal flows alongside the Raritan River from the confluence of the Millstone River to New Brunswick. Major tributaries to the Raritan are the North and South Branches, Millstone River, South River, Green Brook and Lawrence Brook. The section of the Raritan basin reviewed here is the mainstem of the Raritan River from the confluence of the North and South Branches to Raritan Bay and associated small tributaries. For the most part, this drainage area is densely populated, with the centers of population in Plainfield, New Brunswick, Perth Amboy, Edison, South Amboy, Sayreville, Bound Brook, Somerville, Manville, Piscataway, Metuchen and Bridgewater. There are two low dams in the river, Fieldsville Dam and Calco Dam. Among the many small recreational lakes and ponds in this area are Watchung Lake, Surprise Lake, Spring Lake and Green Brook Pond (all manmade).

The land use in this watershed is primarily urban/suburban, with industrial and commercial centers throughout. There are about 73 NJPDES permitted dischargers here, some 12 of which are municipal and the remainder industrial/commercial. Fifteen discharges are to Raritan Bay and tributaries. Classifications of waters in the Lower Raritan River watershed are FW-2 Trout Maintenance, FW-2 Nontrout and SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Raritan River at Manville and at Queens Bridge

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: At Manville, inorganic nitrogen is marginal; median value is 1.12 mg/l. Total phosphorous is slightly elevated, with 26% of samples exceeding the criterion. The median value was 0.1 mg/l.

At Queens Bridge in Bound Brook, inorganic nitrogen is elevated, with a median value of 2.1 mg/l. Total phosphorous is also elevated, with 94% of samples exceeding the criterion. The median value was 0.22 mg/l.

Raritan River continued:

Bacteria: Acceptable levels were recorded at Manville. The geometric mean was 141 MPN/100 ml, with 10% of samples exceeding the 400 MPN/100ml criterion.

At Queens Bridge, the sanitary quality appears lower, with the geometric mean at 269 colonies/100 ml; 56% of samples exceeded 400 colonies/100 ml. It must be noted here that the analytical methods for assessing bacterial density differ between these two locations. The Queens Bridge site is part of the US Geological Survey National Stream-Quality Accounting Network and, as such, employs a membrane filter method to analyze for fecal coliform bacteria in contrast to the EC Broth method employed for samples collected at the USGS/DEP Cooperative Network. Caution should be exercised in comparing the results of the two locations with one another as the same water sample could yield **somewhat different** results if one or the other of the analytical methods were employed.

Heavy Metals: At Manville, one lead sample (of four) approached but did not exceed the chronic criteria for aquatic life support.

Summary: The mainstem Raritan at Manville shows mild nutrient elevations which increase notably downstream at Queens Bridge. Bacterial quality seems to follow a similar pattern, marginally acceptable at Manville degrading to poorer sanitary conditions at Queens Bridge.

Prior to 1991, monitoring at Raritan indicated generally good water quality, similar to conditions recorded at Manville during the same period of review (1986 through 1990). Current conditions at Manville are similar to those recorded in the earlier assessment with the exception that occasional violations of unionized ammonia observed in the late 1980s were no longer observed after 1990. Conditions at Queens Bridge are identical to conditions observed between 1986 and 1990. Significant improvements in the Raritan River at Bound Brook were observed since the beginning of the 1980s and are attributed to the gradual reduction in discharge flows from the American Cyanamid facility. In 1985 the company's discharge had been eliminated with flows being transferred to the Somerset Raritan Valley SA treatment plant.

Biological Monitoring

Macroinvertebrate assessments in the Raritan River at Millville and Piscataway show moderately impaired conditions. Moderately impaired conditions were found in many of the assessed tributaries as well, including Dukes Brook, Peters Brook and Middle Brook. Green Brook is assessed to be severely impaired in Watchung Township, but at Seeley's Mill and below conditions improve to moderately impaired. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

The Raritan River is believed to be heavily influenced by both point and nonpoint sources. The elimination of the American Cyanamid discharge, as

noted above, has resulted in improvements in river water quality. No point source discharges have been listed as being currently under an enforcement action by the Department within the watershed.

The following wastewater treatment plants have been eliminated or upgraded and/or expanded (and if so, have renewed operation):

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Manville STP	Manville Boro., Somerset Co.	Raritan River	Facility eliminated on June 1992.
N.J. Transit	Raritan Boro., Somerset Co.	Gaston Bk.	Facility has completed an upgrade of its wastewater treatment system via an ACO executed with the Department.
Borough of Sayreville	Middlesex Co.	Cheezequake Cr.	Required to upgrade its treatment plant backwash system
Aberdeen Twp. MUA	Aberdeen, Monmouth Co.	Raritan Bay	ACO required the termination of discharges from the three failing treatment plants. The discharge from these three plants are conveyed to the Bayshore Regional Sewage Authority for treatment and discharge to the Atlantic Ocean.

NONPOINT SOURCE ASSESSMENT

The Raritan River is reported to be impacted by nonpoint source pollution from urban/suburban development throughout its length. Additional nonpoint source pollution from landfill leachate is suspected in the lower portions of the river. Runoff from urban surfaces, storm sewers and roadways is believed to be an increasing problem in the watershed. Additional contamination sources are suspected from the land disposal of wastewater and from local chemical spills.

Construction activities were noted to be active in the Peters Brook area of the Upper Raritan watershed and in Franklin and Warren Townships in the Lower Raritan watershed. The result of this urbanization is an increase in the nutrient and sediment loads which the river must absorb, as well as an increase in local flooding.

A number of hazardous waste sites are located in the Raritan River watershed, many of which are on the National Priority List. Sites that have been reported as impacting surface waters include: Blue Spruce International (Raritan River), Chemical Insecticide Corporation (Mill Creek), Horseshoe Road Dump (Raritan River), KinBuc Inc. (Edmonds Creek and Raritan River), Renora Inc. (Mill Creek) and Rhone-Poulene (Raritan River).

DESIGNATED USE ASSESSMENT

The Raritan River fully supports primary contact recreation (swimming) at Manville but fails to support the designated use at Bound Brook due to elevated fecal coliform bacteria.

The freshwater portions of the Raritan River, up and downstream of the confluence with the Millstone River, are considered to partially support the aquatic life support designated use. Those portions of Raritan Bay monitored

by New Jersey for suitability for shellfish harvesting are classified as either prohibited or special restricted (requiring special processing) depending upon location. In addition, there is a fishing advisory in effect because of PCB contamination in certain fishes in the tidal section of the river.

SOUTH RIVER

WATERSHED DESCRIPTION

The South River drains an area of 133 square miles. It begins at Duhernal Lake in Spotswood, Middlesex County, and flows through the county to the Raritan River at Sayreville. Tides affect this 10 mile waterway from Duhernal Lake to the outfall into the Raritan River. The South River is formed by the confluence of Manalapan (20 miles long) and Matchaponix (15 miles) Brooks. Other tributaries include Deep River and Tennants Brook. The major impoundments are Duhernal Lake and Lake Manalapan. The population of this drainage area is concentrated in Spotswood, Old Bridge, East Brunswick and Sayreville. Sub-watersheds include Manalapan Brook, Matchaponix Brook and South River.

Agriculture and forests probably still account for the major portion of land uses in the upper watershed (Manalapan and Matchaponix Brooks), but there is much new industrial and residential development in these watersheds, with older existing development along the South River. There are about 5 NJPDES permitted dischargers in the watershed; all are municipal. Waters have been classified FW-2 Nontrout and SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality:

Location: Manalapan Brook near Manalapan

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen is acceptable; median value is 0.83 mg/l. Total phosphorous is mildly elevated, with 85% of samples exceeding the 0.05 mg/l criterion. The median value was 0.08 mg/l.

Bacteria: Very low bacterial levels were recorded. The geometric mean was 50.6 MPN/100 ml and only one of twenty samples exceeded the 400/100ml criterion.

Heavy Metals: Due to their low hardness, these waters are sensitive to relatively low levels of metal with regard to toxicity to aquatic life. One of three lead samples (at 2 ug/l of total recoverable) exceeded the chronic water quality criteria for aquatic life support.

Location: Matchaponix Brook at Spotswood

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen is unusually high at this location; the median value is 3.4 mg/l, with 6 out of 16 records being over 5 mg/l, with one exceeding the 10 mg/l drinking water standard. Total phosphorous is mildly elevated, with 45% of samples exceeding the 0.05 mg/l criterion, and 15 % exceeding 0.1 mg/l. The median value was 0.05 mg/l.

Bacteria: Bacterial levels were low; the geometric mean was 63.5 MPN/100 ml and only two of twenty sample exceeding the 400 MPN/100ml criterion.

Heavy Metals: Two of five lead samples exceeded the chronic water quality criteria for aquatic life support. Also, one of five zinc samples exceeded the chronic zinc criterion and closely approached the acute criterion for aquatic life support.

Water Quality Summary: Both the Manalapan and the Matchaponix Brooks have very good sanitary quality based upon fecal coliform levels. Both sites have slight to moderately elevated phosphorus levels, but these sites notably differ with regard to inorganic (NO_2 + NO_3) nitrogen levels. While the Manalapan has acceptable levels, the levels recorded in the Matchaponix are extremely elevated. The Manalapan water is very soft and hence is very sensitive to heavy metals, even in relatively low levels. Both monitoring locations suggest a problem with excessive lead, while Matchaponix Brook seems to also have a potential zinc problem.

Present water quality within the Manalapan is similar to conditions observed during the prior assessment, 1986 through 1990. Formerly the Manalapan was also monitored at Spotswood (discontinued in 1991) where conditions were found to be similar to those recorded at Manalapan. Conditions in Matchaponix Brook are also similar to those recorded during the previous review period.

Biological Monitoring

See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed. The monitored waters within the South River watershed are, with some exceptions, moderately impaired. These included the Matchaponix Brook, Pine Brook, Barclay Brook, Deep Run, Millford Brook and Tepehemus Brook.

Manalapan Brook is moderately impaired in the lower end and severely impaired within the central section surrounding Monroe Township. The upper-most portion of the river is assessed as a mix of non-impaired and moderately impaired sections. The lower portion of McGellairds Brook is assessed as severely impaired while the upper reaches are moderately impaired. Weamaconk Creek shows the reverse, with the upper portion being severely impaired and the lower section moderately impaired.

Biological monitoring within the Lawrence Brook watershed (neighboring the South River) shows moderately impaired conditions throughout the watershed.

POINT SOURCE ASSESSMENT

Manalapan Brook contains a few small wastewater discharges that may have localized impacts on water quality. Matchaponix Brook, however, receives wastewaters from a regional sewage treatment system in the headwaters area. This facility may be responsible for the high nutrient (nitrogen) concentrations found in the brook. No facilities are reported to be under enforcement action within the watershed.

The following wastewater treatment plant has been upgraded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Dept. of Corrections Jamesburg Training Facility for Boys	Jamesburg, Middlesex Co.	Matchaponix Brook	ACO required the correction of violations of nutrients being discharged from the treatment plant

NONPOINT SOURCE ASSESSMENT

Land uses in this watershed are primarily agricultural and suburban/commercial, with significant amounts of residential and commercial development continuing to take place. Agricultural soil erosion in the watershed is considered to be moderate by the Natural Resource Conservation Service. Manalapan and Matchaponix Brooks appear to receive nonpoint source pollution primarily from areas of suburban development. A major threat to the fisheries of both streams is the runoff coming from acid-producing soils of the region. When exposed to air and water, as during construction, these soils produce sulfuric acid which, when washed into rivers in runoff, can cause a sudden and sometimes long lasting pH depression. This, in turn, can have a deleterious effect on the aquatic biota of the receiving stream. In addition, increasing amounts of construction activity coupled with urban surface and road runoff have all contributed to silt loadings, flooding, and a reduction in the quality of fish habitat. This is reported to be severe in the Manalapan Township region of Monmouth County. Runoff from construction sites is reported to be a severe and increasing problem along Matchaponix Brook. Also judged to be impacting these two brooks are septic tank leachate and stream bank destabilization. Agricultural impacts to both brooks are evaluated to be largely sediment loads coming from local cropland runoff.

The South River receives nonpoint source pollution largely from developed lands. Construction activities and severe stream bank modification are known to have contributed to silt loads and local flooding. Increasing amounts of runoff from urban surfaces, roads and storm sewers are suspected of contributing to nutrient and sediment loading. In addition, this stream is believed to be threatened with toxic contamination from the Burnt Fly Bog waste disposal site located near Deep Run, a tributary to the South River.

A number of hazardous waste sites are found in the South River watershed, many of which are on the National Priority (Superfund) List. Two sites are suspected of contaminating local surface waters: the Sayreville Landfill, which is adjacent to the South River (releasing pesticides and volatile organics), and the Viking Terminal, also adjacent to the South River (containing mirex).

DESIGNATED USE ASSESSMENT

Based upon fecal coliform bacteria, both the Manalapan Brook at Manalapan and the Matchaponix at Spotswood are assessed as fully supporting the primary contact (swimming) designated use.

The monitored waters within the South River watershed are, with some exceptions, partially supporting the aquatic life designated use. See the description of biological monitoring above for details as to full support (non-impairment) and no support (severe impairment).

BIOLOGICAL ASSESSMENT TABLE: AREA 9

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
9	30	AN0375	Dukes Bk	Dukes Pkwy	Hillsborough Twp	Sep 15, 1993	moderately impaired
9	30	AN0376	Peters Bk	Rt 28	Somerville	Sep 14, 1993	moderately impaired
9	30	AN0377	Raritan R	abv Millstone R conf	Manville	Jul 11, 1990	moderately impaired
9	30	AN0415	Cuckels Bk	Rt 28	Bridgewater Twp	Sep 14, 1993	moderately impaired
9	30	AN0416	Middle Bk W Br	Crim Rd	Bridgewater Twp	Sep 15, 1993	moderately impaired
9	30	AN0417	Middle Bk W Br	Chimney Rock Rd	Bridgewater Twp	Sep 15, 1993	moderately impaired
9	30	AN0418	Middle Bk E Br	Green Valley Rd	Warren Twp	Sep 14, 1993	severely impaired
9	30	AN0419	Middle Bk E Br	Gilbride Rd	Bridgewater Twp	Sep 14, 1993	non-impaired
9	30	AN0420	Middle Bk	Talmage Ave	Bridgewater Twp	Sep 14, 1993	non-impaired
9	30	AN0420	Middle Bk	Talmage Ave	Bridgewater Twp	Sep 12, 1994	non-impaired
9	30	AN0420	Middle Bk	Talmage Ave	Bridgewater Twp	Dec 6, 1994	non-impaired
9	30	AN0420	Middle Bk	Talmage Ave	Bridgewater Twp	Mar 22, 1995	moderately impaired
9	30	AN0420	Middle Bk	Talmage Ave	Bridgewater Twp	Jun 20, 1995	moderately impaired
9	30	AN0421	Green Bk	Raymond Ave	Watchung Twp	Feb 27, 1992	severely impaired
9	30	AN421A	Green Bk	New Providence Rd	Seeleys Mill	Feb 27, 1992	moderately impaired
9	30	AN421B	Green Bk	Appletree Rd	Watchung	Feb 27, 1992	severely impaired
9	30	AN0422	Stony Bk	Westend Ave	N Plainfield	Feb 26, 1992	moderately impaired
9	30	AN422A	Stony Bk	Sunlit Dr	Watchung	Feb 27, 1992	moderately impaired
9	30	AN0423	Green Bk	Clinton Ave	Plainfield	Feb 26, 1992	moderately impaired
9	30	AN0424	Bound Bk	Bound Bk Rd	Middlesex	Feb 26, 1992	moderately impaired
9	30	AN424A	Cedar Bk	Cedar Bk Ave	S Plainfield	Feb 26, 1992	severely impaired
9	30	AN0425	Ambrose Bk	Raritan Ave	Middlesex	Feb 25, 1992	moderately impaired
9	30	AN425A	Ambrose Bk	Behmer Rd	Piscataway	Feb 25, 1992	severely impaired
9	30	AN425B	Ambrose Bk	School St	N Stelton	Feb 25, 1992	non-impaired
9	30	AN0426	Green Bk	Main St	Bound Bk	Feb 25, 1992	moderately impaired
9	30	AN426A	Green Bk	Sebrings Mill	Green Bk	Feb 25, 1992	moderately impaired
9	30	AN0427	Raritan R trib	Rt 527	S Bound Bk	Oct 5, 1993	moderately impaired
9	30	AN0428	Raritan R	Fieldville Dam (I287)	Piscataway	Jul 11, 1990	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
9	30	AN0429	Mile Run	Rt 527	New Brunswick	Oct 5, 1993	moderately impaired
9		AN0430	Lawrence Bk	Ridge Rd	Monmouth Jct	Sep 30, 1993	moderately impaired
9		AN0431	Lawrence Bk	Davidsons Mill Rd	S Brunswick Twp	Sep 30, 1993	moderately impaired
9		AN0432	Oakeys Bk	Davidsons Mill Rd	S Brunswick Twp	Sep 30, 1993	moderately impaired
9		AN0433	Ireland Bk	Riva Rd	nr Patricks Cor	Sep 30, 1993	moderately impaired
9		AN0434	Lawrence Bk	Riva Rd	Milltown	Sep 30, 1993	moderately impaired
9		AN0435	Sawmill Bk	Ryders Ln	Milltown	Sep 30, 1993	moderately impaired
9		AN0436	Mill Bk	Woodbridge Ave	Piscataway	Jul 14, 1994	moderately impaired
9		AN0437	Manalapan Bk	Rt 524	Ely (Millstone Twp)	Sep 29, 1993	non-impaired
9		AN0437	Manalapan Bk	Rt 524	Ely (Millstone Twp)	Dec 16, 1993	non-impaired
9		AN0437	Manalapan Bk	Rt 524	Ely (Millstone Twp)	Mar 15, 1994	non-impaired
9		AN0437	Manalapan Bk	Rt 524	Ely (Millstone Twp)	Jun 8, 1994	moderately impaired
9		AN0437	Manalapan Bk	Rt 524	Ely (Millstone Twp)	Mar 24, 1995	non-impaired
9		AN0438	Manalapan Bk	Rt 33	Millhurst	Sep 29, 1993	moderately impaired
9		AN0439	Manalapan Bk	Federal Rd	Monroe Twp	Sep 29, 1993	severely impaired
9		AN0440	Manalapan Bk	Old Forge Rd	Helmetta	Oct 7, 1993	moderately impaired
9		AN0441	Weamaconk Ck	Rt 9	Freehold	Sep 15, 1993	severely impaired
9		AN0442	Wemrock Bk	Wemrock Rd	Freehold Twp	Sep 15, 1993	moderately impaired
9		AN0443	Weamaconk Ck	Rt 522	Englishtown	Sep 15, 1993	moderately impaired
9		AN0444	McGellairds Bk	Rt 9	Freehold Twp	Sep 15, 1993	moderately impaired
9		AN0445	Tepehemus Bk	Tennent Rd	Manalapan Twp	Sep 14, 1993	moderately impaired
9		AN0446	Milford Bk	Pease Rd	Manalapan Twp	Sep 14, 1993	moderately impaired
9		AN0447	McGellairds Bk	Rt 527	Englishtown	Sep 14, 1993	severely impaired
9		AN0448	Matchaponix Bk	Rt 527	Manalapan Twp	Sep 14, 1993	moderately impaired
9		AN0449	Pine Bk	Pension Rd	Clarks Mills	Sep 1, 1993	moderately impaired
9		AN0450	Barclay Bk	Rt 527	Madison Twp	Sep 1, 1993	moderately impaired
9		AN0451	Matchaponix Bk	Texas Rd	Texas	Sep 14, 1993	moderately impaired
9		AN0452	Iresick Bk	Rt 527	Old Bridge Twp	Sep 1, 1993	severely impaired
9		AN0453	Deep Run	Rt 9	Madison Twp	Aug 31, 1993	moderately impaired

WATERSHED MANAGEMENT AREA 10
MILLSTONE RIVER DRAINAGE

The watershed management area includes watersheds draining the northern coastal plain of New Jersey. Bedens Brook, Stony Brook, Cranbury Brook and Devils Brook all flow into the Millstone which in turn is a tributary to the Raritan River. The area lies in parts of Hunterdon, Somerset, Middlesex, Mercer and Monmouth Counties and includes the following principal watersheds:

Millstone River Stony Brook Bedens Brook

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Millstone River near Manalapan	FW-2 Nontrout
Millstone River at Grovers Mill	FW-2 Nontrout
Stony Brook at Princeton	FW-2 Nontrout
Bedens Brook near Rocky Hill	FW-2 Nontrout
Millstone River at Blackwells Mills	FW-2 Nontrout

Note: Monitoring sites at Millstone River at Kingston (FW-2 Nontrout) and Millstone River at Weston (FW-2 Nontrout) were discontinued in 1991.

OVERALL MANAGEMENT AREA ASSESSMENT

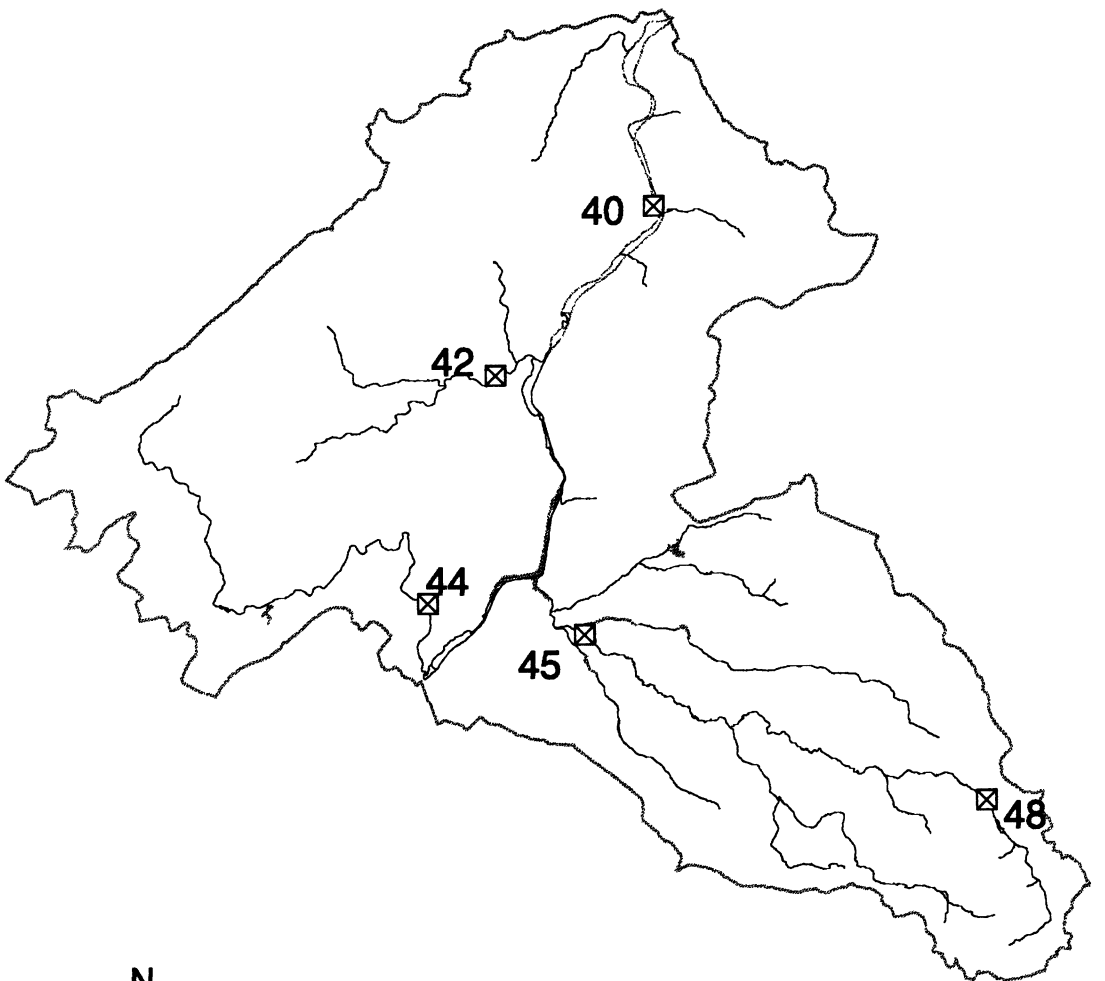
- Swimmable Support Status:

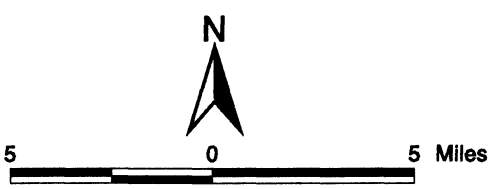
WATERWAY	LOCATION	STATUS
Millstone River	near Manalapan	Partial Support
Millstone River	at Grovers Mill	Partial Support
Stony Brook	at Princeton	Partial Support
Bedens Brook	near Rocky Hill	Partial Support
Millstone River	at Blackwells Mills	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 4 Mod. Impairment: 31 Severe Impairment: 2

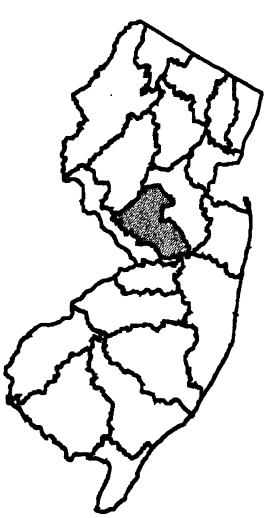
Millstone River
Watershed Management Area 10





Monitoring Sites
Water Bodies
Rivers.shp
Watershed Management Boundary

Location



40. Millstone River, Blackwells Mills
42. Beben Brook, Rocky Hill
44. Stony Brook, Princeton
45. Millstone River, Grovers Mill
48. Millstone River, Manalapan

MILLSTONE RIVER

WATERSHED DESCRIPTION

The Millstone River drains an area of 271 square miles, including parts of Hunterdon, Somerset, Middlesex, Mercer and Monmouth Counties. This river is 38 miles long and flows from Millstone Township in Monmouth County to the Raritan River near Manville and Bound Brook. Most of the lower half of the river flows adjacent to the Delaware and Raritan Canal. The population centers in this drainage basin are Princeton Township and Borough, Manville, South Brunswick Township, East and West Windsor Townships, Hightstown and Pennington Boroughs. Major tributaries include Stony Brook (21 miles), Cranbury Brook, Bear Brook, Ten Mile River, Six Mile River and Bedens Brook (10 miles). The largest impoundment in this area is Carnegie Lake in Princeton Township, but there are a large number of smaller lakes in the watershed.

The land use in the Millstone watershed is primarily suburban development with scattered agricultural areas. Extensive and recent development is present in the Upper Millstone watershed. Of the over 40 NJPDES permitted dischargers here, approximately half are municipal and half industrial/commercial. All surface waters in the Millstone basin are classified as FW-2 Nontrout.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Millstone River near Manalapan

Dissolved Oxygen: Acceptable for nontrout waters.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Low to moderate levels. Inorganic nitrogen (NO_2 + NO_3) is marginal, with a median of 1.245 mg/l and no values recorded at or above 2.0 mg/l. Total phosphorus is slightly elevated, with a median of 0.07 mg/l and 25% of values exceeding the criterion of 0.10 mg/l.

Bacteria: Slightly elevated. The geometric mean is 72.7 MPN/100 ml and 15% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: One of the four lead samples collected during the period of review exceeded the chronic aquatic life criterion. In addition, one zinc sample (again of four) closely approached, but did not exceed, the acute and chronic criteria for zinc.

Locations: Millstone River at Grovers Mill and at Blackwells Mill

Dissolved Oxygen: Problematic at Grovers Mill where one (5%) sample was recorded below the 4.0 mg/l criterion and one other sample closely approached this limit. Acceptable at Blackwells Mill.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Phosphorus levels were elevated at both locations. Grovers Mill showed a median of 0.13 mg/l, with 85% of samples exceeding the 0.05 mg/l criterion for waters upstream of impoundments (65% were over 0.1 mg/l). At Blackwells Mill, levels were higher, with the median at 0.25 mg/l and 94% of samples violating the 0.1 mg/l criterion.

Inorganic nitrogen (NO_2 + NO_3) is very high at Grovers Mill. The median was 3.6 mg/l, with 4 of the 18 samples exceeding 5 mg/l. Blackwells Mill showed lower nitrogen levels; the median was 2.0 mg/l.

Bacteria: Mild elevations at both location, with Blackwells Mill, the more downstream location, showing slightly poorer sanitary quality of the two locations. Grovers Mill produced a geometric mean of 132 MPN/100 ml and 20% of samples violated the 400 MPN/100ml criterion. At Blackwells Mill, the geometric mean was 208 MPN/100 ml, with 17% of samples exceeding the 400 MPN/100ml criterion.

Heavy Metals: Both locations showed elevated lead. Grovers Mill had one sample (of a total of five) exceeding the chronic aquatic life criterion, and a second sample, at 110 ug/l, exceeds both acute and chronic criteria. This is a very high level and a quality assurance check should be made to verify the validity of the sample. In addition to elevated lead, Grovers Mill had exceedances of cadmium (one of five samples). At Blackwells Mill, two of seven samples exceeded the chronic criterion for lead.

Comment: These data appear to reflect an improvement in water quality at Grovers Mill that occurred around the spring of 1992. Total phosphorus, instream BOD, dissolved oxygen, and possible fecal coliform bacteria, all appear to have improved around that time period.

Locations: Bedens Brook near Rocky Hill

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen (NO_2 + NO_3) is marginally acceptable; the median value is 1.6 mg/l, and 28% of samples exceeded 2.0 mg/l. Total phosphorous is elevated, with 50% of samples exceeding the criterion; the median value is 0.105 mg/l.

Bedens Brook near Rocky Hill continued:

Bacteria: Sanitary quality is marginally acceptable. The geometric mean of fecal coliform bacteria was 163 MPN/100ml and 25% of samples exceeded the 400 MPN criterion.

Heavy Metals: One of three lead samples violated the aquatic life chronic criterion.

Other: The upper pH criterion was exceeded in 10% of samples.

Locations: Stony Brook at Princeton

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen (NO_2 + NO_3) is acceptable. The median was 0.625 mg/l, with almost all samples below 1.0 mg/l. Total phosphorous is elevated, with 70% of samples exceeding the 0.05 mg/l impoundment criterion; the median value is 0.085 mg/l.

Bacteria: Sanitary quality is marginally acceptable. The geometric mean of fecal coliform bacteria was 77 MPN/100ml and 15% of samples exceeded the 400 MPN criterion.

Sodium: One wintertime sample (out of 20) exceeded the drinking water criterion for sodium.

Other: Twenty-eight percent of samples exceeded the upper pH criterion. The reasons are not currently clear but vigorous photosynthetic activity is suspected. This location has been known in the past for supersaturated dissolved oxygen conditions, believed to be brought about by nutrient enrichment leading to excessive algal production.

Summary: Nutrient enrichment, as reflected in total phosphorus, varies in the Millstone from mild as observed near Manalapan to severe downstream at Blackwells Mill. The pattern for inorganic nitrogen is different, moderate (but acceptable) near Manalapan, very high at Grovers Mill, and lower again at Blackwells Mill. Grovers Mill shows severely depressed dissolved oxygen in the summer and fall. Sanitary quality to some extent mirrors phosphorus where upstream near Manalapan conditions show mildly elevated bacterial levels, rising a bit at Grovers Mill, and becoming unacceptable at the down-stream-most station at Blackwells Mill. Elevated lead appears to be a problem at all three monitoring locations. In addition, violations were recorded near Manalapan for zinc and at Grovers Mill for cadmium. As mentioned above, the monitoring location at Grovers Mill indicates that there are improvements in water quality occurring around the spring of 1992.

Compared to the previous assessment period (1986 through 1990), the Manalapan site has not changed. Grovers Mill has improved with respect to BOD, dissolved oxygen, total phosphorus and sanitary quality. Lead and

chromium violations appear to come and go through various assessment periods here. Conditions at Blackwells Mill may have improved slightly with regard to total phosphorus and sanitary quality.

Bedens and Stony Brook both have marginally acceptable sanitary quality and elevated total phosphorus. Algal growth is suspected to be behind the elevated pH recordings that both locations exhibit - 10% of samples at Bedens Brook and 28% at Stony Brook. Compared to earlier assessments, there may have been a slight improvement in the overall quality in the Bedens Brook. Stony Brook may have undergone an improvement in its sanitary quality.

Biological Monitoring

See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed. With some exceptions, macroinvertebrate studies have led almost the entire Millstone watershed to be assessed as moderately impaired. Waterways assessed include the Millstone itself, Cranbury Brook, Bear Brook, Devils Brook, Rocky Brook, Stony Brook, Royce Brook, Rock Brook, Bedens Brook and Heathcote Brook. Non-impaired conditions were assessed in the Millstone River at Bergen Mills, Camp Harmony Brook, Cruser and Back Brooks. Severely impaired conditions were encountered at the lower end of Heathcote Brook and in Duck Pond Run.

POINT SOURCE ASSESSMENT

Treatment plant effluents from the Hightstown and East Windsor plants had been major contributors to dissolved oxygen and nutrient problems in the Millstone River. In response, the Hightstown treatment plant has undergone a substantial upgrade and the East Windsor plant has now been completely replaced with a new "state of the art" facility.

The following wastewater treatment plants have either ceased discharging or are being upgraded:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
GSA Depot	Hillsborough Twp., Somerset Co.	Pike Run	Facility has ceased discharging.
Stony Brook RSA	Princeton Twp.	Millstone River	ACO executed with a compliance schedule for the facility to provide additional treatment on its wet weather overflow discharge line. Construction is nearing completion.

NONPOINT SOURCE ASSESSMENT

The predominant nonpoint pollution sources in the Millstone watershed are those associated with suburban development which had been reported to be on the increase throughout the watershed. Runoff from construction sites, suburban surfaces, storm sewers and roads are contributing to excessive sediment loading. Septic systems are also believed to be a potential pollution problem throughout the watershed. In the upper reaches of the Millstone River, this source may also be a threat to the ground water.

Nonpoint pollution associated with agriculture is limited in this watershed to the regions drained by Etra and Peddie lakes, Cranbury Brook, and the lower reaches of the Millstone near its confluence with the Raritan River. Sediments, nutrients, and pesticides are suspected of coming from croplands, and are believed to be severe in the East Windsor area where chronic fish kills have occurred in the past. It is a combination of agricultural and urban runoff that is suspected of degrading the fish communities in the upper Millstone River.

Other nonpoint pollution sources have been reported in the Millstone watershed. Fuel oil spills have occurred in the Upper Millstone, causing fish kills. Landfills are assessed as problems, both in the upper watershed where recreational usage and ground water are impacted and in South Brunswick where leachate from a municipal landfill has been noted by local authorities as a problem.

DESIGNATED USE ASSESSMENT

The monitored waters of the Millstone River are classified as partially supporting primary contact recreation (swimming) near Manalapan and at Grovers Mill. The river does not support the use at Blackwells Mill because of excessive fecal bacteria concentrations. Bedens Brook near Rocky Hill and Stony Brook at Princeton both partially support the use.

With exceptions such as the Millstone at Bergen Mills where it is non-impaired, the entire watershed partially supports the aquatic life designated use.

BIOLOGICAL ASSESSMENT TABLE: AREA 10

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
10	34	AN0378	Millstone R	Baird Rd	Millstone Twp	Jul 25, 1990	non-impaired
10	34	AN0378	Millstone R	Baird Rd	Millstone Twp	Oct 7, 1992	moderately impaired
10	34	AN0378	Millstone R	Baird Rd	Millstone Twp	Jan 21, 1993	severely impaired
10	34	AN0378	Millstone R	Baird Rd	Millstone Twp	Apr 8, 1993	moderately impaired
10	34	AN0379	Millstone R	Rt 33	Bergen Mills	Jul 25, 1990	non-impaired
10	34	AN0380	Rocky Bk	Perrineville Rd	Perrineville	Aug 31, 1993	moderately impaired
10	34	AN0381	Rocky Bk	Rt 33	Hightstown	Oct 6, 1993	moderately impaired
10	34	AN0382	Millstone R	Grovers Mills Rd	Grovers Mills	Jul 24, 1990	moderately impaired
10	34	AN0383	Bear Bk	Old Trenton Rd (Rt 535)	W Windsor Twp	Oct 7, 1993	moderately impaired
10	34	AN0384	Bear Bk	Stobbe Ln	Princeton Jct	Jul 23, 1990	moderately impaired
10	34	AN0385	Cranbury Bk	Applegarth Rd	Monroe Twp	Jul 25, 1990	moderately impaired
10	34	AN0386	Cranbury Bk	Edgemere Ave	Plainsboro	Jul 24, 1990	moderately impaired
10	34	AN0387	Devils Bk	New Rd	S Brunswick Twp	Oct 6, 1993	moderately impaired
10	34	AN0388	Shallow Bk	N of Scotts Cor	S Brunswick Twp	Oct 6, 1993	moderately impaired
10	34	AN0389	Devils Bk	Schalk's Rd	Plainsboro	Oct 6, 1993	moderately impaired
10	34	AN0390	Camp Harmony Br	Van Dyke Rd	Hopewell Twp	Apr 5, 1994	non-impaired
10	34	AN0391	Stony Bk	Mine Rd	Hopewell Twp	May 10, 1982	non-impaired
10	34	AN0391	Stony Bk	Mine Rd	Hopewell Twp	May 13, 1987	non-impaired
10	34	AN0391	Stony Bk	Mine Rd	Hopewell Twp	Aug 25, 1987	moderately impaired
10	34	AN0391	Stony Bk	Mine Rd	Hopewell Twp	Oct 29, 1987	non-impaired
10	34	AN0391	Stony Bk	Mine Rd	Hopewell Twp	Apr 27, 1994	moderately impaired
10	34	AN391A	Stony Bk	Linvale Rd	Amwell Twp	May 14, 1987	moderately impaired
10	34	AN391A	Stony Bk	Linvale Rd	Amwell Twp	Aug 25, 1987	moderately impaired
10	34	AN391A	Stony Bk	Linvale Rd	Amwell Twp	Oct 29, 1987	moderately impaired
10	34	AN0392	Stony Bk	Old Mill Rd	Pennington	May 13, 1987	moderately impaired
10	34	AN0392	Stony Bk	Old Mill Rd	Pennington	Aug 25, 1987	non-impaired
10	34	AN0392	Stony Bk	Old Mill Rd	Pennington	Oct 29, 1987	non-impaired
10	34	AN0392	Stony Bk	Old Mill Rd	Pennington	May 12, 1994	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
10	34	AN392A	Stony Bk	Pennington-Rocky Hill Rd	Hopewell Twp	May 10, 1982	moderately impaired
10	34	AN0393	Stony Bk	Rt 206	Princeton Twp	May 10, 1982	non-impaired
10	34	AN0393	Stony Bk	Rt 206	Princeton Twp	May 12, 1987	moderately impaired
10	34	AN0393	Stony Bk	Rt 206	Princeton Twp	Aug 25, 1987	moderately impaired
10	34	AN0393	Stony Bk	Rt 206	Princeton Twp	Oct 27, 1987	moderately impaired
10	34	AN0393	Stony Bk	Rt 206	Princeton Twp	Jul 23, 1990	moderately impaired
10	34	AN0393	Stony Bk	Rt 206	Princeton Twp	Apr 12, 1994	moderately impaired
10	34	AN393A	Stony Bk	Province Line Rd	Princeton Twp	May 10, 1982	moderately impaired
10	34	AN393A	Stony Bk	Province Line Rd	Princeton Twp	May 12, 1987	non-impaired
10	34	AN393A	Stony Bk	Province Line Rd	Princeton Twp	Aug 25, 1987	non-impaired
10	34	AN393A	Stony Bk	Province Line Rd	Princeton Twp	Oct 27, 1987	non-impaired
10	34	AN393B	Stony Bk	Carter Rd	Lawrence Twp	May 10, 1982	moderately impaired
10	34	AN0394	Duck Pd Run	Rt 1	W Windsor Twp	Apr 12, 1994	severely impaired
10	34	AN0395	Heathcote Bk	Stouts Ln	S Brunswick Twp	Oct 6, 1993	moderately impaired
10	34	AN0396	Heathcote Bk	Academy St	Kingston	Oct 6, 1993	severely impaired
10	34	AN0397	Millstone R	off Rt 27	Kingston	Oct 6, 1993	moderately impaired
10	34	AN0398	Beden Bk	Aunt Molly Rd (abv STP)	Hopewell Twp	May 14, 1987	moderately impaired
10	34	AN0398	Beden Bk	Aunt Molly Rd (abv STP)	Hopewell Twp	Aug 26, 1987	non-impaired
10	34	AN0398	Beden Bk	Aunt Molly Rd (abv STP)	Hopewell Twp	Oct 30, 1987	moderately impaired
10	34	AN0398	Beden Bk	Aunt Molly Rd (abv STP)	Hopewell Twp	Apr 5, 1994	moderately impaired
10	34	AN0399	Rock Bk	Long Hill Rd	Zion	Apr 5, 1994	moderately impaired
10	34	AN0400	Rock Bk	Burnt Hill Rd	Montgomery Twp	Apr 5, 1994	moderately impaired
10	34	AN0401	Beden Bk	Rt 206	Montgomery Twp	Apr 22, 1982	moderately impaired
10	34	AN0401	Beden Bk	Rt 206	Montgomery Twp	May 14, 1987	non-impaired
10	34	AN0401	Beden Bk	Rt 206	Montgomery Twp	Aug 26, 1987	non-impaired
10	34	AN0401	Beden Bk	Rt 206	Montgomery Twp	Oct 29, 1987	non-impaired
10	34	AN0401	Beden Bk	Rt 206	Montgomery Twp	Apr 5, 1994	moderately impaired
10	34	AN401A	Beden Bk	abv Rock Bk confl	Montgomery Twp	May 14, 1987	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
10	34	AN401A	Beden Bk	abv Rock Bk confl	Montgomery Twp	Aug 26, 1987	non-impaired
10	34	AN401A	Beden Bk	abv Rock Bk confl	Montgomery Twp	Oct 30, 1987	non-impaired
10	34	AN401B	Beden Bk	Great Rd	Blawenburg	May 14, 1987	moderately impaired
10	34	AN401B	Beden Bk	Great Rd	Blawenburg	Aug 26, 1987	non-impaired
10	34	AN401B	Beden Bk	Great Rd	Blawenburg	Oct 30, 1987	moderately impaired
10	34	AN401C	Beden Bk	Aunt Molly Rd (blw STP)	Hopewell Twp	May 14, 1987	moderately impaired
10	34	AN401C	Beden Bk	Aunt Molly Rd (blw STP)	Hopewell Twp	Aug 26, 1987	non-impaired
10	34	AN401C	Beden Bk	Aunt Molly Rd (blw STP)	Hopewell Twp	Oct 30, 1987	moderately impaired
10	34	AN0402	Pike Run	Rt 206	Belle Mead	Nov 10, 1993	moderately impaired
10	34	AN0403	Cruser Bk	Rt 206	Montgomery Twp	Nov 10, 1993	non-impaired
10	34	AN0403	Cruser Bk	Rt 206	Montgomery Twp	Aug 2, 1994	non-impaired
10	34	AN0403	Cruser Bk	Rt 206	Montgomery Twp	Nov 3, 1994	non-impaired
10	34	AN0403	Cruser Bk	Rt 206	Montgomery Twp	Feb 14, 1995	non-impaired
10	34	AN0404	Back Bk	Rt 206	Montgomery Twp	Jun 14, 1994	non-impaired
10	34	AN0405	Pike Run	Rt 533	Montgomery Twp	Apr 5, 1994	moderately impaired
10	34	AN0406	Simonson Bk	Canal Rd	Griggstown	Oct 5, 1993	moderately impaired
10	34	AN0407	Ten Mile Run	Canal Rd	Franklin Twp	Oct 5, 1993	moderately impaired
10	34	AN0408	Six Mile Run	Rt 27	Franklin Twp	Oct 5, 1993	moderately impaired
10	34	AN0409	Six Mile Run	Canal Rd	Blackwells Mills	Oct 5, 1993	moderately impaired
10	34	AN0410	Millstone R	Blackwells Mills Rd	Blackwells Mills	Aug 10, 1988	moderately impaired
10	34	AN0410	Millstone R	Blackwells Mills Rd	Blackwells Mills	Jul 23, 1990	moderately impaired
10	34	AN0411	Royce Bk	Rt 206	Bloomingdale	Nov 10, 1993	moderately impaired
10	34	AN0412	Royce Bk Br	Rt 206	Hillsborough Twp	Nov 10, 1993	moderately impaired
10	34	AN0413	Royce Bk	Rt 533	Manville	Nov 10, 1993	moderately impaired
10	34	AN0414	Millstone R	abv Raritan R conf	Manville	Jul 11, 1990	moderately impaired

WATERSHED MANAGEMENT AREA 11
CENTRAL DELAWARE DRAINAGE

The watershed management area includes watersheds draining the central western portion of New Jersey in Hunterdon and Mercer Counties. The Assunpink as well as the Nishisawick, Lockatong, Wickecheoke and Alexsaoken Creeks all flow directly into the Delaware River. The area lies mostly in Hunterdon and Mercer Counties and includes the following watersheds:

Assunpink Creek Lockatong Creek

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Assunpink Creek near Clarksville	FW-2 Nontrout
Assunpink Creek at Trenton	FW-2 Nontrout

Note: Monitoring at Wickecheoke Creek at Stockton (FW-2 Trout Maintenance) was discontinued in 1991.

OVERALL MANAGEMENT AREA ASSESSMENT

- Swimmable Support Status:

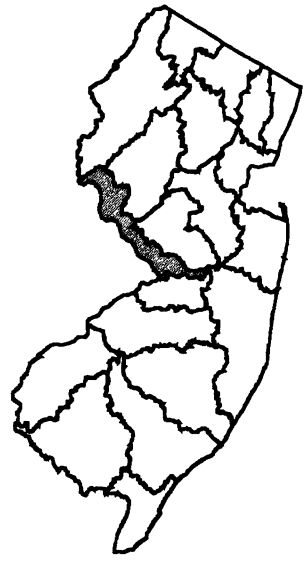
WATERWAY	LOCATION	STATUS
Assunpink Ck	near Clarksville	Full Support
Assunpink Ck	at Trenton	No Support

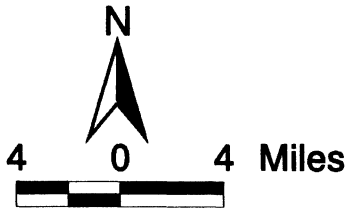
- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 25 Mod. Impairment: 13 Severe Impairment: 6

Central Delaware Tributaries
Watershed Management Area 11

Location





Rivers and Streams
Monitoring Sites
Watershed Management Boundary

47. Assunpink Creek, Clarksville
49. Assunpink Creek, Trenton

ASSUNPINK CREEK

WATERSHED DESCRIPTION

The Assunpink Creek drains an area of 91 square miles. It is about 25 miles long, flowing from Millstone Township in Monmouth County through central Mercer County to the Delaware River at Trenton. Shabakunk Creek and Miry Run are the major tributaries to the Assunpink. A number of impoundments exist along Assunpink Creek and its tributaries for flood control and other purposes.

Land uses in this watershed are both agricultural/undeveloped and urban/suburban. Population is centered in Trenton and surrounding areas. The waters of the Assunpink Creek watershed are classified primarily FW-2 Nontrout with a two mile stretch determined to be FW-2 Trout Maintenance.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Assunpink Creek at Clarksville and Trenton

Dissolved Oxygen: Acceptable at both locations.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: At Clarksville, inorganic nitrogen is acceptable, median value is 0.56 mg/l. Total phosphorous is, in contrast, elevated, with 65% of samples exceeding the criterion. The median value was 0.06 mg/l.

At Trenton, inorganic nitrogen is very high, with a median value of 2.97 mg/l. Total phosphorous is also very high, with 89% of samples exceeding the criterion. The median value was 0.34 mg/l.

Bacteria: Very low bacterial levels were recorded at Clarksville. The geometric mean was 37.4 MPN/100 ml and only one sample exceeded the 400/100ml criterion. This is in marked contrast to Trenton where the sanitary quality was very poor. At Trenton, the geometric mean was 4926 MPN/100 ml and almost 90% of samples exceeded 400 MPN/100 ml.

Heavy Metals: At Clarksville, one copper sample approached but did not exceed the chronic criteria for aquatic life support. Two of the four lead records exceeded the chronic criteria for aquatic life support for lead.

Assunpink Creek continued:

Copper and lead appeared to be problems at Trenton where two of the four copper samples exceeded the chronic criteria for aquatic life support and where all four lead samples exceeded the same criterion for lead. One of the copper samples also, in essence, was recorded at the level of the acute criterion.

Sodium: Very low at Clarksville (median equaled 6.5 mg/l); one violation of the criterion was recorded at Trenton (median equaled 24.5 mg/l).

Other: Two violations of the upper pH criterion were observed at Clarksville.

Summary: Water quality at Clarksville is good with respect to nutrients, with phosphorus being a slight problem at this location (note that the criterion here for phosphorus is 0.05 mg/l). Sanitary quality is very good. Lead and possibly copper, however, appear to be problems which need to be further examined.

Water quality at Trenton is poor. Nutrients are elevated, sanitary quality is very poor and the water seems to have excessive copper and lead.

Biological Monitoring

The macroinvertebrate community within the uppermost portion of the Assunpink Creek (in Roosevelt) is assessed to be severely impaired. Farther downstream in the region around Edinburg, the community appears to be healthy. In Trenton, the biota is assessed to be moderately impaired.

Of the tributaries in the region, Shipetauken and Pond Run are assessed to be severely impaired. Shabakunk Creek appears to be severely impaired in its upper half and moderately impaired in the lower. Little Shabakunk Creek and Miry Run are assessed to be moderately impaired. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Point source discharges influence water quality conditions in the lower sections of Assunpink Creek, especially from Whitehead Mill Pond downstream. Impacts from point sources above the pond have been reported in the past to be localized. No dischargers are currently reported to be out of compliance in this watershed.

NONPOINT SOURCE ASSESSMENT

In the Upper Assunpink subwatershed an increase in suburban and commercial development is currently underway, but water quality does not appear to have been adversely impacted. Pollution problems may be masked by the retention effects of a number of impoundments on the creek which are used for flood control purposes. The problems conveyed in the monitoring data for the Upper Assunpink are likely nonpoint source related. Crop production in the upstream sections of the Assunpink is known to have led to soil erosion and stream siltation. Farther downstream, agriculture gives way

to urban runoff as the principal source of nonpoint source contamination, specifically land development and urban runoff. In Trenton, however, water quality degradation is evident from the large municipal and industrial wastewater contributions to the creek. These wastewaters, combined with the effects of stream channelization and nonpoint sources, result in a water body that cannot assimilate organic and nutrient loads. The high bacterial levels are due to urban runoff.

Evaluated lakes in the Assunpink watershed - Lake Assunpink, Stone Tavern Lake, Rising Sun Lake, and Mercer Lake - are all believed to receive some nutrient loading from agricultural and residential runoff.

DESIGNATED USE ASSESSMENT

The "aquatic life support" designated use is not supported in the upper-most reach of the Assunpink Creek watershed (in Roosevelt). The central portion of the stream fully supports the use while the lower sections, in Trenton, partially support the use.

The primary contact (swimmable) use is fully supported at the Clarksville monitoring location and not supported in the lower reaches.

WICKECHEOKE CREEK AND THE DELAWARE RIVER TRIBUTARIES OF HUNTERDON COUNTY

WATER QUALITY ASSESSMENT

The tributaries to this 45 mile length of the Delaware River include Hakihokake, Harihokake, Nishisakawick, Lockatong, Wickecheoke, Alexauken, and Swan Creeks in Hunterdon County, and Moores, Fiddlers, and Jacobs Creeks in Mercer County. This is a total drainage area of 200 square miles, with approximately 75 total stream miles. The Delaware and Raritan Canal originates in this area. There are no large population centers here, but smaller towns are Milford Borough, Frenchtown, Sergeantsville, Lambertville and Stockton. Two impoundments are the Swan Creek Reservoirs, East and West.

The land use in this area is primarily agricultural and forested, with residential and commercial development scattered throughout. Residential development is increasing in these small watersheds. The waterways in this section have been classified FW-1 at Washington's Crossing State Park, FW-2 Trout Production, FW-2 Trout Maintenance and FW-2 Nontrout.

Physical/Chemical Water Quality: The last of the ambient physical/chemical monitoring stations within this region was discontinued in 1991. Monitoring now is limited to biological assessments.

Historical Water Quality Summary:
Prior to 1991 and throughout the latter half of the 1980s, Wickecheoke Creek at Stockton was the only ambient monitoring station on the Delaware River tributaries between the Musconetcong River and the Assunpink Creek. Streams with sampling data up to 1982 had included Lockatong Creek, Hakihokake Creek, Harihokake Creek, Alexauken Creek and Swan Creek. The streams in this section are small with summer flows generally falling below 20 cubic feet per second (cfs). Wickecheoke Creek, based upon its last ambient monitoring assessment had good overall water quality, with conditions degrading to fair in mid-summer. Water quality problems observed were elevated stream temperatures in warm weather periods and excessive levels of total nitrogen. Some limited violations (7 percent) of State criteria for fecal coliform were recorded, yet the geometric mean for the last period of assessment (68 MPN/100 ml) was low.

Un-ionized ammonia exceeded the State water quality criterion for trout maintenance waters in 10 percent of all samples, with violations usually occurring in July. The pH values indicated highly alkaline conditions due to the nature of the region's bedrock material. No excessive metal values within the water column were observed during this last period of assessment.

Biological Monitoring

Macroinvertebrate sampling within the watershed found largely non-impaired conditions. Locations that appeared to have moderately impaired biota were the lower end of Harihokake Creek. Moderately impaired biota were also observed at the upper-most sites on each of the following; the Lockatong Creek, Wickecheoke Creek and Plum Brook. Also assessed to be moderately impaired were Cooper Creek, Swan Creek, the lower end of Moores Creek, as well as portions of Jacobs Creek.

POINT SOURCE ASSESSMENT

Any introduction of pollutants into these streams can have a deleterious impact, especially during low flow periods. No permitted facilities are currently reported to be out of compliance within this watershed as of the end of 1996 (see Point Source Pollution Table).

The following wastewater treatment plants have been upgraded and/or expanded and have renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Mercer Co. Corrections Center	Hopewell Twp., Mercer Co.	Morris Cr. (Lockatong Cr. watershed)	ACO had required the construction of a new & expanded treatment plant
Phillipsburg STP	Phillipsburg Town, Warren Co.	Lopatcong Creek	Treatment system has been upgraded via an ACO executed with the DEP. Upgrades were required due to violations of effluent limitations. Upgrade completed in June 1992.

The Texas Eastern facility in West Amwell, Hunterdon County, is a hazardous waste site and was suspected in the past to be polluting Alexauken Creek with PCBs, PHC and dioxin. Its current status has not been determined.

NONPOINT SOURCE ASSESSMENT

Locatcong and Wickecheoke Creeks are impacted by runoff from crop land and from pasture land. These agricultural sources are believed to be on the decline and are being replaced by increasing quantities of runoff from road construction/maintenance. These streams also receive occasional septic tank leachate which is suspected to have contributed to nutrient enrichment and fecal coliform contamination.

Alexauken Creek is assessed to be impacted by a wide range of nonpoint pollution sources. Agriculture, specifically crop and pasture land, contributes fertilizers, soil and manure runoff. Suburban runoff from storm sewers contribute oils, salts and fecal coliform contamination. Alexauken Creek receives nutrients and fecal bacteria from local septic systems.

DESIGNATED USE ASSESSMENT

Of the Delaware River tributaries discussed in this segment, the most recently monitored for sanitary quality was the Wickecheoke. As of 1990, its water quality did not support primary contact recreation based upon

fecal coliform levels. Its current status in unknown.

Based upon macroinvertebrate assessments, most of the waters assessed here fully support the "aquatic life support" designated use. Partial support is observed at a limited number of biomonitoring sites within this area.

BIOLOGICAL ASSESSMENT TABLE: AREA 11

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
11	32	AN0075	Hakihokake Ck	Myler Rd	nr Ltl York	Jul 28, 1992	non-impaired
11	32	AN0076	Hakihokake Ck	Miller Park Rd	Holland Twp	Jul 28, 1992	non-impaired
11	32	AN0077	Hakihokake Ck	Bridge St	Milford	Jul 28, 1992	non-impaired
11	32	AN0078	Harihokake Ck	Hartpence Rd	Alexandria	Jul 27, 1992	non-impaired
11	32	AN0079	Harihokake Ck	River Rd	abv Frenchtown	Jul 27, 1992	moderately impaired
11	32	AN0080	Nishisakawick Ck	Airport Rd	Alexandria	Jul 27, 1993	non-impaired
11	32	AN0080	Nishisakawick Ck	Airport Rd	Alexandria	Oct 6, 1992	non-impaired
11	32	AN0080	Nishisakawick Ck	Airport Rd	Alexandria	Jan 22, 1993	non-impaired
11	32	AN0080	Nishisakawick Ck	Airport Rd	Alexandria	Apr 12, 1993	non-impaired
11	32	AN0081	Nishisakawick Ck		blw Everittstown	Jul 27, 1992	non-impaired
11	32	AN0081	Nishisakawick Ck		blw Everittstown	Oct 6, 1992	non-impaired
11	32	AN0081	Nishisakawick Ck		blw Everittstown	Jan 22, 1993	non-impaired
11	32	AN0081	Nishisakawick Ck		blw Everittstown	Apr 12, 1993	non-impaired
11	32	AN0082	Nishisakawick Ck	Creek Rd (Frenchtown Pk)	Frenchtown	Jul 27, 1992	non-impaired
11	32	AN0082	Nishisakawick Ck	Creek Rd (Frenchtown Pk)	Frenchtown	Oct 6, 1992	non-impaired
11	32	AN0082	Nishisakawick Ck	Creek Rd (Frenchtown Pk)	Frenchtown	Jan 22, 1993	non-impaired
11	32	AN0082	Nishisakawick Ck	Creek Rd (Frenchtown Pk)	Frenchtown	Apr 12, 1993	non-impaired
11	32	AN0083	Ltl Nishisakawick Ck	Rt 29	Frenchtown	Jul 21, 1992	non-impaired
11	32	AN0084	Copper Ck	Horseshoe Bend Rd	blw Frenchtown	Jul 21, 1992	moderately impaired
11	32	AN0085	Warford Ck	Rt 29	Kingwood Sta	Jul 20, 1992	non-impaired
11	32	AN0086	Lockatong Ck	Oak Grove Rd	Oak Grove	Jul 21, 1992	moderately impaired
11	32	AN0087	Lockatong Ck	Rt 12	Baptistown	Jul 21, 1992	non-impaired
11	32	AN0088	Lockatong Ck	Rt 519	Kingwood	Jul 21, 1992	non-impaired
11	32	AN0089	Lockatong Ck	Rt 29	Raven Rock	Jul 21, 1992	non-impaired
11	32	AN0090	Wickecheoke Ck	Rt 579	Croton	Jul 20, 1992	moderately impaired
11	32	AN0091	Wickecheoke Ck	Locktown - Sergeantsville Rd	Locktown	Jul 20, 1992	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
11	32	AN0092	Plum Bk	Rt 579	nr Croton	Jul 20, 1992	moderately impaired
11	32	AN0093	Plum Bk	Pine Hill Rd	Delaware Twp	Jul 20, 1992	non-impaired
11	32	AN0094	Wickecheoke Ck	Sergeantsville Rd	Sergeantsville	Jul 20, 1992	non-impaired
11	32	AN0095	Wickecheoke Ck	Rt 29	Prallsville	Jul 20, 1992	non-impaired
11	32	AN0096	Alexauken Ck	Lambertville Rd	W Amwell Twp	Jul 14, 1992	non-impaired
11	32	AN0097	Alexauken Ck trib	Queen Rd & Alexauken Ck Rd	Mt Airy	Jul 14, 1992	non-impaired
11	32	AN0098	Alexauken Ck	Rt 29	Lambertville	Jul 14, 1992	non-impaired
11	32	AN0099	Swan Ck	Swan St	Lambertville	Jul 14, 1992	moderately impaired
11	32	AN0100	Moores Ck	Barry Rd	W Amwell Twp	Jul 14, 1992	non-impaired
11	32	AN0101	Moores Ck	Rt 29	Hopewell Twp	Jul 14, 1992	moderately impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	May 12, 1987	non-impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	Aug 24, 1987	non-impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	Oct 27, 1987	non-impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	Jul 13, 1992	non-impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	Oct 6, 1992	non-impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	Jan 21, 1993	moderately impaired
11	32	AN0102	Jacobs Ck	Woosamonsa Rd	Hopewell Twp	Apr 8, 1993	non-impaired
11	32	AN0103	Airport Br	Rt 579	Hopewell Twp	Jul 13, 1992	moderately impaired
11	32	AN0104	Woolseys Bk	Rt 546	Hopewell Twp	Jul 13, 1992	moderately impaired
11	32	AN0105	Jacobs Ck	Rt 546	Hopewell Twp	May 12, 1987	non-impaired
11	32	AN0105	Jacobs Ck	Rt 546	Hopewell Twp	Aug 24, 1987	non-impaired
11	32	AN0105	Jacobs Ck	Rt 546	Hopewell Twp	Oct 27, 1987	non-impaired
11	32	AN0105	Jacobs Ck	Rt 546	Hopewell Twp	Jul 13, 1992	non-impaired
11	32	AN105A	Jacobs Ck	abv Pleasant Valley Rd	Hopewell Twp	May 12, 1987	non-impaired
11	32	AN105A	Jacobs Ck	abv Pleasant Valley Rd	Hopewell Twp	Aug 24, 1987	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
11	32	AN105A	Jacobs Ck	abv Pleasant Valley Rd	Hopewell Twp	Oct 27, 1987	non-impaired
11	32	AN0106	Jacobs Ck	Rt 29	Hopewell Twp	May 12, 1987	moderately impaired
11	32	AN0106	Jacobs Ck	Rt 29	Hopewell Twp	Aug 24, 1987	moderately impaired
11	32	AN0106	Jacobs Ck	Rt 29	Hopewell Twp	Oct 27, 1987	moderately impaired
11	32	AN0106	Jacobs Ck	Rt 29	Hopewell Twp	Jul 13, 1992	non-impaired
11	32	AN106A	Jacobs Ck	Bear Tavern Rd	Hopewell Twp	May 12, 1987	moderately impaired
11	32	AN106A	Jacobs Ck	Bear Tavern Rd	Hopewell Twp	Aug 24, 1987	non-impaired
11	32	AN106A	Jacobs Ck	Bear Tavern Rd	Hopewell Twp	Oct 27, 1987	non-impaired
11	32	AN0107	Gold Run	Rt 29 & L Ferry Rd	Wilburtha	Jul 13, 1992	non-impaired
11	40	AN0108	Assunpink Ck	Roosevelt Rd	Roosevelt	Mar 4, 1992	severely impaired
11	40	AN0109	Assunpink Ck	Rt 535	Edinburg	Mar 4, 1992	non-impaired
11	40	AN109T	Assunpink Ck trib	nr Assunpink WMA office	Millstone Twp	May 22, 1991	severely impaired
11	40	AN0110	Shipetauken Ck trib	Van Kirk Rd	Lawrence Twp	May 21, 1991	moderately impaired
11	40	AN0110	Shipetauken Ck trib	Van Kirk Rd	Lawrence Twp	Sep 24, 1991	non-impaired
11	40	AN0110	Shipetauken Ck trib	Van Kirk Rd	Lawrence Twp	Dec 9, 1991	moderately impaired
11	40	AN0110	Shipetauken Ck trib	Van Kirk Rd	Lawrence Twp	Mar 3, 1992	severely impaired
11	40	AN0111	Shipetauken Ck	Rt 583	Lawrence Twp	Mar 4, 1992	severely impaired
11	40	AN0112	Ltl Shabakunk Ck	Rt 206	Lawrence Twp	Mar 4, 1992	moderately impaired
11	40	AN0113	Shabakunk Ck	Bull Run Rd	Ewing Twp	Mar 4, 1992	severely impaired
11	40	AN0114	Shabakunk Ck	Rt 206	Lawrence Twp	Mar 4, 1992	moderately impaired
11	40	AN0115	Miry Run	Rt 533	Hamilton Twp	Mar 4, 1992	moderately impaired
11	40	AN0116	Assunpink Ck	Mulberry St	Trenton	Mar 4, 1992	moderately impaired
11	40	AN0117	Pond Run	Rt 533	Hamilton Twp	Mar 4, 1992	severely impaired
11	40	AN0118	Assunpink Ck	Willow St	Trenton	Mar 3, 1992	moderately impaired

WATERSHED MANAGEMENT AREA 12
EASTERN MONMOUTH COUNTY DRAINAGE

These watersheds drain the eastern portions of Monmouth County and flow in one of two directions. One portion drains into the Raritan estuary by way of Sandy Hook Bay. The waterways included within this portion are the Shrewsbury River, the Navesink River and a series of small Raritan Bay tributaries. The other portion drains directly into the Atlantic Ocean and includes the Shark and Manasquan Rivers. The area includes the following watersheds:

Matawan Creek	Navesink River	Shrewsbury River
Shark River	Manasquan River	Wreck Pond Brook

Summary of ambient physical/chemical monitoring stations and classifications

Station Name	Classification
Manasquan River at Squankum	FW-2 Trout Maintenance

The following monitoring locations have been discontinued as of 1991:

Jumping Brook near Neptune City (FW-2 Nontrout)
Shark River near Neptune (FW-2 Trout Maintenance)
Marsh Bog Brook at Squankum (FW-2 Nontrout)

OVERALL MANAGEMENT AREA ASSESSMENT

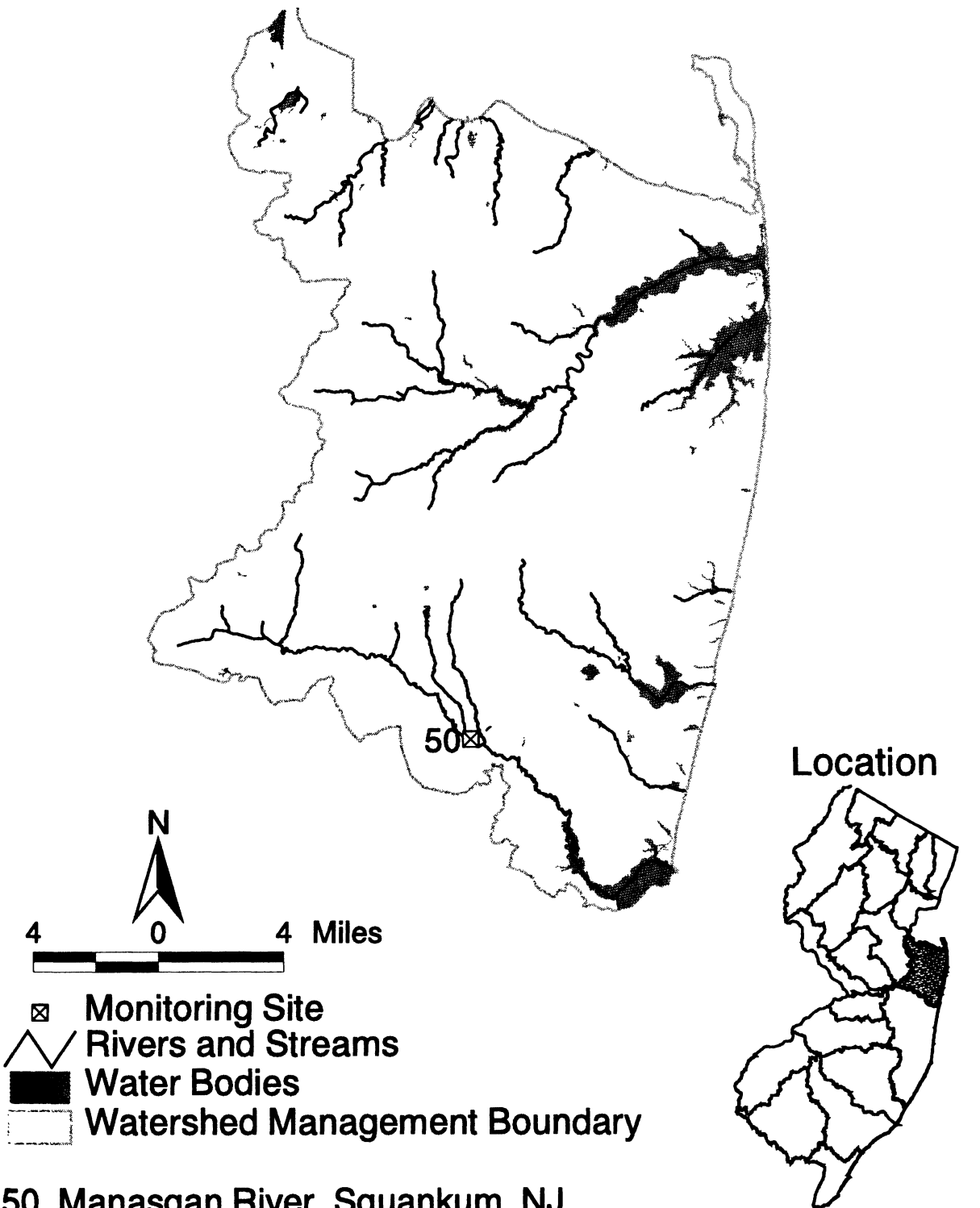
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Manasquan River	at Squankum	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 4	Mod. Impairment: 30	Severe Impairment: 9

Monmouth Watersheds, Manasquan, Navesink Watershed Management Area 12



50. Manasqan River, Squankum, NJ

NAVESINK AND SHARK RIVERS

WATERSHED DESCRIPTION

The Navesink River drains an area of 95 square miles. The Shrewsbury River drains an area of 27 square miles and the Shark River an area of 23 square miles. Tributaries to these rivers include the Swimming River, Yellow Brook, Big Brook, Mine Brook, and Willow Brook to the Navesink; Parkers Creek, Oceanport Creek, and Little Silver Creek to the Shrewsbury River; and Jumping Brook (7 miles long) to the Shark River (10 miles). Small tidal streams drain northern Monmouth County to Raritan Bay and Sandy Hook Bay. These creeks include Cheesequake Creek, Matawan Creek and Waackaack Creek. Sub-watersheds include the Navesink, Shrewsbury, and Shark Rivers and tributaries to Raritan Bay. Population centers in this area include Asbury Park, Long Branch, Red Bank, Keyport and Eatontown. Deal Lake lies in this area as do many small ponds. Also here are the Swimming River Reservoir and the Glendola Reservoir - both major potable water impoundments.

Land use in this watershed is about one-third forested, with a smaller percentage agricultural. An appreciable amount of land is used for residential/commercial/industrial uses, with about 15 percent being wetlands and water. Of the approximately 35 NJPDES permitted discharges, one-quarter are municipal and three-quarters are industrial/commercial. The waters in this region have been classified FW-2 Trout Maintenance, FW-2 Nontrout and SE-1.

The Navesink estuary supports substantial hard (Mercenaria mercenaria) and soft clam (Myra arenaria) populations. The Navesink and adjoining Shewsbury River produce almost the entire soft clam fishery for New Jersey and, as a result, the Navesink estuary has been the target since 1981 of a major interagency effort to reduce nonpoint source bacterial pollution (NJDEP, 1993).

WATER QUALITY ASSESSMENT

Prior to 1991 and through the second half of the 1980s there were two ambient monitoring stations collecting physical/chemical data within these watersheds - Jumping Brook near Neptune City (FW-2 Nontrout) and Shark River near Neptune (FW-2 Trout Maintenance). During that time period, monitoring found water quality to be excellent and good in Jumping Brook and the Shark River, respectively. The only water quality indicators found at problematic levels in Jumping Brook were occasional (25 percent) fecal coliform counts greater than 200 MPN/100ml. In the Shark River, nutrient and fecal coliform levels were slightly higher than in Jumping Brook. Fecal coliform levels had a geometric mean of 121 MPN/100ml, with 39 percent of samples greater than 200 MPN/100ml. Total phosphorus was above the 0.1 mg/l criterion in 13 percent of the samples collected. Dissolved oxygen was sufficient throughout the year in the two streams. Both streams are moderately acidic.

Deal Lake has been impaired since the 1950s due to sedimentation, poor sanitary quality and excessive aquatic macrophyte and algae growth. A 1983 study indicated that overland runoff is responsible for most of the sediment and nutrients.

Within the shellfish harvesting portions of the Navesink River the major pollution problem is high bacterial loadings from nonpoint sources. The highest concentrations occur in the segment of the river near Red Bank. Water quality steadily improves as one proceeds downstream until conditions are acceptable at the lower third of the river (NJDEP, 1993). The poorest sanitary quality is observed during the summer, especially following a rainfall. Substantial improvements in water quality in the Navesink River have occurred within this region during the late 1980s and early 1990s as a direct result of reductions of nonpoint source loadings. For the first time in 25 years, the potential now exists for unrestricted shellfish harvesting within the assessed shellfish harvesting waters of the Navesink.

Biological Monitoring

Biological monitoring within the Navesink and Shark River watersheds indicate either moderate to severe impairment throughout the freshwater portions of these watersheds (see the Biological Assessment Table located at the end of this section). No monitoring locations were observed to be non-impaired.

POINT SOURCE ASSESSMENT

No waste water dischargers are reported to be under enforcement actions by the NJDEP within the Navesink and Shark River watersheds at the present time. Willow Brook has in the past been reported to suffer from the contribution of both point and nonpoint sources. A number of industrial point sources combined with suburban/agricultural runoff and septic systems were all suspected causes of the elevated nutrients and bacteria found in the brook. The current status is not known. Also in the past, Imperial Oil Co. containing a hazardous waste site was affecting Lake Lefferts and Birch Swamp Brook with organics, metals and PCBs. The Seaview Square Mall has been built on an old dump site and was suspected of contaminating Deal Lake with metals and polynuclear aromatic hydrocarbons.

NONPOINT SOURCE ASSESSMENT

Horse farms, construction activities, and urban runoff are believed to be the principal nonpoint sources of pollution in this region. These have brought about siltation, nutrient loading, and excess bacterial contamination in the local rivers. Bacteria from horse farms and urban runoff had contaminated many of the shellfish harvesting beds in the downstream reaches of these rivers.

In the Navesink watershed both agricultural and suburban construction activities have created severe pollution problems. Crop production and horse farming, especially the stockpiling of manure has resulted in excessive nutrients and bacterial loadings. In addition, depressed dissolved oxygen levels threaten the local fresh water fishery in the Navesink. Urban

development impacts the Navesink; largely by contributing stormwater runoff and septic tank leachate, both of which are believed by local authorities to contribute to siltation, nutrient loading and oil and grease contamination.

In the tidal Navesink River an inter-agency nonpoint source control project has been underway to alleviate the bacterial contamination of shellfish growing waters by suburban and agricultural runoff. In concert with this effort, the Federal Natural Resources Conservation Service is sponsoring a soil erosion and animal waste control project in the watershed. As the direct result of this inter-agency effort, there have been notable reductions in bacterial loadings from coastal development, agricultural waste and marina- and boat-related contamination (NJDEP, 1993).

The Shark River watershed appears to be impacted more by suburban pollution sources and less by agricultural sources than the Navesink River watershed. Agricultural activity is suspected of contributing some runoff from pasturelands - resulting in nutrient and silt loads entering the waterway. In this watershed, road and housing construction, as well as urban runoff and landfills, predominate as the suspected principal nonpoint pollution sources. Local construction on roadways and housing are suspected of contributing to severe siltation and turbidity, especially in the headwaters. In addition, construction activities expose acid-producing soils which, in turn, can cause a pH depression in local streams. Widespread suburban runoff from both suburban surfaces has sent excess silt, road salts and bacteria into the Shark River, its tributaries and lakes. Landfills and other forms of waste storage are also suspected sources of pollution in the Shark River. In the headwaters at Tinton Falls, volatile organics have been reported in the past to be leaking into the local waters during rain. In Neptune City, underground waste storage tanks had been reported to be leaking petroleum products.

As mentioned earlier, Deal Lake is impaired by sedimentation, poor sanitary quality and excessive aquatic macrophyte and algae growth. Restoration efforts began in 1989 and included public education and the planned construction of four sediment retention basins. Efforts at constructing the basins are still ongoing.

The Shrewsbury River is affected by many of the same problems that impact the other local waters. Agricultural runoff from croplands, pastures, and animal holding areas is believed to be contributing excess nutrients, silt, and bacteria to surface water. Horse manure at Monmouth Race Track had been contributing high levels of bacteria to the river, however, enforcement efforts by NJDEP in concert with the Monmouth County Health Department have significantly reduced this source. Increases in suburban and commercial construction in the watershed and runoff from storm sewers and suburban surfaces have sent excess silt, salts, nutrients, and oil and grease into the waterway. This has caused high water temperatures, low dissolved oxygen levels, and restrictions in shellfish harvesting. Some nonpoint pollution in the Shrewsbury watershed is also suspected as originating from septic systems and waste disposal sites.

DESIGNATED USE ASSESSMENT

Aquatic life designated use support in the Shark and Navesink Rivers is a mixture of partial support and nonsupport. Shellfish growing waters in this region are classified as Special Restricted (further treatment required) for harvesting. No current sanitary data exists for assessing the primary contact support within the freshwater portions of the Navesink and Shark Rivers.

MANASQUAN RIVER

WATERSHED DESCRIPTION

The Manasquan River drains an area of 81 square miles and flows for 23 miles southeasterly from Freehold Township in Central Monmouth County to the Manasquan Inlet on the Ocean/Monmouth County line. Here, it empties into the Atlantic Ocean at Manasquan Inlet. The headwaters flow from a rural/agricultural area to the densely populated shore. The Manasquan River is connected in its lower reach to Barnegat Bay through the Point Pleasant Canal. The Manasquan River is fed by the major tributaries of Debois Creek, Mingamahone Creek and Marsh Bog Brook. Population centers include Point Pleasant, Howell Township, Freehold Township, Freehold Borough and Wall Township. The tides affect the Manasquan River up to a point approximately two miles east of the Garden State Parkway.

About half of the land use in this watershed is crop/pastureland, although large-scale development is taking place in many areas. There are a number of small lakes and ponds, most of which are used for recreational purposes. Of the 11 NJPDES permitted dischargers in the watershed, one is municipal, the rest are industrial/commercial. The waters are classified FW-1, FW-2 Trout Maintenance, FW-2 Nontrout and SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Manasquan River at Squankum

Dissolved Oxygen: Acceptable.

Temperature: One violation (of 18 samples) of the upper criterion for trout maintenance waters.

Nutrients: Inorganic nitrogen is acceptable; the median value is 0.52 mg/l with no values greater than 0.89 mg/l. Total phosphorous is also acceptable, with only 2 of 18 samples exceeding the criterion of 0.10 mg/l. The median value was 0.055 mg/l.

Bacteria: Moderate bacterial levels were recorded at Squankum. The geometric mean was 217 MPN/100 ml, with 33% of samples exceeding the 400/100ml criterion.

Heavy Metals: One copper sample approached but did not exceed the chronic criteria for aquatic life support. One of the seven lead records exceeded the chronic criteria for aquatic life support for lead. Elevated levels of lead, zinc, and mercury have been detected within the sediments of the Manasquan (NJDEP, 1990).

Summary: Within the freshwater portions of the Manasquan, nutrients and dissolved oxygen levels are acceptable. Instream temperatures, however, are high, with several readings approaching or exceeding 20° C. Lead and possibly copper within the water column may impair aquatic life support at

Squankum. Studies have found elevated lead, zinc, and mercury within the sediments of the Manasquan River (NJDEP, 1990). Sanitary quality is marginally poor.

Within the Manasquan River estuary, low summertime dissolved oxygen levels (sometimes below the 4.0 mg/l criterion for SE 1 waters) are reported by the Monmouth and Ocean County Health Departments (Monmouth-Ocean County, 1996). Sanitary quality is poor here also, causing the upper portions of the estuary to be condemned for shellfish harvesting and the mid to lower portions to be classified as Special Restricted for harvesting.

Biological Monitoring

With a few exceptions, biological monitoring found moderately to severely impaired biota within the Manasquan watershed (See the Biological Assessment Table located at the end of this section). The exceptions are Stan and Squankum Brooks in Howell Township and the lower portion of Mingamahone Brook in Squankum, all of which were observed to be non-impaired.

POINT SOURCE ASSESSMENT

One permitted surface water discharge is reported to be undergoing an enforcement action within the watershed. In July 1994, The Department executed an ACO with Nestle Beverage Co. in Freehold Township. The ACO required Nestle to improve their collection and disposal of contaminated stormwater runoff.

The Manasquan River and Marsh Bog Brook had in the past experienced significant point source loadings. These had contributed to excessive nutrients and, as a result, low levels of dissolved oxygen in some sections of these streams. In the Freehold Borough area, a number of industrial facilities discharged to tributaries of the Upper Manasquan. The Lone Pine Landfill, a Superfund hazardous waste site, is located in the headwaters of the river and contributes pollutants (volatile organics and metals) to the river. In addition, the Bog Creek Farm site has been reported to have contaminated the North Branch Squankum Brook with volatile organics. As of 1994, all municipal wastewater facilities within the Manasquan watershed have been eliminated and their wastewater flows transferred to the Ocean County UA Northern facility for treatment and discharge to the Atlantic Ocean. The Manasquan estuary has only one remaining NJPDES permitted discharge, a pump-and-treat groundwater remediation system in Point Pleasant Beach.

NONPOINT SOURCE ASSESSMENT

The Manasquan River watershed receives a wide range of nonpoint source pollutants. Sources include agriculture, waste disposal and suburban development. Here, as in other eastern coastal watersheds, bacterial contamination of waterways is a widespread and significant problem.

In the Manasquan River itself, agricultural nonpoint source pollution impacts are reported to be largely centered in the region just east of Route 9. Here,

croplands, pastureland, feed lots and animal holding areas have combined to cause nutrient loading, siltation, and high bacterial levels in the river. Non-agricultural problems include dam and reservoir construction (Manasquan Reservoir), which has led to local stream bank modification and the loss of riparian vegetation. This has caused erosion, siltation, and turbidity in the stream which in turn have posed a threat to the local freshwater fishery. Housing construction within the downstream end is also contributing to siltation and turbidity problems, while moderate to severe levels of runoff from urban surfaces and road salting have led to salinity and nutrient loading. Within the estuary, the high concentrations of waterfowl have contributed to the buildup of bacteria (Monmouth - Ocean Counties, 1996).

Tributaries to the Manasquan received much the same types of nonpoint pollution as does the Manasquan itself. Squankum Brook is suspected of receiving runoff from cropland, pastures, and animal holding areas. Marsh Bog Brook is suspected of being impacted by agricultural runoff from cropland and animal holding areas. Local landfills and septic systems are also suspected and known sources of pollution, respectively. DeBois Creek is known to be impacted by siltation from both road and home construction. Here, tree cutting during road construction has led to the destabilization of stream banks. DeBois Creek is also degraded by urban runoff. Lakes assessed in the watershed are experiencing high bacterial levels and eutrophication as a result of inputs from waterfowl and road runoff.

DESIGNATED USE ASSESSMENT

The Manasquan River at Squankum will not support the swimmable (primary contact) designated use because of elevated fecal coliform levels.

These streams in general will either not support or only partially support the aquatic life support designated use based upon macroinvertebrate assessments. The exceptions to this are Stan and Squankum Brooks in Howell Township and the lower portion of Mingamahone Brook in Squankum, all of which fully support the use.

The tidal Manasquan River is condemned for the harvesting of shellfish in the tidal reaches downstream to the Rt. 70 bridge. Downstream of the bridge, the waters are classified as Special Restricted.

BIOLOGICAL ASSESSMENT TABLE: AREA 12

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
12	36	AN0456	Matawan Ck	Morganville Rd	Madison Twp	Aug 2, 1994	moderately impaired
12	36	AN0457	Gravelly Bk	Church St	Aberdeen Twp	Aug 1, 1994	severely impaired
12	36	AN0458	Wilksons Bk	Church St	Aberdeen Twp	Aug 1, 1994	severely impaired
12	36	AN0459	Flat Ck	Middle Rd	Raritan Twp	Aug 1, 1994	severely impaired
12	36	AN0460	Mahoras Ck	Rt 35	Middletown Twp	Aug 1, 1994	severely impaired
12	36	AN0461	Town Bk	Spruce Rd	Middletown Twp	Aug 2, 1994	moderately impaired
12	38	AN0462	McClees Ck	Whippoorwill Rd	Middletown Twp	Aug 3, 1994	moderately impaired
12	38	AN0463	Poricy Bk	Navesink R Rd	Middletown Twp	Aug 3, 1994	moderately impaired
12	38	AN0464	Nut Swamp Bk	Normandy Rd	Middletown Twp	Aug 3, 1994	severely impaired
12	38	AN0465	Hop Bk	Roberts Rd	Holmdel Twp	Aug 9, 1994	moderately impaired
12	38	AN0466	Hop Bk	Willow Bk Rd	Holmdel Twp	Aug 3, 1994	moderately impaired
12	38	AN0467	Willow Bk	Schank Rd	Holmdel Twp	Aug 9, 1994	moderately impaired
12	38	AN0468	Willow Bk	Willow Bk Rd	Colts Neck Twp	Aug 3, 1994	severely impaired
12	38	AN468A	Willow Bk trib	Igoe Rd	Marlboro	Oct 31, 1990	moderately impaired
12	38	AN0469	Big Bk	Rt 79	Marlboro Twp	Aug 9, 1994	severely impaired
12	38	AN0470	Big Bk	Cross Rd	Colts Neck Twp	Aug 3, 1994	moderately impaired
12	38	AN0471	Yellow Bk	Rt 537	Freehold Twp	Aug 9, 1994	moderately impaired
12	38	AN0472	Yellow Bk	Creamery Rd	Colts Neck Twp	Aug 9, 1994	moderately impaired
12	38	AN0473	Mine Bk	Creamery Rd	Colts Neck Twp	Aug 9, 1994	moderately impaired
12	38	AN0474	Swimming R	Swimming R Rd	Lincroft	Aug 3, 1994	moderately impaired
12	38	AN0475	Hockhockson Bk	Hockhockson Rd	Colts Neck Twp	Aug 3, 1994	moderately impaired
12	38	AN0475	Hockhockson Bk	Hockhockson Rd	Colts Neck Twp	Feb 16, 1995	moderately impaired
12	38	AN0475	Hockhockson Bk	Hockhockson Rd	Colts Neck Twp	May 8, 1995	moderately impaired
12	38	AN0475	Hockhockson Bk	Hockhockson Rd	Colts Neck Twp	Nov 3, 1995	non-impaired
12	38	AN0476	Pine Bk	Tinton Ave (Rt 537)	Tinton Falls	Aug 3, 1994	moderately impaired
12	38	AN476A	Pine Bk	Squankum Rd	Macedonia	Oct 31, 1990	moderately impaired
12	41	AN0477	Whale Pd Bk	Larchwood Ave	Oakhurst	Aug 4, 1994	moderately impaired
12	41	AN0478	Poplar Bk	Almyr Ave	Deal	Aug 4, 1994	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
12	42	AN0479	Jumping Bk	Essex Rd	New Shrewsbury Twp	Aug 4, 1994	moderately impaired
12	42	AN0480	Jumping Bk	Corlies Ave	Neptune Twp	Sep 20, 1994	moderately impaired
12	42	AN0481	Shark R	Shark R Sta Rd	Reevytown (Wall Twp)	Oct 30, 1990	moderately impaired
12	42	AN0481	Shark R	Shark R Sta Rd	Reevytown (Wall Twp)	Aug 4, 1994	severely impaired
12	42	AN0482	Shark R	Remsens Mills Rd	Remsensmill	Sep 20, 1994	moderately impaired
12	47	AN0483	Wreck Pd Bk	Old Mill Rd	Wall Twp	Aug 10, 1994	moderately impaired
12	47	AN0484	Hannabrand Bk	Old Mill Rd	Wall Twp	Aug 10, 1994	non-impaired
12	47	AN0484	Hannabrand Bk	Old Mill Rd	Wall Twp	Nov 3, 1995	moderately impaired
12	43	AN0485	Manasquan R	off Turkey Swamp Rd	Freehold Twp	Apr 11, 1989	moderately impaired
12	43	AN0485	Manasquan R	off Turkey Swamp Rd	Freehold Twp	Jul 8, 1992	moderately impaired
12	43	AN0485	Manasquan R	off Turkey Swamp Rd	Freehold Twp	Oct 7, 1992	moderately impaired
12	43	AN0485	Manasquan R	off Turkey Swamp Rd	Freehold Twp	Jan 21, 1993	moderately impaired
12	43	AN0485	Manasquan R	off Turkey Swamp Rd	Freehold Twp	Apr 8, 1993	non-impaired
12	43	AN0486	Debois Ck	Rt 33	Freehold Twp	Sep 14, 1994	moderately impaired
12	43	AN0487	Debois Ck	Strickland Rd	Freehold Twp	Sep 14, 1994	severely impaired
12	43	AN0488	Manasquan R trib	Strickland Rd	Howell Twp	Sep 14, 1994	moderately impaired
12	43	AN0489	Manasquan R	Rt 9	Wyckoff Mills	Sep 14, 1994	moderately impaired
12	43	AN489A	Turkey Swamp Bk	blw Turkey Swamp Lk	Freehold Twp	Oct 30, 1990	severely impaired
12	43	AN0490	Manasquan R	W Farms Rd	Howell Twp	Aug 9, 1994	moderately impaired
12	43	AN0491	Marsh Bog Bk	Cranberry Bog Rd	Howell Twp	Aug 9, 1994	moderately impaired
12	43	AN0492	Marsh Bog Bk	Yellow Bk Rd	Squankum	Aug 9, 1994	moderately impaired
12	43	AN0493	Manasquan R	Rt 547	Squankum	Aug 9, 1994	moderately impaired
12	43	AN0494	Mingamahone Bk	Cranberry Bog Rd	Howell Twp	Aug 9, 1994	moderately impaired
12	43	AN0495	Mingamahone Bk	Rt 524	Squankum	Aug 9, 1994	non-impaired
12	43	AN0496	Stan Bk	Easy St	Howell Twp	Oct 30, 1990	non-impaired
12	43	AN0496	Stan Bk	Easy St	Howell Twp	Mar 1, 1991	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

12	43	AN0496	Stan Bk	Easy St	Howell Twp	May 17, 1991	non-impaired
12	43	AN0496	Stan Bk	Easy St	Howell Twp	Jul 10, 1991	moderately impaired
12	43	AN0497	Squankum Bk	Spur 549	Howell Twp	Aug 10, 1994	non-impaired
12	43	AN0498	Manasquan R	Hospital Rd	Wall Twp	Aug 10, 1994	moderately impaired

WATERSHED MANAGEMENT AREA 13
THE BARNEGAT BAY DRAINAGE

The watershed management area includes watersheds draining the central Atlantic drainage of New Jersey. The area lies mostly in Ocean County and includes the Barnegat Bay as well as the following subwatersheds:

Metedeconk River
Forked River
Toms River
Cedar Creek

Summary of ambient physical/chemical monitoring stations and classifications:

Station	Classification
Toms River near Toms River	FW-2 Nontrout

OVERALL MANAGEMENT AREA ASSESSMENT

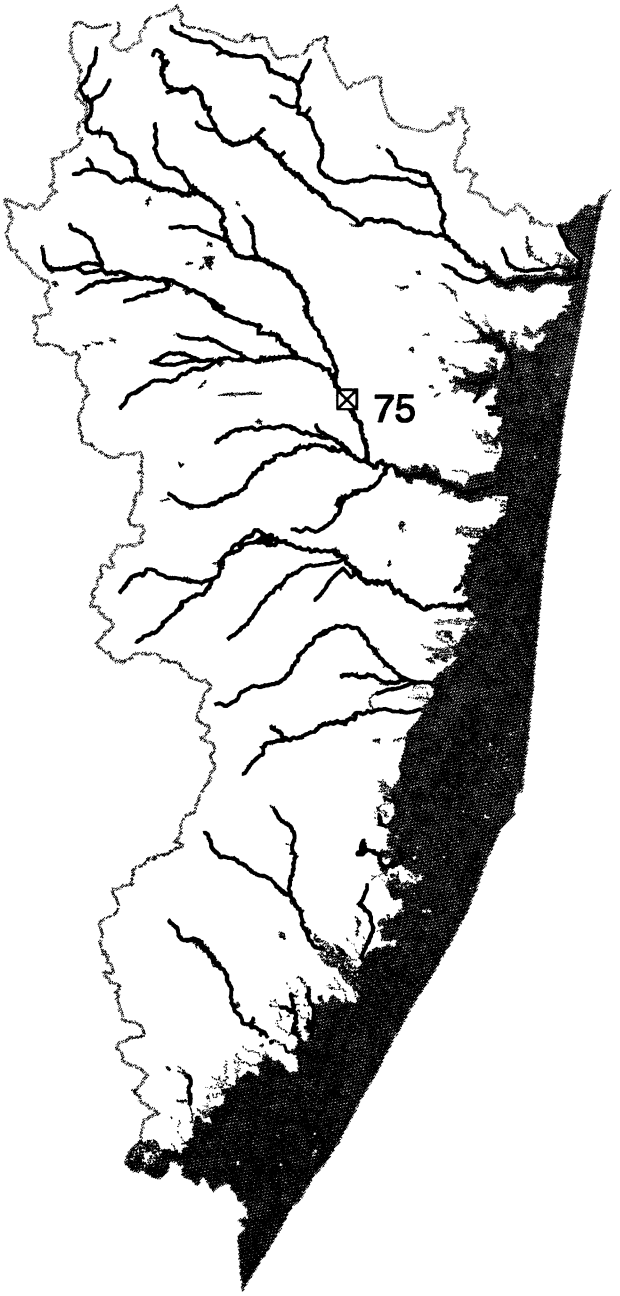
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Toms River	near Toms River	Full Support
Barnegat Bay	most monitored sections	Full Support
Barnegat Bay	portions within the northern area	Partial support

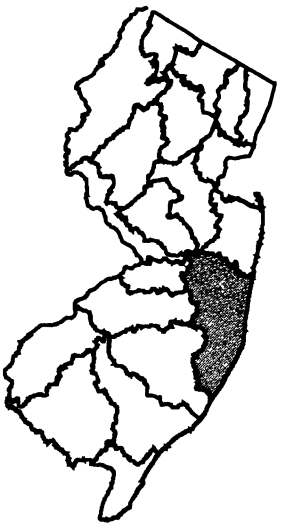
- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 35 Mod. Impairment: 22 Severe Impairment: 4

Barnegat Bay Watersheds, Metedeconk Watershed Management Area 13



Location



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4 0 4 Miles

Monitoring Site
Rivers and Streams
Water Bodies
Watershed Management Boundry

75. Toms River, Toms River, NJ

TOMS RIVER

WATERSHED DESCRIPTION

Toms River drains an area of 124 square miles. It flows from western Ocean and Monmouth Counties southeast to Barnegat Bay at the Town of Toms River, 11 miles north of Barnegat Inlet. This is an area of low relief, containing many small tributaries which feed into the Toms River. The larger tributaries include Davenports Branch, Union Branch, and Wrangle Brook. The watershed also drains a large area of the Pinelands. Major impoundments include Success Lake and Horicon Lake. Population centers include Toms River, Lakehurst, Dover, and Manchester.

This watershed lies in the Coastal Plain and is about one-half forested, with the remainder residential developments, a military installation and agricultural. There has been a substantial amount of new residential and commercial development throughout the watershed in the past five years. Of the approximately 9 NJPDES permitted discharges within the watershed, half are industrial/commercial, and half are municipal/institutional. Waters have been classified as Pinelands (some of the Pinelands waters are also designated trout maintenance), FW-l, FW-2 Nontrout, and SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Toms River near Toms River

Dissolved Oxygen: Acceptable.

Temperature: No violations of the upper criterion for non-trout waters.

Nutrients: Inorganic nitrogen is acceptable, median value is 0.46 mg/l. Total phosphorous is also acceptable, with only one of 21 samples exceeding the 0.10 mg/l criterion. The median value was 0.03 mg/l.

Bacteria: Very low bacterial levels were recorded near Toms River. The geometric mean was 37.8 MPN/100 ml and no sample exceeded the 400 MPN/100ml criterion.

Summary: Water quality in the Toms River as monitored near Toms River is very good with respect to nutrients, dissolved solids and sanitary quality. Of note is that sanitary quality appears to be on a long term trend towards better and better quality. In the mid 1980s almost half the bacterial samples were above 200/100ml. By 1990 the assessments found this number of violations to have declined to 14 percent, and the current assessment found no values over 200 (in fact no values above 120).

Biological Monitoring

Macroinvertebrate monitoring found non-impaired conditions widespread throughout the Toms River watershed (See the Biological Assessment Table located at the end of this section). Moderately impaired conditions were restricted to Jakes Brook, Sunken Brook, Lower Blacks Brook, Union Branch in Manchester, Maple Root Branch, and a portion of the upper Toms River in Holmson Township.

POINT SOURCE ASSESSMENT

The Toms River does not suffer from any severe pollution problems, based on the ambient monitoring. A few minor point sources are present in the watershed, but they do not appear to have significant effects on stream quality.

Two hazardous waste sites in the past were suspected of impacting surface waters in the Toms River watershed. They are the Lakehurst Naval Air Engineering Center adjacent to the Ridgeway Branch (aromatics, volatile organics, and metals), and Ciba-Geigy which was suspected to be affecting the Toms River with volatile organics and metals.

NONPOINT SOURCE ASSESSMENT

Nonpoint source runoff in the watershed has affected water quality from the standpoint of increases in nutrients and stream pH. The streams of the Pinelands region are very susceptible to increases in pH because of their low buffering capacity. Human activity tends to cause increases in stream pH. The predominant nonpoint sources in the Toms River and surrounding watersheds are those associated with suburban development. It is the urban surface runoff and septic systems which are suspected to be primarily responsible for the loss of shellfish harvesting areas in Barnegat Bay. Agricultural inputs appear to be limited largely to the Upper Toms River sub-watershed. Another prominent source of nonpoint pollution in this central New Jersey region is the acid-producing mineral deposits located in the soil. When these soils are exposed to air and water as during construction, they produce sulfuric acid, which when carried away in runoff, acts to depress the pH of the receiving waters.

The upper reaches of the Toms River watershed receive agricultural runoff largely from croplands. It appears that the irrigated fields produce greater runoff problems in contrast to nonirrigated fields. Here, the principal complaint is that runoff is silting-in private ponds. Suburban development has been known to create a wide range of severely deleterious impacts to the Toms River including elevations in fecal coliform levels, turbidity, phosphorus, and dissolved solids, as well as declining dissolved oxygen levels and a decline in the River's suitability for recreational use. These problems were reported to be brought about as a result of the combined impacts of septic tank leachate and urban surface runoff. Housing construction in this watershed has caused increased turbidity and siltation as well as the release of increasing amounts of sulfuric acid from acid producing soils.

In the Lower Toms River subwatershed, suburban development is the primary reported source of nonpoint pollution. Urban surface runoff, storm sewer drainage, and natural pollution were known to have brought about high levels of phosphorus and coliform bacteria, increases in dissolved solids, and a decrease in dissolved oxygen levels. A decline in the recreational use of the waterway had resulted from periodic beach closures which have occurred in the downstream stretches. The lower Toms River and the Union Branch have received impacts from stream encroachment and housing construction. Wrangle Brook, a tributary to Toms River in Berkeley Township, had been reported to be undergoing a decline in water quality resulting from the impacts of urban surface runoff and septic tank leachate. These sources had caused high ammonia levels in the stream and had correspondingly threatened the stream's recreational use.

Pine Lake in Manchester Township has had beach closures because of pollution brought about by urban surface runoff combined with municipal sewage treatment plant effluent.

DESIGNATED USE ASSESSMENT

The Toms River fully supports the swimmable (primary contact) use in the freshwater sections as monitored near Toms River. The Toms River itself and most of the local tributaries fully support the aquatic life use; partial support is assigned to those tributaries assessed as partially impaired (see Biological Monitoring above). The tidal reaches of the Toms River are classified as condemned for the harvesting of shellfish.

BARNEGAT BAY

The following discussion, unless otherwise indicated, is drawn from Profile of the Barnegat Bay (NJDEP, 1990). This general discussion has been updated with supplemental material regarding water quality.

Barnegat Bay provides innumerable recreational, economic and aesthetic benefits for New Jersey residents and visitors. Like estuaries almost everywhere, the Bay is experiencing development pressure which may be adversely affecting its water quality and ecology. The watersheds draining to the Bay are among the fastest growing areas in the state. Barnegat Bay is very shallow and this limits its dilution capacity as compared to other bays possessing greater depth. The Bay also possesses a very low flushing rate and a high ratio of estuary volume to fresh water flow. As a result of these factors, relatively small changes in nutrient inputs are likely to have a large impact on bay water quality. In other words, water quality in the Bay is susceptible to degradation because of its high potential to concentrate both dissolved and particulate pollutants.

Nutrients and Bay Eutrophication

Numerous lines of evidence suggest that, as of 1993, Barnegat Bay is in a moderately eutrophic state (Academy of Natural Sciences, 1993). One of the central concerns revolving around eutrophication in the Bay is that nutrient enrichment may lead to ever increasing phytoplankton blooms which may cause a decline in rooted aquatic plants such as eel grass and, in turn, the fin and shellfish resources that depend upon these grass beds for habitat. Concerns are focused upon the influx of nutrients from direct inputs (such as incoming fresh waters), the resuspension of bottom sediments and the increase in water column turbidity brought about by boat activity (Academy of Natural Sciences, 1993).

Sanitary Quality

Sanitary quality in Barnegat Bay influences both the value of the resource for primary contact recreation and the fitness of the waters for the harvesting of shellfish for human consumption. Coliform bacteria arise in the Bay from a multitude of sources including failing septic systems, runoff from developed areas, domestic animals, wildlife and boats. Sanitary quality needed to support swimming, as measured along the shoreline through the Coastal Cooperative Monitoring Program (CCMP), is poorest along the northern third of the Bay. The beaches with the highest number of closings in 1996 were Windward Beach in Brick, Hancock Avenue beach in Seaside Heights and Money Island beach in Dover Township. Bacterial levels are greatest after rain events, indicating nonpoint sources. Wet weather also was correlated with elevations in bacterial levels in Bay areas monitored for shellfish harvesting.

Metals

Metals in Barnegat Bay are largely contained in the sediments. Sediment samples with high concentrations were found in the most densely populated portions of Barnegat Bay. The presence of metals, despite the absence of major industrial or harbor facilities near the sampling locations, suggests that diffuse sources like urban runoff, fuel and paint used for pleasure boats may be produced in such quantities as to be sufficient to cause substantial sediment contamination in enclosed estuaries. When sediments within the Bay were measured for metals, generally levels were found that could be accounted for by natural background levels characteristic of coastal plain sediments. However, the following locations had moderate or high levels of metals in the sediments not accountable for by background levels:

- Double Creek Channel - moderate to high contamination of arsenic and lead.
- West Creek - high contamination of arsenic.
- Manasquan River - moderate to high contamination with lead and zinc, high contamination with arsenic.
- Metedeconk - moderate to high contamination with mercury, copper, arsenic and lead.
- Toms River - elevated lead levels (attributed to urban land uses in the area).

DESIGNATED USE ASSESSMENT

The Barnegat Bay fully supports the swimmable (primary contact) use in the sections as monitored by the Coastal Cooperative Monitoring Program. However, certain portions within the northern portion of the Bay are regarded as partially supporting the use because of intermittent and short-term beach closures due to poor sanitary quality.

The majority of open bay waters are fully open to shellfish harvesting (fully supporting the use). Harvesting restrictions are enacted within the northern portion of the Bay from Toms River northward and along most of the shoreline regions of the bay (partially supporting the use).

BIOLOGICAL ASSESSMENT TABLE: AREA 13

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
13	46	AN0499	Metedeconk R N Br	Rt 527	Freehold Twp	Sep 28, 1994	non-impaired
13	46	AN0500	Metedeconk R N Br	Jackson Mills Rd	Freehold Twp	Sep 28, 1994	non-impaired
13	46	AN0501	Metedeconk R N Br	Aldrich Rd	Howell Twp	Sep 28, 1994	moderately impaired
13	46	AN0502	Metedeconk R N Br	Rt 9	Lakewood	Sep 28, 1994	moderately impaired
13	46	AN0503	Haystack Bk	Southard Rd	Howell Twp	Aug 10, 1994	moderately impaired
13	46	AN0504	Haystack Bk	Rt 547	Howell Twp	Aug 10, 1994	non-impaired
13	46	AN0505	Muddy Ford Bk	Greenville Rd	Howell Twp	Sep 20, 1994	non-impaired
13	46	AN0506	Metedeconk R N Br	Rt 88	Lakewood Twp	Sep 20, 1994	moderately impaired
13	46	AN0507	Cabinfield Br	Lanes Mill Rd	Lakewood Twp	Sep 20, 1994	moderately impaired
13	46	AN0508	Metedeconk R S Br	Leesville-Siloam Rd	Jackson Twp	Oct 29, 1990	non-impaired
13	46	AN0508	Metedeconk R S Br	Leesville-Siloam Rd	Jackson Twp	Feb 20, 1991	non-impaired
13	46	AN0508	Metedeconk R S Br	Leesville-Siloam Rd	Jackson Twp	May 17, 1991	non-impaired
13	46	AN0508	Metedeconk R S Br	Leesville-Siloam Rd	Jackson Twp	Jul 10, 1991	non-impaired
13	46	AN0509	Metedeconk R S Br	Jackson Mills Rd	Jackson Mills	Sep 28, 1994	moderately impaired
13	46	AN0510	Metedeconk R S Br	Bennetts Mill Rd	Bennetts Mill	Sep 28, 1994	severely impaired
13	46	AN0511	Metedeconk R S Br	Cedar Bridge Rd	Lakewood	Oct 18, 1994	moderately impaired
13	46	AN0512	Metedeconk R S Br	Chambers Bridge Rd	Brick Twp	Oct 18, 1994	moderately impaired
13	46	AN0513	Beaver Dam Ck	Rt 88	Brick Twp	Sep 20, 1994	moderately impaired
13	46	AN0514	Cedar Bridge Br	Moore Rd	Brick Twp	Oct 18, 1994	severely impaired
13	53	AN0515	Kettle Ck	New Hampshire Ave	Lakewood Twp	Oct 18, 1994	non-impaired
13	53	AN0515	Kettle Ck	New Hampshire Ave	Lakewood Twp	Jan 11, 1995	non-impaired
13	53	AN0515	Kettle Ck	New Hampshire Ave	Lakewood Twp	Apr 19, 1995	moderately impaired
13	53	AN0515	Kettle Ck	New Hampshire Ave	Lakewood Twp	Jul 18, 1995	moderately impaired
13	53	AN0516	Kettle Ck	Moore Rd	Brick Twp	Oct 18, 1994	moderately impaired
13	48	AN0517	Toms R	Paint Island Rd	Millstone Twp	Oct 29, 1990	non-impaired
13	48	AN0517	Toms R	Paint Island Rd	Millstone Twp	Feb 22, 1991	moderately impaired
13	48	AN0517	Toms R	Paint Island Rd	Millstone Twp	May 17, 1991	non-impaired
13	48	AN0517	Toms R	Paint Island Rd	Millstone Twp	Jul 10, 1991	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
13	48	AN0518	Toms R	Rt 571	Holmson	Oct 12, 1994	moderately impaired
13	48	AN0519	Toms R	Rt 528	Cassville	Oct 12, 1994	non-impaired
13	48	AN0520	Toms R trib	Rt 528	Van Hiseville	Oct 12, 1994	non-impaired
13	48	AN0521	Maple Root Br	Bowman Rd	Jackson Twp	Oct 12, 1994	moderately impaired
13	48	AN0522	Dove Mill Br	Grawtown Rd	Jackson Twp	Oct 13, 1994	non-impaired
13	48	AN0523	Toms R	S Hope Chapel Rd (Rt 547)	Whitesville	Oct 13, 1994	non-impaired
13	48	AN0524	Toms R	Rt 571	Dover Twp	Oct 13, 1994	non-impaired
13	48	AN0525	Bordens Mill Br	Colliers Mills WMA	Jackson Twp	Oct 18, 1994	severely impaired
13	48	AN0526	Shannae Br	Colliers Mills WMA	Jackson Twp	Oct 18, 1994	non-impaired
13	48	AN0527	Ridgeway Br	Rt 571	Legler	Oct 19, 1994	non-impaired
13	48	AN0528	Ridgeway Br	Rt 70	Manchester Twp	Oct 19, 1994	non-impaired
13	48	AN0529	Blacks Br	Naval Air Sta boundary	Manchester Twp	Oct 18, 1994	non-impaired
13	48	AN0530	Blacks Br	Rt 70	Lakehurst	Oct 19, 1994	moderately impaired
13	48	AN0531	Old Hurricane Br	Beckerville Rd	Manchester Twp	Nov 14, 1990	non-impaired
13	48	AN0531	Old Hurricane Br	Beckerville Rd	Manchester Twp	Mar 12, 1991	non-impaired
13	48	AN0531	Old Hurricane Br	Beckerville Rd	Manchester Twp	May 16, 1991	non-impaired
13	48	AN0531	Old Hurricane Br	Beckerville Rd	Manchester Twp	Jul 11, 1991	non-impaired
13	48	AN0532	Manapaqua Bk	Rt 70	Lakehurst	Oct 19, 1994	severely impaired
13	48	AN0533	Union Br	Colonial Dr	Manchester Twp	Oct 19, 1994	moderately impaired
13	48	AN0534	Union Br	Beacon Ave	Pine Lk Pk-Manchester Twp	Nov 1, 1994	non-impaired
13	48	AN0535	Toms R	Oakridge Pkwy	Dover Twp	Oct 13, 1994	non-impaired
13	48	AN0535	Toms R	Oakridge Pkwy	Dover Twp	Jan 11, 1995	non-impaired
13	48	AN0535	Toms R	Oakridge Pkwy	Dover Twp	Apr 19, 1995	non-impaired
13	48	AN0535	Toms R	Oakridge Pkwy	Dover Twp	Jul 18, 1995	non-impaired
13	48	AN0536	Wrangel Bk	Congasia Rd	Manchester Twp	Nov 3, 1994	non-impaired
13	48	AN0537	Wrangel Bk	Mule Rd	Berkeley Twp	Nov 1, 1994	non-impaired
13	48	AN0538	Sunken Br	Mule Rd	Berkeley Twp	Nov 3, 1994	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
13	48	AN0539	Wrangel Bk	S Hampton Rd	Berkeley Twp	Nov 3, 1994	non-impaired
13	48	AN0540	Davenport Br	Lacey Rd	Berkeley Twp	Nov 29, 1994	non-impaired
13	48	AN0541	Davenport Br	Mule Rd	Berkeley Twp	Nov 3, 1994	non-impaired
13	48	AN0542	Jakes Br	Dover Rd	Berkeley Twp	Nov 29, 1994	moderately impaired
13	48	AN0543	Jakes Br	Double Trouble Rd	S Toms R	Nov 29, 1994	moderately impaired
13	48	AN0544	Toms R trib	Rt 37	Dover Twp	Oct 19, 1994	moderately impaired
13	62	AN0545	Webbs Mill Br	Rt 539	Lacey Twp	Nov 14, 1990	moderately impaired
13	62	AN0545	Webbs Mill Br	Rt 539	Lacey Twp	Dec 1, 1994	non-impaired
13	62	AN0546	Cedar Ck	Whiting Lacey Rd	Bamber Lk-Lacey Twp	Dec 1, 1994	non-impaired
13	62	AN0547	Factory Br	Whiting Lacey Rd	Lacey Twp	Dec 1, 1994	non-impaired
13	62	AN0548	Cedar Ck	Double Trouble St Pk	Lacey Twp	Dec 1, 1994	moderately impaired
13	62	AN0549	Cedar Ck	Rt 9	Lanoka Harbor	Dec 1, 1994	non-impaired
13	67	AN0550	Long Br		Lacey - Ocean Twp boundary	Dec 13, 1994	non-impaired
13	67	AN0551	Forked R N Br	@ powerlines	Lacey Twp	Nov 29, 1994	moderately impaired
13	67	AN0552	Oyster Ck	Rt 532	Ocean Twp	Dec 13, 1994	non-impaired
13	67	AN0553	Waretown Ck	Rt 9	Waretown	Dec 13, 1994	non-impaired
13	67	AN0554	Four Mile Br	Oxycocus St	Manahawkin	Dec 20, 1994	non-impaired
13	67	AN0555	Mill Ck	Rt 72	Manahawkin	Dec 13, 1994	moderately impaired
13	67	AN0556	Cedar Run	Rt 9	Mayetta	Dec 20, 1994	non-impaired
13	67	AN0557	Westecunk Ck	Forge Rd	Eagleswood Twp	Dec 20, 1994	non-impaired
13	67	AN0558	Westecunk Ck	RR Ave	W Ck	Dec 20, 1994	non-impaired
13	67	AN0559	Mill Br	Nugentown Rd	Nugentown	Dec 20, 1994	moderately impaired

WATERSHED MANAGEMENT AREA 14

MULLICA RIVER DRAINAGE

The watershed management area includes watersheds draining portions of the Pinelands of New Jersey. Major rivers include the Mullica, the Wading River, Nochescatauxin Brook, Atsion Creek, the Bass River, Batsto River, Nescochaque Creek, Landing Creek, Hammonton Creek and the Oswego River. The area lies in Burlington and Atlantic Counties and includes the following watersheds:

Mullica River	Wading River	Batsto River
Mechesactauxin Creek	Atsion Creek	Doughty Creek

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
West Branch Wading River at Maxwell	Pinelands Waters
Oswego River at Harrisville	Pinelands Waters
East Branch Bass River at New Gretna	Pinelands Waters
Mullica River at outlet of Atsion Lake	Pinelands Waters
Batsto River at Batsto	Pinelands Waters
Hammonton Creek at Wescoatville	Pinelands Waters

The following monitoring locations have been discontinued as of 1991:
Mullica River at Green Bank (Pinelands Waters)

OVERALL MANAGEMENT AREA ASSESSMENT

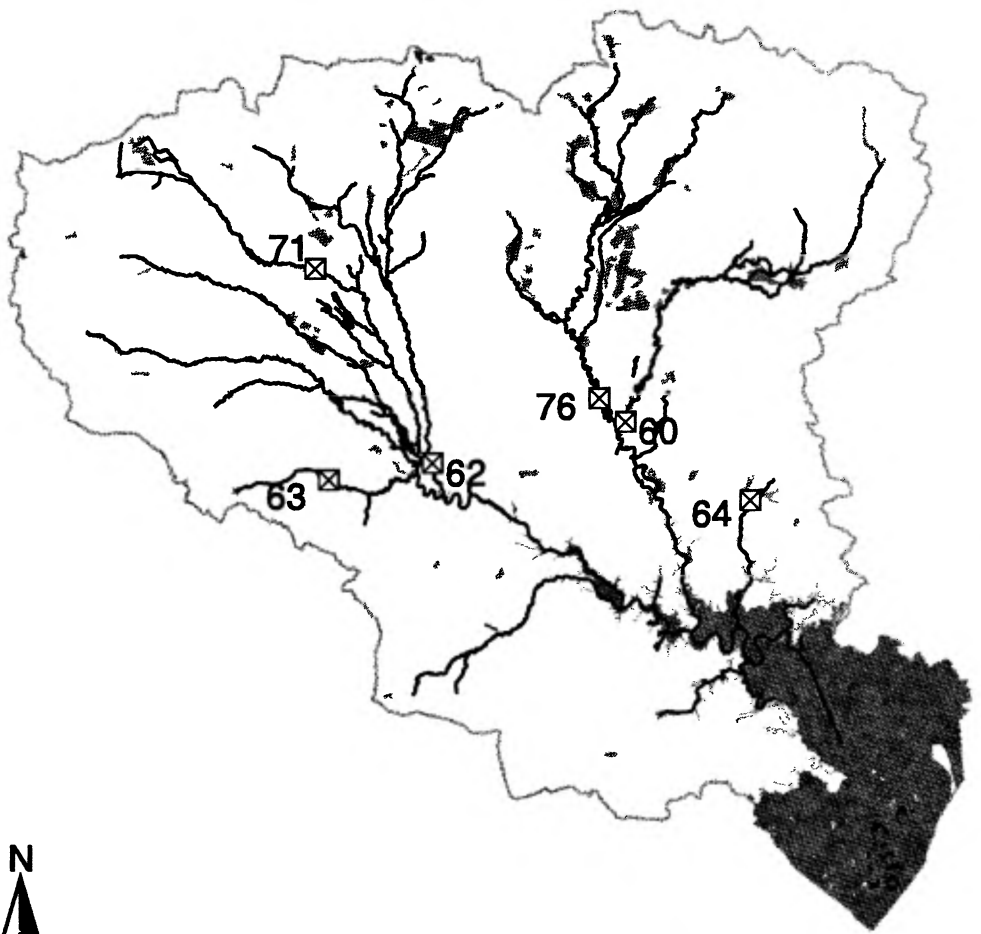
- Swimmable Support Status:

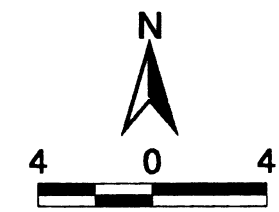
WATERWAY	LOCATION	STATUS
W Br Wading River	at Maxwell	Full Support
Oswego River	at Harrisville	Full Support
E Br Bass River	at New Gretna	Full Support
Mullica River	outlet of Atsion Lake	Full Support
Batsto River	at Batsto	Full Support
Hammonton Creek	at Wescoatville	Partial Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 23	Mod. Impairment: 27	Severe Impairment: 6

Mulica/Wading River System
Watershed Management Area 14





Location

⊠ Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary

60. Oswego River, Harrisville, NJ
62. Batsto River, Batsto, NJ
63. Hammonton Creek, Wescoatville, NJ
64. East Branch Bass River, New Gretna, NJ
71. Mullica River , Atsion Lake Outlet, NJ
76. WB Wading River, Maxwell, NJ

WATERSHED DESCRIPTION

The Mullica River and tributaries are considered the primary drainage system for the Pinelands. The total area of the drainage basin (Mullica River and tributaries) is some 561 square miles. Major tributaries within the watershed include the Wading River, Nochescatauxin Brook, Atsion Creek, the Bass River, Batsto River, Nescochaque Creek, Landing Creek, Hammonton Creek and the Oswego River. The Mullica River empties into Great Bay, a large estuarine system. The population centers are Winslow, Galloway and Hammonton.

About 80 percent of this watershed consists of state parks and forests, with the remainder being agricultural and developed areas. Of the approximately 7 NJPDES permitted discharges here, roughly half are municipal/ institutional and half are industrial/commercial. The streams are classified FW-Pinelands Waters, FW-1, FW-2 Nontrout and SE-1. Much of these waterways are incorporated in the New Jersey Wild and Scenic River System.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location: Mullica River at Atsion Lake

Dissolved Oxygen: Acceptable.

Temperature: Summer-time temperatures tend to run high. Insteam temperatures around 25° C and higher are commonly recorded.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3) level was characteristic of moderately disturbed Pinelands waters. Current levels may be higher than levels observed at this site by Zampella (1994). The median of organic nitrogen levels was at the high end of levels encountered in moderately disturbed Pinelands waters. Ammonia, in contrast, was at undisturbed levels. Total phosphorus was characteristic of undisturbed Pinelands waters and was consistent with levels observed between 1975 and 1986 (Zampella 1994).

pH and Conductivity: The median pH was between undisturbed and moderately disturbed conditions. Specific conductance was at the lower end of moderately disturbed conditions.

Bacteria: Fecal coliform levels were very low with a geometric mean calculated to be 20 MPN/100ml.

Heavy Metals: Heavy metals violations were frequent in these acid waters, especially during the early period of review. Two of five copper samples exceeded the acute and chronic criteria. Of five lead samples, two exceeded both the acute and chronic criteria, while two others violated the chronic criteria. One violation of the acute and chronic criteria for zinc was recorded (out of five samples).

Summary: Current pH, conductance, and nutrient levels are generally at levels similar to those observed prior to 1986. One concern are the levels of

$NO_2 + NO_3$, which may be slightly on the rise as compared to pre-1987 levels. Another concern is the high summertime in-stream temperatures which may be detrimental to aquatic life. The Mullica as monitored at Atsion Lake represents a moderately disturbed Pinelands waterbody but with the possible exception of inorganic nitrogen, reflects conditions as recorded prior to 1987. Copper, lead and zinc appear to be a problem during the early portion of the current review period. Sanitary quality is very good.

Location: Hammonton Creek at Wescoatville

Dissolved Oxygen: Daytime levels can be very poor; twenty percent of the records between 1991 and 1995 were below 4 mg/l. Because these are daytime recordings, it is assumed that nighttime conditions are much worse, when oxygen generation from photosynthesis is not active.

Nutrients: Levels of total ammonia, organic nitrogen, and inorganic nitrogen were all indicative of severely disturbed Pinelands conditions. The median inorganic nitrogen ($NO_2 + NO_3$) was 2.9 mg/l, with 78% of samples exceeding the 2.0 mg/l criterion.

Median total phosphorus was 0.435 mg/l, and all records exceeded 0.1 mg/l. These phosphorus levels are extremely high, even for northern New Jersey waterbodies, not to mention Pinelands waters.

pH and Conductivity: Both the median pH and specific conductance were indicative of severely disturbed conditions. Almost all pH records were above the 5.5 SU limit for Pinelands waters.

Bacteria: Fecal coliform levels were moderate, with a geometric mean calculated to be 78 MPN/100ml and 25% of the samples exceeding the 400 MPN/100ml criterion.

Heavy Metals: Heavy metals violations were frequent at this location. All five copper samples exceeded both the acute and chronic criteria. All five lead samples violated the chronic criteria for this metal. Finally, two of five zinc records either equaled or closely approached their chronic criteria.

Summary: Hammonton Creek is the only waterway in the Mullica drainage with significant pollution problems. The creek is subjected to a significant municipal point source discharge which still has degraded water quality. The creek at Wescoatville is in very poor condition, with severely reduced dissolved oxygen, elevated nutrients, and pH not reflective of typical Pinelands water. During summer months water quality worsens to yet even poorer conditions. Daytime dissolved oxygen approached 3 mg/l in summer months. Copper, lead, and zinc appear to be a problem at this location.

Regardless of the poor conditions here, some limited water quality improvements have been recorded as reflected in biochemical oxygen demand (BOD), which has been notably reduced as compared to prior assessments. In the prior assessment (1986 through 1990), BOD values were frequently above 4.0 mg/l. Under current conditions, only one record of 20 exceeded 4.0 and the median value was 1.6 mg/l. Upgrades in the Hammonton STP (see Point

Source Assessment, below) are likely to be behind this change. Overall improvements in in-stream water quality, however, in terms of dissolved oxygen, nutrient levels, pH alterations, and metal contamination, have yet to be recorded.

Hammonton Creek has been listed by the Department as an impaired waterway due to toxic discharges emanating from point sources. The contaminants of concern are arsenic, mercury, cadmium, lead, zinc and nickel. The criteria violated are USEPA's Federal Aquatic Life chronic criteria, USEPA's Federal Human Health/water and fish ingestion criteria, and USEPA's Federal human health criteria. Current status must await a re-analysis of conditions.

Location: East Branch Bass River near New Gretna

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3), organic nitrogen, ammonia, and total phosphorus levels were characteristic of undisturbed Pinelands waters (Zampella 1992).

pH and Conductivity: The median pH and specific conductance were characteristic of the lower end of moderately disturbed conditions (Zampella 1992). This should be cause of concern. This station is characterized as indicative of low land use intensity (Zampella 1994) based upon data collected before 1987; hence, any future investigations should focus on more recent (late 1980s to present) water quality trends in dissolved solids at this location.

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be 26 MPN/100ml.

Heavy Metals: Heavy metals violations were frequent in these acid waters, especially during the early period of review. One of five copper samples exceeded the acute and chronic criteria. Of six lead samples, two exceeded both the acute and chronic criteria. Two samples out of six violated the acute and chronic criteria for zinc.

Summary: Current nutrient levels are generally similar to those observed prior to 1987. Of concern are the levels of pH and conductance, which may be slightly higher (indicative of less acid conditions) as compared to pre-1987 levels. Prior to 1987, this location was characteristic of undisturbed Pinelands conditions (Zampella, 1994). Current pH and conductance levels are more suggestive of moderately disturbed conditions. Copper, lead and zinc appear to be a problem during the early portion of the current review period at this location. Sanitary quality is very good.

Location: Batsto River at Batsto

Dissolved Oxygen: Acceptable.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3) level was characteristic of moderately disturbed Pinelands waters (Zampella, 1992), but was higher than the upper third quartile of the distribution recorded by Zampella (1992) using data collected prior to 1987, suggesting that this constituent may be at higher in-stream levels now than in the past.

In contrast, the medians of organic nitrogen and ammonia levels, as well as total phosphorus, were characteristic of undisturbed Pineland levels (Zampella 1992) and similar to conditions observed prior to 1987 (Zampella, 1994).

pH and Conductivity: The median pH was characteristic of the upper end of moderately disturbed conditions (Zampella 1992). Five of twenty records were above the upper (5.5 SU) criterion for Pinelands waters. The current median pH recorded was above the upper (third) quartile reported by Zampella (1994) using data collected prior to 1987. This suggests that the pH levels might be increasing at this location.

Median value for specific conductance was characteristic of the lower end of moderately disturbed conditions (Zampella 1992) and was similar to values recorded from data collected prior to 1987 (Zampella, 1994).

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be 29 MPN/100ml.

Heavy Metals: Heavy metals violations were observed, all during the early period of review. One of five copper samples exceeded the acute and chronic criteria. One of five lead samples exceeded the chronic criteria, and one zinc record (of five) violated both the acute and chronic zinc criteria.

Summary: Organic nitrogen and ammonia levels, as well as total phosphorus, were characteristic of undisturbed Pinelands levels and are similar to conditions observed prior to 1987. The inorganic nitrogen median was characteristic of moderately disturbed Pinelands waters but appeared higher than the distribution recorded from data collected prior to 1987, suggesting that this constituent may be at higher in-stream levels now than in the past.

Also of concern are pH levels which may be slightly higher (indicative of less acid conditions) as compared to pre-1987 levels. Current specific conductance levels are suggestive of moderately disturbed conditions and resemble past records. Copper, lead and zinc appear to be a problem during the early portion of the current review period. Sanitary quality is very good.

Location: Oswego River at Harrisville

Dissolved Oxygen: Acceptable.

Nutrients: Ammonia, organic nitrogen, and total phosphorus medians were all at undisturbed Pinelands levels (Zampella, 1992). Levels currently observed resembled levels observed before 1987 (Zampella, 1994). The median inorganic nitrogen (NO_2 + NO_3), however, was characteristic of moderately disturbed Pinelands waters and may be higher than pre-1987 records.

pH and Conductivity: The median pH and specific conductance were at levels characteristic of undisturbed conditions (Zampella, 1992) and resembled levels observed before 1987 (Zampella, 1994).

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be 21 MPN/100ml.

Heavy Metals: Heavy metals violations were limited to one of three copper samples exceeding the acute and chronic criteria.

Summary: Levels of organic nitrogen and ammonia, as well as total phosphorus, were characteristic of undisturbed Pineland waters and are similar to conditions observed prior to 1987. The inorganic nitrogen median was characteristic of moderately disturbed Pinelands waters and appeared higher than the distribution recorded from data collected prior to 1987, suggesting that this constituent may be at higher in-stream levels now than in the past. Current specific conductance and pH levels are suggestive of undisturbed Pinelands conditions and resemble past records. Copper may be a problem at this location. Sanitary quality is very good.

Location: West Branch of the Wading River at Maxwell

Dissolved Oxygen: Acceptable.

Nutrients: Ammonia, inorganic and organic nitrogen, and total phosphorus medians were all at undisturbed Pinelands levels (Zampella, 1992). Levels currently observed resembled levels observed before 1987 (Zampella, 1994).

pH and Conductivity: The median pH was at levels characteristic of undisturbed conditions (Zampella, 1992), while specific conductance was at the low end of moderately disturbed conditions (Zampella, 1992). Both constituents resembled levels observed before 1987 (Zampella, 1994).

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be 5.5 MPN/100ml.

Summary: Nutrient levels were characteristic of undisturbed Pinelands waters and are similar to conditions observed prior to 1987. The current specific conductance median was characteristic of mildly disturbed Pinelands waters, while pH levels are suggestive of undisturbed conditions. Both are represented at levels similar to those found in previous assessments. Sanitary quality is very good.

Biological Monitoring

The upper and lower Mullica watershed exhibits a mixture of non-impaired and moderately impaired monitoring locations (see the Biological Assessment Table located at the end of this section). Severely impaired sites are very limited within this management area. These sites are the upper Hammonton, Gun Branch in Hammonton, Great Swamp Brook in Winslow Township, Landing Creek in Egg Harbor City, West Branch of the Wading River in Woodland Township, Little Hauken Run and Mattix Run.

POINT SOURCE ASSESSMENT

The Mullica watershed contains surface waters that are extremely sensitive to the effects of man's activities. Both point and nonpoint sources can seriously alter the acid-tolerant stream environments of the watershed.

Reports of deleterious point source discharges are limited to the Hammonton Creek MUA which has historically been severely impacting Hammonton Creek with wastewater discharges of excess nutrients and oxygen-demanding substances and continues to be under enforcement action.

One hazardous waste site has in the past been identified in the Mullica watershed to be contaminating local surface waters. This is Woodland Chemical Dumps 1 and 2 near Chatsworth. The dumps were suspected of releasing volatile organics, pesticides, and metals to nearby cranberry bogs. The following wastewater treatment plant has been upgraded and/or expanded and renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Hammonton STP	Hammonton, Atlantic Co.	Hammonton Creek	Substantial plant upgrades were completed in June 1994. Water quality is still impacted based upon water quality sampling, especially for pH, phosphorus and ammonia. A permitting decision is pending as to whether the discharge will continue to surface water or if Hammonton will be required to discharge to ground water.

NONPOINT SOURCE ASSESSMENT

Agricultural and suburban runoff can have significant impacts on the water quality of Pinelands waters by adding nutrients and raising stream pH. This appears to be occurring throughout the Pinelands region in various waterways.

The Upper Mullica is reported to suffer water quality problems caused by moderate amounts of nonpoint source contamination from construction activities, surface mining and landfills. Also reported is a problem with ditch bank erosion in drainage ditches associated with cropland areas. The Upper Mullica, Sleeper Branch, Gum Branch, and Albertsons Branch are all suspected of being impacted by road and highway runoff.

In the Mid-Mullica, runoff from croplands has been suspected to be an occasional water quality problem, although it was reported to be on the decline. As in the Upper Mullica, there are problems with ditch bank erosion. Hammonton Creek is suspected of being impacted on occasion by leachate from land disposal sites, urban runoff, as well as runoff from construction sites. Landing Creek, Indian Cabin Creek, and Union Creek are all reported to be impacted by moderate amounts of urban stormwater runoff. Landing Creek is also suspected to be impacted by occasional leachate from local landfills.

In the Lower Mullica/Great Bay sub-watersheds, the Wading River has been suspected of being severely impacted by hazardous waste sites. The problem had been reported to be increasing and impairing the local fisheries. Surface mining, although evaluated as being in decline, is known to be causing occasional turbidity in Morses Mill Creek, a tributary to Great Bay. Matix Run, also a Great Bay tributary, is suspected of being impacted by runoff from housing construction sites and stormwater. To the northeast, the Oswego River is reported by local authorities to have no observable nonpoint source pollution problems.

The only lake evaluated in the Mullica watershed was Hammonton Lake. Here, runoff from urban surfaces, roads, and storm sewers is believed to be impacting the lake's water quality.

DESIGNATED USE ASSESSMENT

Five of the six physical/chemical monitoring locations (Mullica, Bass, Batsto, Oswego, and Wading Rivers) indicate very good sanitary quality and full support of the primary contact (swimming) designated use. Only Hammonton Creek at Wescoatville shows marginal sanitary quality and only partially supports the use.

Most waters in the Mullica River system either fully support or partially support the aquatic life support designated use. There are some exceptions where there is severe impairment and no support of use, and these are delineated above in the discussion of biological monitoring.

Tidal sections of the Mullica River and tributaries are classified as "special restricted," "seasonal," or "fully approved" with regard to shellfish harvesting, depending on location. The Mullica itself is classified as special restricted above Moss Point. Between Moss Point and Doctors Point, the waters are "seasonal restricted." Downstream of Doctors Point, the waters are "fully approved" for shellfish harvesting. The Mullica system ultimately flows into Great Bay where the waters are classified as "fully approved" for shellfish harvesting.

BIOLOGICAL ASSESSMENT TABLE: AREA 14

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
14	80	AN0560	Mullica R	Jackson - Medford Rd	Waterford Twp	Mar 9, 1995	moderately impaired
14	80	AN0561	Mullica R	Jackson Rd	Waterford Twp	Mar 9, 1995	moderately impaired
14	80	AN0562	Mullica R	Burnt House Rd	Shamong Twp	Mar 9, 1995	non-impaired
14	80	AN0563	Wesickamon Ck	Atsion-Quakerbridge Rd	Atsion	Feb 23, 1995	moderately impaired
14	80	AN0564	Mullica R	Constable Bridge	Mullica Twp	Feb 23, 1995	moderately impaired
14	80	AN0565	Hays Mill Ck	Tremont Ave	Waterford Twp	Mar 16, 1995	non-impaired
14	80	AN0566	Sleeper Br	Parkdale	Waterford Twp	Mar 16, 1995	non-impaired
14	80	AN0567	Clarks Br	Burnt Mill Rd	Waterford Twp	Mar 16, 1995	moderately impaired
14	80	AN0568	Prices Br	Burnt Mill Rd	Waterford Twp	Apr 4, 1991	moderately impaired
14	80	AN0568	Prices Br	Burnt Mill Rd	Waterford Twp	Mar 16, 1995	moderately impaired
14	80	AN568G	Gun Br	Rt 206	Hammonton	Jan 29, 1992	severely impaired
14	80	AN0569	Pump Br	Old White Horse Pike	Winslow Twp	Mar 23, 1995	moderately impaired
14	80	AN0570	Blue Anchor Bk	Rt 30	Winslow Twp	Mar 28, 1995	moderately impaired
14	80	AN0571	Albertson Bk	Wharton Ave	Waterford Twp	Mar 23, 1995	moderately impaired
14	80	AN0572	Albertson Bk	Old Bridge Crossing	Hammonton	Mar 23, 1995	non-impaired
14	80	AN0573	Gr Swamp Br	Rt 30	Winslow Twp	Mar 23, 1995	severely impaired
14	80	AN0574	Gr Swamp Br	Rt 206	Hammonton	Mar 16, 1995	non-impaired
14	80	AN0575	Cedar Bk	Myrtle Ave	Hammonton	Mar 23, 1995	moderately impaired
14	80	AN0576	Nescochague Ck	Pleasant Mills	Mullica Twp	Mar 28, 1995	non-impaired
14	80	AN0577	Hammonton Ck	Boyer Rd (blw STP)	Hammonton	Jan 29, 1992	severely impaired
14	80	AN577A	Hammonton Ck	Rt 542 (abv STP)	Hammonton	Jan 29, 1992	moderately impaired
14	80	AN0578	Hammonton Ck	Columbia Rd	Mullica Twp	Jan 29, 1992	non-impaired
14	70	AN0579	Batsto R	Carranza Rd	Shamong Twp	Feb 16, 1995	non-impaired
14	70	AN0580	Roberts Br	Carranza Rd	Shamong Twp	Feb 16, 1995	moderately impaired
14	70	AN0581	Skit Br	Carranza Rd	Shamong Twp	Jan 23, 1992	moderately impaired
14	70	AN0581	Skit Br	Carranza Rd	Shamong Twp	Feb 16, 1995	moderately impaired
14	70	AN0582	Indian Mills Bk	Willow Grove Rd	Indian Mills	Feb 16, 1995	moderately impaired
14	70	AN0583	Muskingum Bk	Tabernacle Rd	Indian Mills	Feb 22, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
14	70	AN0584	Springers Bk	Rt 206	Shamong Twp	Feb 16, 1995	moderately impaired
14	70	AN0585	Springers Bk	Hampton Rd	Shamong Twp	Feb 16, 1995	moderately impaired
14	70	AN0586	Batsto R	Quaker Bridge	Washington Twp	Feb 22, 1995	moderately impaired
14	70	AN0587	Penn Swamp Br	Quaker Bridge - Batsto Rd	Washington Twp	Feb 22, 1995	non-impaired
14	70	AN0587	Penn Swamp Br	Quaker Bridge - Batsto Rd	Washington Twp	May 12, 1995	moderately impaired
14	70	AN0587	Penn Swamp Br	Quaker Bridge - Batsto Rd	Washington Twp	Aug 8, 1995	non-impaired
14	70	AN0587	Penn Swamp Br	Quaker Bridge - Batsto Rd	Washington Twp	Nov 2, 1995	non-impaired
14	70	AN0588	Batsto R	Rt 542	Batsto	Feb 22, 1995	non-impaired
14	80	AN0589	Lucas Br	Pleasant Mills - Weekstown Rd	Mullica Twp	Mar 28, 1995	non-impaired
14	80	AN0590	Landing Ck	Rt 30	Egg Harbor City	Apr 6, 1995	severely impaired
14	80	AN0591	Elliots Ck	Bremen Ave	Egg Harbor City	Mar 28, 1995	non-impaired
14	80	AN0592	Landing Ck	Indian Cabin Rd	Mullica Twp	Mar 28, 1995	non-impaired
14	80	AN0593	Indian Cabin Ck	Fifth Ave	Mullica Twp	Apr 6, 1995	moderately impaired
14	80	AN0594	Indian Cabin Ck	EHC Lk outlet	Egg Harbor City	Mar 28, 1995	non-impaired
14	66	AN0595	Wading R W Br	Rt 532	Woodland Twp	Jan 24, 1995	severely impaired
14	66	AN0596	Wading R W Br	Rt 563	Washington Twp	Apr 4, 1991	severely impaired
14	66	AN0596	Wading R W Br	Rt 563	Washington Twp	Jan 24, 1995	moderately impaired
14	66	AN0597	Shoal Br	Jones Mill Rd	Woodland Twp	Jan 26, 1995	moderately impaired
14	66	AN0598	Mile Run	Hawkins - Speedwell Rd	Washington Twp	Jan 26, 1995	moderately impaired
14	66	AN0599	Tulpehocken Ck	Carranza Rd	Tabernacle Twp	Jan 23, 1992	moderately impaired
14	66	AN0600	Tulpehocken Ck	Maxwell - Friendship Rd	Washington Twp	Jan 26, 1995	moderately impaired
14	66	AN0601	Ltl Hauken Run	Rt 563	Washington Twp	Jan 24, 1995	severely impaired
14	66	AN0602	Wading R W Br	Rt 563	Washington Twp	Jan 24, 1995	non-impaired
14	66	AN0603	Oswego R	Rt 539	Barnegat Twp	Jan 18, 1995	moderately impaired
14	66	AN0604	Plains Br	Jenkins Rd	Bass R Twp	Jan 18, 1995	non-impaired
14	66	AN0605	Papoose Br	Jenkins Rd	Washington Twp	Jan 18, 1995	non-impaired
14	66	AN0606	Oswego R	Andrews Rd	Oswego Lk	Jan 18, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
14	66	AN0607	Oswego R	Spur 563	Harrisville	May 16, 1991	non-impaired
14	66	AN0607	Oswego R	Spur 563	Harrisville	Sep 23, 1991	non-impaired
14	66	AN0607	Oswego R	Spur 563	Harrisville	Dec 9, 1991	non-impaired
14	66	AN0607	Oswego R	Spur 563	Harrisville	Mar 3, 1992	moderately impaired
14	66	AN0608	Arnolds Br	Spur 563	Bass R Twp	Jan 12, 1995	moderately impaired
14	66	AN0609	Tub Mill Br	Spur 563	Bass R Twp	Jan 12, 1995	moderately impaired
14	66	AN0610	Bass R W Br	Stage Rd	Bass R Twp	Jan 12, 1995	non-impaired
14	66	AN0611	Dan's Bridge Br	Dan's Bridge Rd	Bass R Twp	Jan 12, 1995	non-impaired
14	66	AN0612	Bass R E Br	Stage Rd	Bass R Twp	Jan 12, 1995	non-impaired
14	66	AN0613	Clarks Mill Stream	Rt 575	Port Republic	Apr 6, 1995	non-impaired
14	66	AN0614	Morses Mill Stream	Riverside Dr	Port Republic	Apr 6, 1995	non-impaired
14	66	AN0615	Mattix Run	Moss Mill Rd	Galloway Twp	Apr 6, 1995	severely impaired

WATERSHED MANAGEMENT AREA 15
GREAT EGG HARBOR RIVER DRAINAGE

The watershed management area includes watersheds draining to Great Egg Harbor Bay in Atlantic County. The management area encompasses waters draining eastern Gloucester and Camden Counties. The area includes the following watersheds:

Great Egg Harbor River
Tuckahoe River
Absecon Creek
Patcong Creek

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Great Egg Harbor River near Sicklerville	FW-2 Nontrout/Pinelands
Great Egg Harbor River at Folsom	Pinelands Waters
Great Egg Harbor River at Weymouth	Pinelands Waters

The following monitoring location has been discontinued as of 1991:

Great Egg Harbor River near Blue Anchor (Pinelands Waters)

OVERALL MANAGEMENT AREA ASSESSMENT

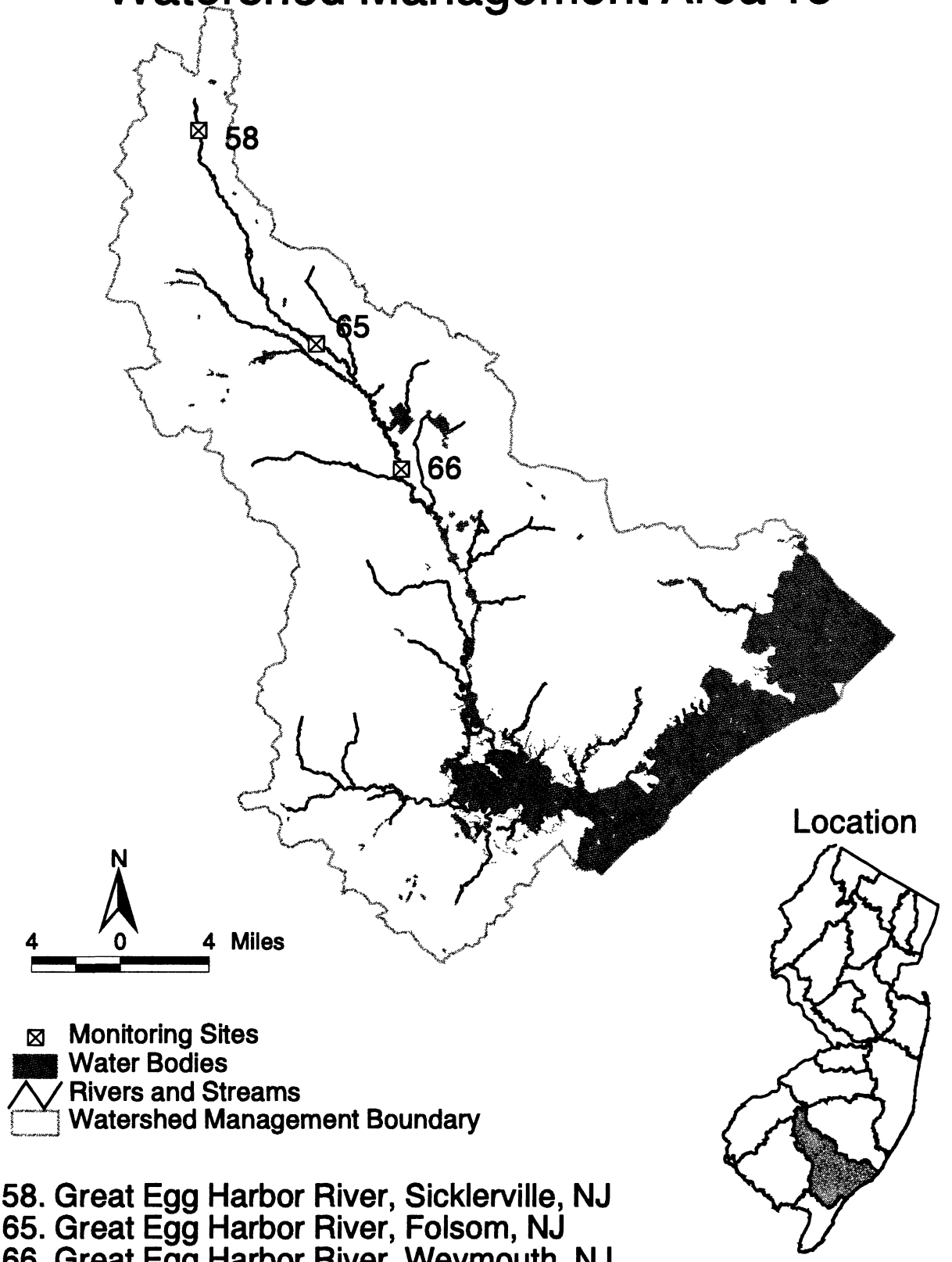
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Great Egg Harbor River	near Sicklerville	Full Support
Great Egg Harbor R	at Folsom	Full Support
Great Egg Harbor R	at Weymouth	Full Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 14 Mod. Impairment: 21 Severe Impairment: 2

Great Egg Harbor, Tuckahoe Watershed Management Area 15



58. Great Egg Harbor River, Sicklerville, NJ
65. Great Egg Harbor River, Folsom, NJ
66. Great Egg Harbor River, Weymouth, NJ

GREAT EGG HARBOR RIVER

WATERSHED DESCRIPTION

The Great Egg Harbor River is 49 miles long and drains an area of 304 square miles. It originates in eastern Gloucester and Camden Counties, an agricultural and suburban area, before flowing through the Pinelands region. The river drains into Great Egg Harbor Bay before emptying into the Atlantic Ocean. The river is tidal downstream of the dam at Mays Landing.

The watershed's dominate land use is forests, with the remainder agricultural and developed. Population centers include Berlin, Winslow, Monroe, Mays Landing and Egg Harbor City. The major tributaries are Hospitality Branch, Watering Race, Babcock Creek, Deep Run, South River and Stephens Creek. There are many lakes and ponds in this area, but the largest is Lake Lenape, near Mays Landing. Of the approximately 12 NJPDES permitted dischargers here, about half are municipal and half are industrial/commercial. Waters in the Great Egg Harbor watershed are classified FW-2 Nontrout, Pinelands Waters, FW-1 and SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Gt. Egg Harbor River nr Sicklerville

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3) level was characteristic of disturbed Pinelands waters. Current levels appear to be lower than levels observed prior to 1987 at this site by Zampella (1994). The median of organic nitrogen level was at the level encountered in moderately disturbed Pinelands waters (Zampella 1992). Ammonia, in contrast, was at undisturbed levels and was notably less than the levels observed prior to 1987. Total phosphorus was characteristic of moderately disturbed Pinelands waters and is currently much lower than levels observed between 1975 and 1986 (Zampella 1994).

pH and Conductivity: The median pH was at disturbed conditions. Eighty-four percent of samples (19) were above the upper (5.5 SU) criterion for Pinelands waters. Specific conductance was between moderately disturbed and disturbed conditions (Zampella 1992). Medians for both constituents appear to be slightly lower levels as compared to levels observed between 1975 and 1986 (Zampella 1994), suggesting that water quality may be improving.

Gt. Egg Harbor River nr Sicklerville continued:

Heavy Metals: Heavy metals violations were frequent in these acid waters. Two of five copper samples exceeded both the acute and chronic criteria; one additional sample exceeded the chronic criteria. Of five lead samples, three exceeded the chronic criteria, while one other closely approached the chronic criteria. Two violations of the acute and chronic criteria for zinc were recorded (out of five samples). One of five arsenic samples may be violating the human health criterion.

Bacteria: Fecal coliform levels were low, with a geometric mean calculated to be 32 MPN/100ml.

Locations: Gt. Egg Harbor River at Folsom

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3) level was characteristic of disturbed Pinelands waters (Zampella 1992). The median of organic nitrogen was at a level encountered in moderately disturbed to disturbed Pinelands waters (Zampella 1992). Ammonia, in contrast was at undisturbed levels. Total phosphorus was characteristic of moderately disturbed Pinelands (Zampella 1992); twenty-eight percent of samples exceeded the 0.05 mg/l criterion for phosphorus applied at this location.

pH and Conductivity: The median pH was representative of disturbed conditions (Zampella 1992). Seventy-eight percent of total samples (18) were above the upper (5.5 SU) criterion for Pinelands waters. Specific conductance was representative of moderately disturbed conditions (Zampella 1992).

Heavy Metals: Heavy metals violations were frequent. All four copper samples exceeded both the acute and chronic criteria. Of four lead samples, two exceeded the chronic criterion. One violation of the acute criterion for zinc was recorded (out of four samples); one other sample closely approached but did not exceed either the acute or chronic criteria for this metal.

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be 23 MPN/100ml.

Locations: Gt. Egg Harbor River at Weymouth

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3) level was characteristic of disturbed Pinelands waters. Current levels appear to be slightly higher than levels observed prior to 1987 at this site by Zampella (1994). The median of organic nitrogen was at levels encountered in moderately disturbed Pinelands waters (Zampella 1992). Median level of ammonia, in contrast, was at undisturbed levels and appeared to be at the same level as that observed prior to 1987.

Gt. Egg Harbor River at Weymouth continued:

Total phosphorus was characteristic of undisturbed Pinelands waters and currently appears to be slightly lower than levels observed between 1975 and 1986 (Zampella 1994). Two of nineteen samples exceeded the 0.05 mg/l criterion applicable to locations upstream of impoundments.

pH and Conductivity: The median pH was representative of disturbed conditions (Zampella 1992). Sixty-three percent of total samples (19) were above the upper (5.5 SU) criterion for Pinelands waters. Specific conductance was representative of moderately disturbed conditions (Zampella 1992). Medians for both constituents appear to be at the same levels as those observed between 1975 and 1986 (Zampella 1994).

Heavy Metals: All three copper samples exceeded both the acute and chronic criteria. Of three lead samples, one exceeded both the acute and the chronic criteria. One zinc violation of the acute and chronic criteria was recorded, again out of three samples.

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be 17 MPN/100ml.

Summary: The Great Egg Harbor River as monitored near Sicklerville, at Folsom, and at Weymouth is characteristic of a Pinelands waterbody exhibiting varying degrees of disturbance. The degree of disturbance declines as one proceeds downstream from Sicklerville.

Water quality has improved dramatically at Sicklerville based upon comparisons with nutrient, BOD, and dissolved oxygen data collected in 1986 and 1991. Water quality has also improved at Folsom and at Weymouth, where total phosphorus has declined as compared to the same previous assessment. Sanitary quality is good at all three locations. Copper, lead and zinc appear to be a problem at all three locations and should undergo further investigations using clean sampling techniques. In addition, the degree of toxicity of the dissolved metal fraction may need to be determined within this tannic-rich environment.

Biological Monitoring:

The Great Egg Harbor and Tuckahoe River watersheds exhibit a mixture of non-impaired and moderately impaired monitoring locations as does the Mullica watershed to the north. The Great Egg/Tuckahoe system, however, contains far fewer severely impaired locations (all are within the Great Egg watershed). Here, severe impairment is limited to the Great Egg as assessed at the Camden County Park in 1992, Deep Run in Buena and Stephens Creek in Estellville. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Many of the past water quality problems in the Great Egg Harbor River appear to have been related to point source discharges in the upper

watershed; however, a number of enforcement cases have led to improvements in many of these facilities. The Berlin Borough STP, which has been a problem in the past, has been converted into a pump station with the effluent now being processed at the Camden County MUA in Camden. The effluent is now discharged directly into the Delaware River. The Buena Borough STP has been upgraded (see table below). No facilities are currently reported as undergoing enforcement action at the present time within the Great Egg Harbor River Watershed.

The following wastewater treatment plant has been upgraded and/or expanded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Buena Borough STP	Atlantic Co.	Deep Run	Plant was substantially upgraded and operational in early 1992.

NONPOINT SOURCE ASSESSMENT

Runoff from croplands is suspected to be impacting the entire length of the Great Egg Harbor River above Mays Landing. Additional pollution sources in this watershed are believed to be from surface mining, which impact the uppermost reaches of the river, and sediment loads, which result from ditch bank erosion occurring in the small tributary streams that flow into the Great Egg Harbor River in the region around Lake Lenape. Below Mays Landing, nonpoint source pollution is believed to shift from agricultural sources to suburban development - storm sewers, road surfaces and septic systems.

In the assessed tributaries feeding into the Upper Great Egg Harbor River, stormwater runoff and suburban development appear to be the major contributors of nonpoint source pollution. Squankum Branch and Four Mile Branch are both suspected of being impacted by stormwater runoff. Water quality in Hospitality Branch is believed to be affected by stormwater/road runoff. In addition, surface mining is reported to be a known, yet declining, source of sedimentation in the Hospitality Branch. Babcock Creek is undergoing excessive sedimentation; the suspected sources are runoff from animal holding areas, construction sites, surface mines, and outfalls from combined sewers. Local authorities have reported, however, that these problems in Babcock Creek are presently on the decline. Gravelly Run and Miry Run are both suspected of receiving sediment loads. Mill Branch is suspected of being impacted by housing construction and combined sewers. Maple Run is reported to be affected by siltation, known sources of which are construction and stream channelization occurring in the watershed. Patcong River receives sediment, which is suspected of coming from local storm sewers.

Of the lakes assessed in the Great Egg Harbor River Watershed, Colling Lake is reported to be receiving septic system leachate and road runoff. Lake Lenape is believed to be impacted by road and cropland runoff. Patcong Lake is "silting in" from runoff; the suspected source is housing construction and suburban surfaces.

DESIGNATED USE ASSESSMENT

The monitored portions of the Great Egg Harbor River will fully support the swimmable (primary contact) use based upon levels of fecal coliform bacteria.

Waters in the Great Egg Harbor/Tuckahoe River system either fully support or partially support the aquatic life support designated use. There are just a few exceptions where there is severe impairment and no support of use, and these are delineated above in the discussion of biological monitoring.

The uppermost tidal sections of the Great Egg Harbor River are classified as condemned for the direct harvesting of shellfish. Below the confluence with Powell Creek the river's shellfish classification becomes either special restricted or seasonal. At a point just upstream of the confluence with the Tuckahoe River going downstream and including the Great Egg Harbor Bay, the waters are fully approved for shellfishing.

Other estuaries within the management area are classified for shellfish harvesting as follows; Absecon and Lakes Bay are largely "seasonally approved," while Reed and Scull Bay are both fully approved.

BIOLOGICAL ASSESSMENT TABLE: AREA 15

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
15	91	AN0620	Gr Egg Harbor R	Watsontown-New Freedom Rd	Berlin	May 31, 1995	moderately impaired
15	91	AN620A	Gr Egg Harbor R	Camden Co Pk	Berlin	Mar 10, 1992	severely impaired
15	91	AN0621	Gr Egg Harbor R	Williamstown - New Freedom Rd	Winslow Twp	Mar 10, 1992	non-impaired
15	91	AN0621	Gr Egg Harbor R	Williamstown - New Freedom Rd	Winslow Twp	Sep 9, 1992	non-impaired
15	91	AN0621	Gr Egg Harbor R	Williamstown - New Freedom Rd	Winslow Twp	Dec 8, 1992	non-impaired
15	91	AN0621	Gr Egg Harbor R	Williamstown - New Freedom Rd	Winslow Twp	Mar 26, 1993	non-impaired
15	91	AN0621	Gr Egg Harbor R	Williamstown - New Freedom Rd	Winslow Twp	Jun 3, 1993	non-impaired
15	91	AN0622	Four Mile Br	Malaga Rd (Rt 536)	Monroe Twp	Mar 10, 1992	moderately impaired
15	91	AN0623	Gr Egg Harbor R	Williamstown - Winslow Rd	Winslow Twp	Mar 10, 1992	non-impaired
15	91	AN0623	Gr Egg Harbor R	Williamstown - Winslow Rd	Winslow Twp	Sep 9, 1992	non-impaired
15	91	AN0623	Gr Egg Harbor R	Williamstown - Winslow Rd	Winslow Twp	Dec 8, 1992	non-impaired
15	91	AN0623	Gr Egg Harbor R	Williamstown - Winslow Rd	Winslow Twp	Mar 26, 1993	moderately impaired
15	91	AN0623	Gr Egg Harbor R	Williamstown - Winslow Rd	Winslow Twp	Apr 13, 1993	non-impaired
15	91	AN0623	Gr Egg Harbor R	Williamstown - Winslow Rd	Winslow Twp	Jun 3, 1993	non-impaired
15	91	AN0624	Squankum Br	Malaga Rd	Monroe Twp	Mar 10, 1992	moderately impaired
15	91	AN0625	Gr Egg Harbor R	Rt 54	Folsom	Mar 10, 1992	non-impaired
15	91	AN0625	Gr Egg Harbor R	Rt 54	Folsom	Sep 9, 1992	non-impaired
15	91	AN0625	Gr Egg Harbor R	Rt 54	Folsom	Dec 8, 1992	non-impaired
15	91	AN0625	Gr Egg Harbor R	Rt 54	Folsom	Apr 13, 1993	non-impaired
15	91	AN0625	Gr Egg Harbor R	Rt 54	Folsom	Jun 3, 1993	non-impaired
15	91	AN0626	Penny Pot Stream	Eighth St	Folsom Twp	Mar 10, 1992	non-impaired
15	91	AN0627	Hospitality Br	Blue Bell Rd	Monroe Twp	May 31, 1995	moderately impaired
15	91	AN0628	Hospitality Br	Rt 538	Monroe Twp	May 23, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
15	91	AN0629	Faraway Br	Jackson Rd	Monroe Twp	Mar 26, 1991	moderately impaired
15	91	AN0629	Faraway Br	Jackson Rd	Monroe Twp	May 23, 1995	moderately impaired
15	91	AN0630	White Oak Br	Jackson Rd	Monroe Twp	May 23, 1995	moderately impaired
15	91	AN0631	Collings Br	Unexpected Rd	Franklin Twp	May 31, 1995	moderately impaired
15	91	AN0632	Collings Br	Blue Anchor Rd	Buena Vista Twp	May 23, 1995	non-impaired
15	91	AN0633	Hospitality Br	Rt 54	Folsom	Mar 10, 1992	non-impaired
15	91	AN0634	Three Pond Run	Rt 54	Folsom	May 23, 1995	moderately impaired
15	91	AN0635	Gr Egg Harbor R	Rt 559	Weymouth	Mar 11, 1992	non-impaired
15	91	AN0635	Gr Egg Harbor R	Rt 559	Weymouth	Sep 9, 1992	non-impaired
15	91	AN0635	Gr Egg Harbor R	Rt 559	Weymouth	Dec 8, 1992	non-impaired
15	91	AN0635	Gr Egg Harbor R	Rt 559	Weymouth	Apr 13, 1993	non-impaired
15	91	AN0635	Gr Egg Harbor R	Rt 559	Weymouth	Jun 3, 1993	non-impaired
15	91	AN635H	Gr Egg Harbor R trib	2nd Ave	Hammonton	Apr 3, 1991	moderately impaired
15	91	AN0636	Deep Run	Rt 54	Buena	Mar 11, 1992	severely impaired
15	91	AN0637	Deep Run	Rt 559	Hamilton Twp	Mar 11, 1992	moderately impaired
15	91	AN0638	Mare Run	Rt 559	Hamilton Twp	May 16, 1995	moderately impaired
15	91	AN0639	Watering Race	Rt 50	Hamilton Twp	Apr 11, 1995	moderately impaired
15	91	AN0640	Babcock Ck	Rt 322	Hamilton Twp	May 9, 1995	moderately impaired
15	91	AN0641	Gravelly Run	Rt 559	Hamilton Twp	May 9, 1995	moderately impaired
15	91	AN0642	Miry Run	Thelma Ave	Egg Harbor Twp	May 9, 1995	moderately impaired
15	91	AN0643	So. R	Estelle Ave	Hamilton Twp	May 16, 1995	non-impaired
15	91	AN0644	So. R	Forty Wire Rd	Weymouth Twp	May 16, 1995	non-impaired
15	91	AN0645	Stephens Ck	Eleventh Ave	Estell Manor Twp	May 16, 1995	non-impaired
15	91	AN0646	Stephens Ck	Rt 50	Estellville	May 9, 1995	severely impaired
15	91	AN0647	Gibson Ck	Rt 50	Estell Manor Twp	May 9, 1995	non-impaired
15	94	AN0648	Tuckahoe R	Cumberland Ave	Estell Manor Twp	Jun 1, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
15	94	AN0649	Tuckahoe R	Rt 49	Hunters Mill (Estell Manor Twp)	Jun 1, 1995	non-impaired
15	94	AN0649	Tuckahoe R	Rt 49	Hunters Mill (Estell Manor Twp)	Sep 12, 1995	non-impaired
15	94	AN0649	Tuckahoe R	Rt 49	Hunters Mill (Estell Manor Twp)	Jan 4, 1996	non-impaired
15	94	AN0650	Tuckahoe R	Rt 49	Head of River (Estell Manor Twp)	Jun 1, 1995	non-impaired
15	94	AN0651	McNeals Br	Rt 666	Head of River (Estell Manor Twp)	Jun 1, 1995	non-impaired
15	94	AN0651	McNeals Br	Rt 666	Head of River (Estell Manor Twp)	Sep 12, 1995	non-impaired
15	94	AN0651	McNeals Br	Rt 666	Head of River (Estell Manor Twp)	Jan 4, 1996	non-impaired
15	94	AN0652	Mill Ck	Rt 557	U Twp	Jun 1, 1995	moderately impaired

WATERSHED MANAGEMENT AREA 16

CAPE MAY DRAINAGE

The watershed management area includes watersheds draining the Cape May portion of New Jersey. The region includes Cape May County south and east of the Tuckahoe River watershed. The region contains minimal surface water flow. Ground water and shellfish harvesting water quality are the principal water issues. No fixed physical/chemical fresh (surface) water monitoring locations are currently located within this management area. The area includes the following watersheds:

Dennis Creek	Delaware Bay Coastal Drainage	Cape May Atlantic Coastal Drainage

Cape May County is located at the southern-most point of New Jersey and represents a continuation of the Atlantic Coastal Plain. The county is 267 square miles in area and is bounded on the north by Atlantic and Cumberland Counties, on the east by the Atlantic Ocean and on the west and south by the Delaware Bay. The region represents a low lying, gently rolling plain whose highest point is 54 feet above sea level and whose surface is largely covered by wet soils and wetlands. Large swamps (Great Cedar, Timber and Beaver Swamps) occupy the north-central part of the county. Most, if not all, streams are tidal in their lower reaches and terminate by flowing into fresh water swamps that, in turn, discharge into saltwater marshes near the shore.

The county's permanent year-round population is about 77,000, with approximately 42 percent of the population residing on the barrier islands that comprise the eastern perimeter of the peninsula. The summertime population rises to 564,000, with 69 percent residing on the barrier islands.

As stated previously, one of the principal water resource issues within this management area is drinking water supply. The resource is largely dependent upon ground water that is in turn highly vulnerable to saltwater intrusion from the west, south and east, especially in the southern portion of the peninsula. The expected increase in population (an expected 68 percent increase by 2040) is predicted to put further stress on the already overextended water supply.

OVERALL MANAGEMENT AREA ASSESSMENT

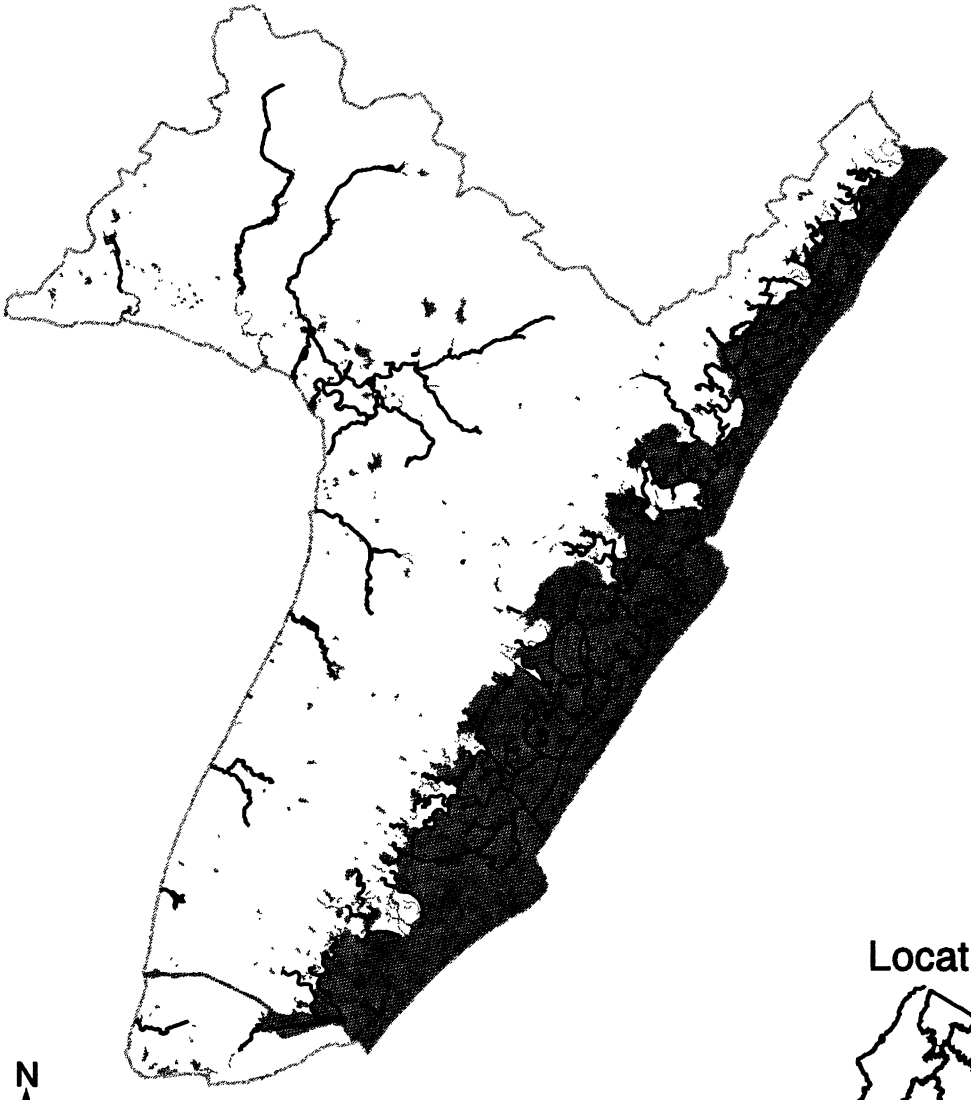
- Swimmable Support Status: Status on inland waters not reported here; no fixed physical/chemical fresh water monitoring locations are currently located within this region.

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment

Table located at the end of this section for details regarding macroinvertebrate assessments within the management area.

No Impairment: 0 Mod. Impairment: 2 Severe Impairment: 4

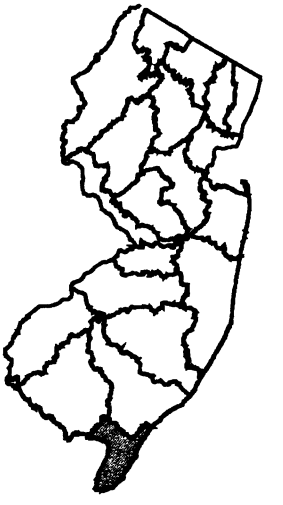
Cape May
Watershed Management Area 16



4 0 4 Miles

Rivers and Streams
Water Bodies
Watershed Management Boundary

Location



No Monitoring Sites in this Area.

WATER QUALITY ASSESSMENT

Nontidal surface water quality assessments in this region are limited to in-stream macroinvertebrate assessments on streams in the northwestern part of the county and the western drainage of the peninsula (see the Biological Assessment Table located at the end of this section). Most monitoring locations were assessed as severely impaired. Moderate impairment was observed at two locations - West Creek in Maurice Township and Savage Run in Dennis Township.

Shellfish classifications within the coastal estuary and bay network of the region include approved, seasonal, special restricted, and prohibited waters, depending on location. A somewhat simpler pattern exists in the ocean waters where large tracts of water are classified as either approved or prohibited.

Of particular concern in Cape May is the saltwater encroachment that is occurring in the shallow aquifer system within the peninsula as a result of increasing withdrawals for public supply. This has necessitated the abandonment and sealing of formerly productive freshwater wells. This shallow aquifer system consists of three aquifers - a water table aquifer, and two confined aquifers (estuarine sand and the Cohansey). Large withdrawals of water for public supply from the two confined aquifers at the Rio Grande, Cape May City and Lower Township well fields have lowered ground-water levels below sea level in a large area of the peninsula and offshore, causing an inward migration of saline ground water towards these wellfields. Large withdrawals from the deeper Atlantic City 800-foot sand aquifer in Cape May, Atlantic and Ocean Counties (a fourth aquifer system that underlies the three systems mentioned above) will likely impact wells in southern Cape May County. This impact is not expected, however, for several decades and perhaps for several hundred years.

DESIGNATED USE ASSESSMENT

Most assessed fresh water locations fail to support the aquatic life support designated use. Some locations partially support the use; no assessed locations were found to fully support this use. All freshwater public bathing areas in this region are monitored by the Cape May County Health Department for sanitary conditions reflecting swimmable quality. Readers interested in local sanitary water quality are directed to this agency.

Support of shellfish harvesting, both in the bays and ocean, range from full to no support, depending upon location.

BIOLOGICAL ASSESSMENT TABLE: AREA 16

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
16	93	AN0765	W Ck	Rt 550	Maurice R Twp	Feb 22, 1996	moderately impaired
16	93	AN0766	Savages Run	Sunset Rd	Dennis Twp	Feb 22, 1996	moderately impaired
16	93	AN0767	Dennis Ck trib	Rt 47 (blw Dennisville Lk)	Dennis Twp	Feb 27, 1996	severely impaired
16	93	AN0769	Old Robins Br	Beaver Causeway	Dennis Twp	Feb 29, 1996	severely impaired
16	96	AN0770	Green Ck	Rt 47	Middle Twp	Feb 27, 1996	severely impaired
16	96	AN0771	Fishing Ck	Rt 47	Middle Twp	Feb 27, 1996	severely impaired

WATERSHED MANAGEMENT AREA 17
DELAWARE BAY DRAINAGE

The watershed management area includes watersheds draining Delaware Bay except those in Cape May County. The principal rivers here are the Maurice, Salem, and Cohansey. The area overlies Salem and Cumberland Counties and includes the following watersheds:

Maurice River
Mill Creek
Alloways Creek
Manantico Creek
Stow Creek
Salem River (Creek)
Dividing Creek
Manumuskin Creek
Cohansey River
Miles Creek

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Salem River at Woodstown	FW-2 Nontrout
Cohansey River at Seeley	FW-2 Nontrout
Maurice River at Norma	FW-2 Nontrout
Maurice River near Millville	FW-2 Nontrout

The following monitoring location has been discontinued as of 1991:

Salem River at Courses Landing (FW-2 Nontrout)

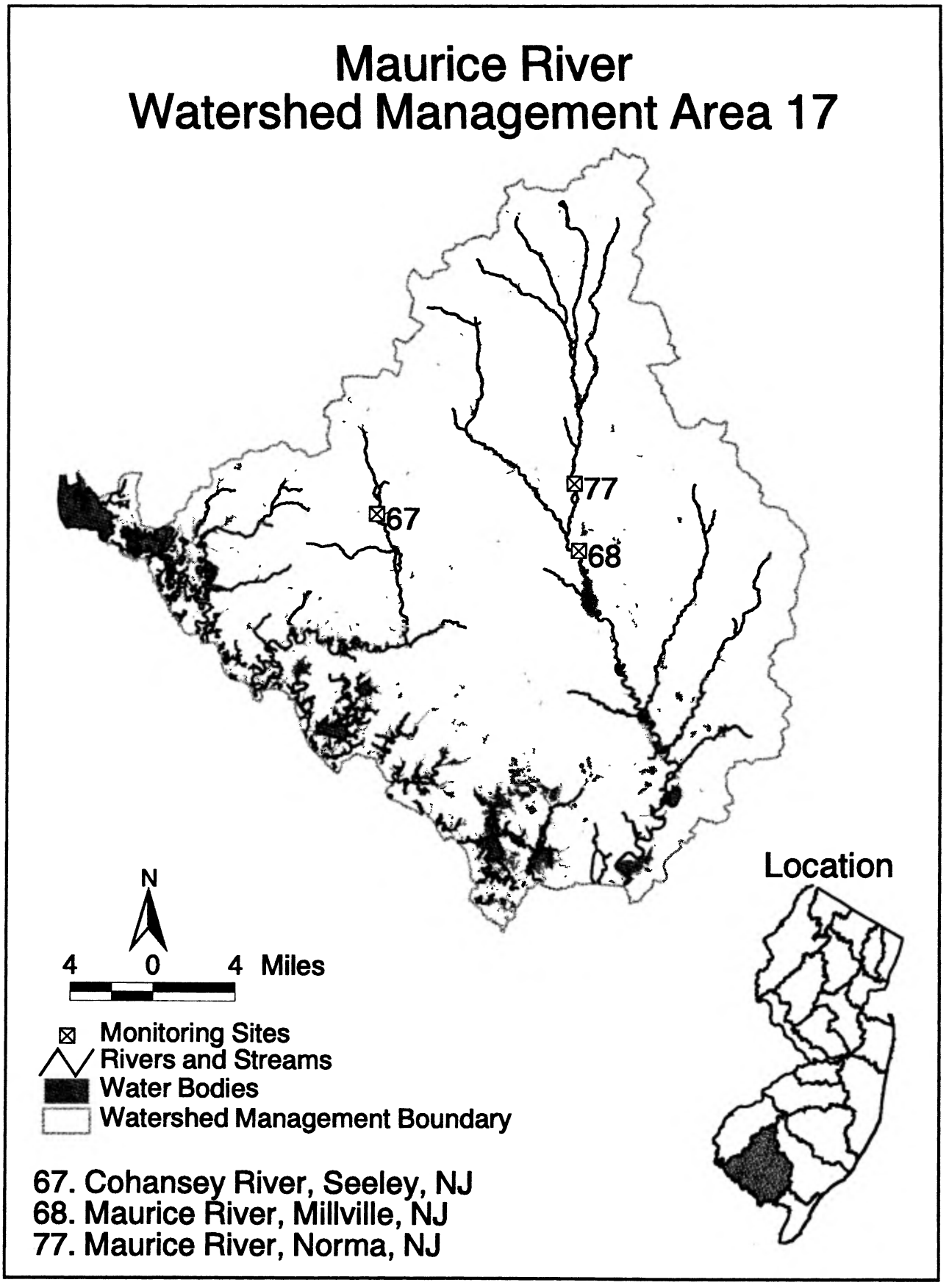
OVERALL MANAGEMENT AREA ASSESSMENT

- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Salem River	at Woodstown	Partial Support
Cohansey River	at Seeley	No Support
Maurice River	at Norma	Partial Support
Maurice River	near Millville	Partial Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 16 Mod. Impairment: 35 Severe Impairment: 7


Maurice River
Watershed Management Area 17
67
68
77
N
4 0 4 Miles
Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary
Location
67. Cohansey River, Seeley, NJ
68. Maurice River, Millville, NJ
77. Maurice River, Norma, NJ

SALEM RIVER

WATERSHED DESCRIPTION

The Salem River drains an area of 114 square miles and flows 32 miles from Upper Pittsgrove Township west to Deepwater, then south to the Delaware River. The area lies within Salem County, the major population center being Salem City. Much of the lower section of the river is tidal. Major tributaries to the Salem River include Mannington Creek, Game Creek, Majors Run, and Fenwick Creek. There are some ponds on this creek; a major impoundment is East Lake.

Land use in this watershed is about 40 percent cropland, with the rest woodland, tidal/freshwater marshes, urban, and pasture. There are approximately 10 NJPDES permitted dischargers here - about half are municipal and half industrial. Surface water has been classified FW-2 Nontrout, except for the tidal portions, which are SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Salem River at Woodstown

Dissolved Oxygen: Acceptable.

Temperature: Two violations (out of twenty samples) of the upper criterion for non-trout waters were recorded. Summertime water temperatures tend to run warm at this location.

Nutrients: High levels are observed. Median inorganic nitrogen ($NO_2 + NO_3$) is 1.83 mg/l, with some values exceeding 4.0 mg/l. Total phosphorus is also elevated, with a median of 0.15 mg/l and 85% of values exceeding the criterion of 0.10 mg/l. Samples are high with oxygen-demanding material; BOD levels were frequently above 4.0 mg/l, some samples exceeding 6.0.

Bacteria: Slightly elevated. The geometric mean is 64.4 MPN/100 ml and 45% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: Two of the five lead samples collected during the period of review exceeded the chronic aquatic life criterion. In addition, arsenic was observed at 2 ug/l in three of five samples, which can cause concern for drinking water use.

Summary: The Salem River - Woodstown monitoring site is located at the outlet of Memorial Lake and therefore may not be indicative of true stream conditions due to the retentive properties of the lake. The Salem River here is degraded by elevated nutrients and oxygen-demanding substances, warm summer-time temperatures, and possibly by lead and arsenic. Conditions appear, however, to have improved since the previous assessment (data from 1986 to 1991) when total phosphorus averaged 0.29 mg/l, more than half the

inorganic nitrogen samples exceeded 2.0 mg/l and the fecal coliform geometric mean was 371.

Biological Monitoring

Most locations biologically monitored on the Salem River (upper portion only) contain moderately impaired biota, except at Woodstown where the community was severely impaired. Tributaries of the Salem were a mixture of moderate and severe impairment. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

The upper watershed of the Salem River has water quality problems resulting from the combined effects of both point and nonpoint sources. It is hoped that an upgrade in the Woodstown SA (see table below) will lead to an improvement in water quality conditions here. In tidal sections of the Salem River, conditions are thought to be generally poor. A limited assimilative capacity and numerous point sources in the lower watershed are considered to be reasons for the suspected water quality conditions.

The following industrial/commercial discharger is reported to been releasing effluent of poor quality in the watershed and had been under enforcement action:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Merton Coles' Dairy Farm	Pliesgrove, Salem Co.	Nichomus Run	sewage discharge and milking operation wastewater	Discharge occurred from an overflow pipe from the on-site subsurface sewage disposal system. Discharge has ceased following a September 1995 Notice of Violation, but final resolution is still pending.

The following wastewater treatment plant has been upgraded and/or expanded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Woodstown SA	Salem Co.	Salem River	New tertiary plant put into service in April 1994.

NONPOINT SOURCE ASSESSMENT

The upper Salem River is believed to be receiving occasional nonpoint source runoff from agricultural and urban sources. Agricultural sources include cropland, feedlots, and animal holdings. Urban contributors include surface and road runoff, septic tank leachate, building construction runoff, and mining runoff. The agricultural runoff is believed to be threatening the fishery of Game Creek, a tributary to the Salem River. The Lower Salem watershed receives nonpoint source pollution from croplands, pastures, feedlots, animal holdings, road and housing construction sites, septic systems, suburban surfaces, and road runoff. These sources are estimated to be at moderate to severe levels. The fishery resource of Swedes Run, a tributary to the lower Salem, is believed to be degraded by the combined inputs of industrial point sources and nonpoint road runoff. In addition, local

authorities have noted that housing developments, storm sewers, and pasturelands all present moderate to severe problems to water quality in Swedes Run.

Local officials have pointed out that the Salem River Watershed contains some 13 landfills, which although at present do not produce any "known" impact, do represent a potential problem and hence should be monitored.

DESIGNATED USE ASSESSMENT

Most locations biologically monitored on the Salem River (upper portion only) partially support the aquatic life support designated use, except at Woodstown where the community was severely impaired and the use is not supported. Tributaries of the Salem were a mixture of full and partial support. The swimmable (primary contact) use is partially met at Woodstown because of moderate fecal coliform counts in the river.

COHANSEY RIVER

WATERSHED DESCRIPTION

The Cohansey River is nearly 30 miles long, draining 105 square miles of eastern Salem County to the Delaware Bay. This is an area of very low relief which results in numerous small tributaries. Sunset Lake and Mary Elmer Lake are among 10 major impoundments in this drainage basin. The largest population center is Bridgeton, from which the river becomes tidal.

The main land use of this watershed is agriculture, but much of this area is forested. There are only a few NJPDES permitted discharges in the watershed. Waterways are classified FW-2 Nontrout, except those portions that are SE-1 (downstream of Sunset Lake) and FW-1 (within State parks and wildlife management areas).

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Cohansey River at Seeley

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: Median inorganic nitrogen (NO_2 + NO_3) is very high, 4.4 mg/l with some values exceeding 5.0 mg/l. Total phosphorus is somewhat elevated with a median of 0.07 mg/l and 60% of values exceeding the criterion of 0.05 mg/l for waters flowing into lakes and impoundments.

Bacteria: Elevated. The geometric mean is 246 MPN/100 ml and 30% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: Two of the four lead samples collected during the period of review exceeded the chronic aquatic life criterion.

Summary: Cohansey River at Seeley is impaired from excess nitrogen and poor sanitary quality. Total phosphorus is mildly elevated and lead may be a problem. Current conditions appear to be identical to conditions observed during the last review period using data collected between 1986 and 1991.

Biomonitoring:

The Cohansey drainage exhibited somewhat better conditions compared to those encountered in the Salem River watershed (see the Biological Assessment Table located at the end of this section). Here, only one location was severely impaired - Parsonage Run in Upper Deerfield Township. The Cohansey itself is nonimpaired at its up-stream most location in Alloway Township, and moderately impaired along its remaining length. With the

exception of Parsonage Run, mentioned above, the tributaries to the Cohansey are all moderately impaired.

POINT SOURCE ASSESSMENT

The Cohansey River watershed has some impacts from point sources, but they are not clearly defined. The presence of municipal and industrial point sources likely influences local water quality conditions. No enforcement actions are currently reported in this watershed. In addition, there are no hazardous waste sites in the watershed suspected of impacting surface water quality.

NONPOINT SOURCE ASSESSMENT

Nonpoint source pollution, most likely from agriculture, is cited by local officials as the probable cause of the moderately degraded water quality in the Cohansey River at Seeley. Numerous nonpoint pollution sources are known to impact the Upper Cohansey River and have resulted in siltation and the impairment of the local fisheries. Pollution sources include both agricultural and suburban development activities; specific sources include runoff from croplands, pasture lands, feedlots, housing developments, roads and urban surfaces. In addition, septic systems have been described by local authorities in this region as creating a severe water quality problem. Landfills, too, are noted as a potential problem, yet their actual impact on local waterways at the present time is not known.

Impacts in the Lower Cohansey watershed are much the same. Suspected sources, both agricultural and urban, include runoff from crop production, pasture lands, feedlots, animal holdings, tree harvesting, urban surfaces, house construction, road maintenance runoff, surface mining, as well as leachate from septic systems. Of these sources, cropland runoff is known to have brought about the degradation of local fishing and shellfish harvesting waters. Here as in the Upper Cohansey, landfills are noted as a potential problem.

DESIGNATED USE ASSESSMENT

The Cohansey River does not support the swimmable (primary contact) use based on monitoring at Seeley. The Cohansey itself fully supports the aquatic life support use at its upstream-most location in Alloway Township, and partially supports the use along its remaining length of its freshwater section. With the exception of Parsonage Run (no support), the tributaries to the Cohansey all partially support the use. The tidal sections of the Cohansey do not support the shellfish harvesting designated use because of excessive bacteria levels.

MAURICE RIVER

WATERSHED DESCRIPTION

The Maurice River has a drainage area of 386 square miles and meanders south for 50 miles through Cumberland County to the Delaware Bay. The population centers are Vineland and Millville. The major tributaries of this river are Scotland Run, Manantico Creek, Muskee Creek, Muddy Run, and the Manumuskin River. There are about 20 major lakes in this area, with Union Lake the largest. The river is tidal below Union Lake. Principal land use in this watershed is agriculture, with much of the area forested. Of the 15 to 20 NJPDES permitted dischargers in the watershed, most are industrial/commercial. The Maurice watershed is primarily classified FW-2 Nontrout, with some SE-1 and FW-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Maurice River at Norma and near Millville

Dissolved Oxygen: Acceptable at both locations.

Temperature: Acceptable, although summertime temperatures at Millville tend to run on the warm side, often above 20^0 C.

Nutrients: At Norma nutrients are at acceptable levels. Median inorganic nitrogen (NO_2 + NO_3) is 1.6 mg/l. Median total phosphorus is 0.01 mg/l, with 8% of values exceeding the 0.05 mg/l criterion.

Down-stream near Millville, nutrient levels are slightly higher; median inorganic nitrogen (NO_2 + NO_3) is 1.8 mg/l, and median total phosphorus is 0.02 mg/l, with 31% of values exceeding the 0.05 mg/l criterion.

Bacteria: Mildly elevated at both locations. At Norma, the geometric mean is 25 MPN/100 ml and 28% of samples exceeded the 400 MPN/100ml criterion. Near Millville, the geometric mean is 33 MPN/100 ml, with 23% of samples exceeding the 400 MPN/100ml criterion.

Heavy Metals: Near Millville, one of three lead samples collected during the period of review exceeded the chronic aquatic life criterion. In addition, arsenic was observed at 5, 7 and 26 ug/l in the three samples collected during the period of review. These levels are all elevated and are a cause of concern for drinking water use.

The Norma monitoring site represents a US Geological Survey National Stream-Quality Accounting Network (NASQAN) station, and as such, does not monitor for the normal assemblage of heavy metals including lead, zinc, copper, chromium, arsenic.

Summary: Water quality conditions are good at Norma and relatively good as monitored near Millville. Nutrients are acceptable at Norma and slightly elevated at Millville. Bacterial quality is slightly elevated at both locations. What is of concern in terms of human health (potability) are the elevated arsenic concentrations recorded at Millville. Current conditions appear to more or less mirror conditions observed between 1986 and 1990.

No monitoring is performed in the freshwater portions of the Maurice River below Union Lake; however, the quality of the river is suspected to be degraded downstream of the lake. Regional-specific monitoring in the future should focus on this issue. In the lower tidal sections of the Maurice River, bacterial contamination of shellfish growing areas has resulted in these waters being condemned for shellfishing.

Biomonitoring:
The Maurice River is monitored above Union Lake where it exhibits a mixture of both nonimpaired and moderately impaired communities. Tributaries to the Maurice, both above and below Union Lake, exhibit a similar mixture of nonimpaired and moderately impaired communities. Severe impairment was limited to Indian Run in Pittsgrove Township and Blackwater Branch in Franklin Township. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Current enforcement activities within the Maurice River watershed are limited to one - Shield Alloy (see Point Source Pollution Table). In the Lower Maurice River, point source effluents are believed to have led to the impairment of shellfish harvesting waters.

In the past, two hazardous waste sites were reported to be contaminating surface waters - Vineland Chemical Corporation site and Shield Alloy. The Vineland Chemical Corporation has caused widespread arsenic contamination of sediments in Union Lake, while Shield Alloy is contaminating Hudson Branch with chromium (see Point Source Table below).

Current status of permitted wastewater discharges within the watershed that were reported to be in noncompliance with their discharge permits:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Shield Alloy	Newfield, Glou-cester Co.	Hudson Br of Maurice River	Chromium	Industrial waste discharged into unlined lagoon where it percolated into surface water. An ACO was executed in June of 1991 for "pump & treat" to contain the contamination. The remaining impacts on the surface water still need to be evaluated.

The following wastewater treatment plant has been upgraded and/or expanded and has renewed operation:

FACILITY	LOCATION	RECEIVING STREAM	COMMENTS
Bayside State Prison	Maurice River Twp., Cumberland Co.	Riggins Ditch to Delaware Bay	STP was upgraded to tertiary treatment and became operational in April 1995.

NONPOINT SOURCE ASSESSMENT

Tributaries to Still Run, Little Ease Run, and Reeds Branch, in the northernmost assessed areas of the Maurice River watershed, are believed to be receiving storm water runoff. Still Run is suspected of suffering fish kills and overall water quality degradation from moderate to large quantities of both agricultural and urban nonpoint source pollution. Suspected sources impacting this waterway, as well as Scotland Run, are septic tank leachate, runoff from crop and pasture lands, urban surfaces, road and home construction and road maintenance. The Upper Maurice River itself receives both agricultural and suburban nonpoint source pollution from crop production, tree harvesting, road and home construction, road maintenance and road runoff. Additional pollution sources include sludge disposal activities and local landfills. This runoff is suspected to be contributing to a reported general decline in water quality and to fish kills in the Upper Maurice River.

Farther downstream in the area surrounding Union Lake, runoff is believed to be coming from urban storm sewers, urban surfaces, sludge disposal sites, landfills, hazardous waste sites, and dam construction activities, all of which are estimated to be on the rise. Additional sources reported are surface mining, road maintenance, and housing construction. Below Union Lake, pollution from storm sewers and urban surfaces, while estimated to be on the decline, is believed to have contributed to the impairment of shellfish harvesting areas farther downstream. In this region also, landfills are viewed as a possible source of pollution whose actual impact upon local waters is not yet known.

Other suspected sources of nonpoint pollution are tree harvesting activities, home construction, urban and road surfaces, dredging, and septic systems. Of the two large tributaries to the Lower Maurice, Manantico Creek receives occasional runoff from croplands, construction sites, urban surfaces, storm sewers, tree harvesting, as well as from what is estimated to be increasing levels of road construction and maintenance. Manamuskin River is believed to receive pollution in its headwaters from croplands, and is impacted in its mainstem by road construction, road runoff, suburban surface runoff, landfills, and dredging. To the west, a third tributary (Muddy Run) is suspected of experiencing degradation from cropland and pastureland runoff, pollution from road and housing construction sites, surface mining, and sludge disposal.

DESIGNATED USE ASSESSMENT

The Maurice River at Norma and near Millville is considered to be partially meeting the swimmable (primary contact) designated use, based on fecal coliform monitoring.

The Maurice River above Union lake exhibits a mixture of both full and partial support of the "aquatic life support" designated use. Tributaries to the Maurice, both above and below Union Lake, exhibit a similar mixture of full and partial support of this use. No support is limited to Indian Run in Pittsgrove Township and Blackwater Branch in Franklin Township.

The tidal sections of the Maurice River are condemned for shellfish harvesting.

BIOLOGICAL ASSESSMENT TABLE: AREA 17

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
17	78	AN0690	Salem R	Commissioners Rd (Rt 581)	U Pittsgrove Twp	Aug 24, 1995	moderately impaired
17	78	AN690A	Salem R	Newkirk Sta Rd	U Pittsgrove Twp	Oct 17, 1990	moderately impaired
17	78	AN0691	Salem R	Mill St	Woodstown	Aug 22, 1995	severely impaired
17	78	AN0692	Nichomus Run	Rt 45	Pilesgrove Twp	Aug 22, 1995	severely impaired
17	78	AN0693	Salem R	Kings Hwy	Sharptown	Aug 22, 1995	moderately impaired
17	78	AN0694	Major Run	Pointers - Sharptown Rd	Mannington Twp	Aug 22, 1995	severely impaired
17	78	AN0695	Two Penny Run	E Quillytown Rd	U Penns Neck Twp	Aug 22, 1995	moderately impaired
17	78	AN0696	Game Ck	Rt 48	U Penns Neck Twp	Aug 22, 1995	moderately impaired
17	78	AN0697	Culliers Run	Bassett Rd	Mannington Twp	Sep 12, 1995	moderately impaired
17	78	AN0698	Swedes Run	Swedes Bridge Rd	Mannington Twp	Sep 12, 1995	moderately impaired
17	81	AN0699	Alloway Ck	Yorktown - Friesburg Rd	Alloway Twp	Aug 24, 1995	moderately impaired
17	81	AN0700	Cool Run	Stockington - Pleasant Hill Rd	Alloway Twp	Aug 24, 1995	moderately impaired
17	81	AN0701	Cedar Bk	Alloway - Aldine Rd	Alloway Twp	Sep 21, 1995	moderately impaired
17	81	AN0702	Alloway Ck	Welchville - Alloway Rd	Alloway	Sep 12, 1995	moderately impaired
17	81	AN0703	Deep Run	Waterworks Rd	Alloway	Sep 12, 1995	moderately impaired
17	81	AN0704	Alloway Ck trib	Perry Rd	L Alloway Ck Twp	Sep 12, 1995	moderately impaired
17	86	AN0705	Sarah Run	Telegraph Rd	Quinton Twp	Oct 12, 1995	moderately impaired
17	86	AN0706	Stow Ck	Buckhorn Rd	L Alloway Ck Twp	Sep 21, 1995	moderately impaired
17	86	AN0707	Canton Drain	Maskell Mill Rd	L Alloway Ck Twp	Sep 21, 1995	moderately impaired
17	86	AN0708	Raccoon Ditch	Davis Mill Rd	Stow Ck Twp	Sep 21, 1995	moderately impaired
17	82	AN0709	Cohansey R	Beal Rd	Alloway Twp	Oct 19, 1995	non-impaired
17	82	AN0709	Cohansey R	Beal Rd	Alloway Twp	Jan 4, 1996	non-impaired
17	82	AN0710	Cohansey R	Rt 540	Hopewell Twp	Oct 19, 1995	moderately impaired
17	82	AN0711	Parsonage Run	Finley Rd	U Deerfield Twp	Oct 19, 1995	severely impaired
17	82	AN0712	Cohansey R	Silver Lk Rd	U Deerfield Twp	Sep 26, 1995	moderately impaired
17	82	AN0713	Barrett Run	Maple Ave	Hopewell Twp	Oct 12, 1995	moderately impaired
17	82	AN0714	Barrett Run	W Ave	Bridgeton	Sep 26, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
17	82	AN0715	Indian Fields Br	Grove St	Bridgeton	Sep 26, 1995	moderately impaired
17	83	AN716A	Town Swamp Bk	Buckshutem Rd	Fairfield Twp	Oct 25, 1990	moderately impaired
17	83	AN716B	Mill Ck	Rt 650	Greenwich Twp	Oct 12, 1995	moderately impaired
17	82	AN0717	Pine Mt Ck	Rt 623	Greenwich Twp	Oct 12, 1995	moderately impaired
17	90	AN0718	Cedar Ck	Main St	Cedarville	Oct 19, 1995	moderately impaired
17	90	AN0719	Pages Run	Rt 553	Downe Twp	Oct 19, 1995	moderately impaired
17	92	AN0721	Scotland Run	Rt 322	Monroe Twp	Nov 1, 1995	non-impaired
17	92	AN0721	Scotland Run	Rt 322	Monroe Twp	Feb 13, 1996	moderately impaired
17	92	AN0722	Scotland Run	Clayton - Williamstown Rd (Rt 610)	Clayton	Feb 22, 1996	non-impaired
17	92	AN0723	Scotland Run	Rt 538	Franklin Twp	Feb 14, 1996	non-impaired
17	92	AN0724	Indian Br	Rt 47	Franklin Twp	Feb 14, 1996	moderately impaired
17	92	AN724A	Indian Br	Sta Rd	Janvier (Franklin Twp)	Mar 26, 1991	non-impaired
17	92	AN724A	Indian Br	Sta Rd	Janvier (Franklin Twp)	Jun 10, 1991	moderately impaired
17	92	AN0725	Scotland Run	Rt 40	Malaga	Feb 15, 1996	moderately impaired
17	92	AN0726	Ltl Ease Run	Carpenter Rd	Glassboro	Nov 1, 1995	moderately impaired
17	92	AN0727	Ltl Ease Run	Grant Ave	Franklin Twp	Feb 15, 1996	moderately impaired
17	92	AN0728	Ltl Ease Run	Leonard Cake Rd	Franklin Twp	Feb 15, 1996	moderately impaired
17	92	AN0729	Still Run	Aura Rd	Aura (Elk Twp)	Nov 1, 1995	non-impaired
17	92	AN0730	Still Run	Ltl Mill Rd	Franklin Twp	Feb 22, 1996	moderately impaired
17	92	AN0731	Reed Br	Royal Ave	Franklin Twp	Feb 15, 1996	moderately impaired
17	92	AN0732	Still Run	Rt 40	Franklin Twp	Feb 15, 1996	non-impaired
17	92	AN0733	Maurice R	Willow Grove Rd	Pittsgrove Twp	Jan 18, 1996	moderately impaired
17	92	AN0734	Burnt Mill Br	W Blvd	Newfield	Feb 14, 1996	moderately impaired
17	92	AN734A	Burnt Mill Br	Forest Grove Rd	Newfield	Mar 26, 1991	moderately impaired
17	92	AN0735	Burnt Mill Br	Rt 55	Vineland	Jan 18, 1996	non-impaired
17	92	AN0736	Green Br	Crow Pond Rd	Pittsgrove Twp	Mar 25, 1991	non-impaired
17	92	AN0736	Green Br	Crow Pond Rd	Pittsgrove Twp	Jun 10, 1991	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
17	92	AN0736	Green Br	Crow Pond Rd	Pittsgrove Twp	Sep 23, 1991	non-impaired
17	92	AN0736	Green Br	Crow Pond Rd	Pittsgrove Twp	Dec 9, 1991	non-impaired
17	92	AN0737	Green Br	Jesse Bridge Rd	Pittsgrove Twp	Jan 18, 1996	moderately impaired
17	92	AN0738	Blackwater Br	Main Rd	Franklin Twp	Feb 14, 1996	severely impaired
17	92	AN0739	Blackwater Br	Maurice R Pkwy	Vineland	Feb 14, 1996	moderately impaired
17	92	AN0740	Maurice R	Almond Ave	Vineland	Dec 5, 1995	non-impaired
17	92	AN0741	Muddy Run	Burlington Rd	U Pittsgrove Twp	Jan 17, 1996	moderately impaired
17	92	AN0742	Muddy Run	Dutch Row Rd	Elmer	Jan 18, 1996	moderately impaired
17	92	AN0743	Palatine Br	Shirley Rd	U Pittsgrove Twp	Jan 17, 1996	moderately impaired
17	92	AN0744	Palatine Br	Dubois Rd	Pittsgrove Twp	Jan 18, 1996	moderately impaired
17	92	AN0745	Muddy Run	blw Palatine Lk	Pittsgrove Twp	Dec 12, 1995	moderately impaired
17	92	AN0746	Indian Run	Cedar Ln Rd	U Pittsgrove Twp	Jan 17, 1996	moderately impaired
17	92	AN0747	Indian Run	Husted Sta Rd	Pittsgrove Twp	Jan 17, 1996	severely impaired
17	92	AN0748	Muddy Run	Parvins Mill Rd	Pittsgrove Twp	Jan 17, 1996	moderately impaired
17	92	AN0749	Muddy Run	Lebanon Rd	Pittsgrove Twp	Nov 30, 1995	moderately impaired
17	92	AN0750	Parvin Br	Rt 55	Vineland	Dec 12, 1995	moderately impaired
17	92	AN0751	Maurice R	Sherman Ave	Vineland	Nov 30, 1995	moderately impaired
17	92	AN0752	Lebanon Br	Sherman Ave	Deerfield Twp	Nov 30, 1995	non-impaired
17	92	AN0753	Mill Ck	off Spur 552 (Union Lk WMA)	Millville	Dec 5, 1995	non-impaired
17	92	AN0754	White Marsh Run	Hogbin Rd	Millville	Oct 25, 1990	moderately impaired
17	92	AN0754	White Marsh Run	Hogbin Rd	Millville	Mar 12, 1991	moderately impaired
17	92	AN0754	White Marsh Run	Hogbin Rd	Millville	May 16, 1991	moderately impaired
17	92	AN0754	White Marsh Run	Hogbin Rd	Millville	Jul 11, 1991	moderately impaired
17	92	AN0755	White Marsh Run	Rt 555	Millville	Nov 30, 1995	moderately impaired
17	92	AN0756	Buckshutem Ck	Rt 555	Millville	Oct 31, 1995	moderately impaired
17	85	AN0757	Cedar Br	Italia Ave	Vineland	Dec 5, 1995	moderately impaired
17	85	AN0758	Panther Br	Italia Ave	Vineland	Dec 5, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
17	85	AN0759	Manantico Ck	Hance Bridge Rd	Vineland	Nov 28, 1995	moderately impaired
17	85	AN0760	Manantico Ck	Rt 49	Millville	Nov 28, 1995	non-impaired
17	85	AN0761	Berryman Br	Rt 49	Millville	Nov 28, 1995	non-impaired
17	87	AN0762	Manumuskin R	Old Mays Landing Rd	Maurice R Twp	Nov 28, 1995	non-impaired
17	87	AN762A	Manumuskin R	Main Ave	Milmay	Mar 26, 1991	severely impaired
17	87	AN0763	Manumuskin R	Fries Mill (off Cumberland - Port Elizabeth Rd)	Maurice R Twp	Nov 28, 1995	non-impaired
17	92	AN0764	Muskee Ck	Rt 548	Maurice R Twp	Oct 31, 1995	non-impaired

WATERSHED MANAGEMENT AREA: 18
LOWER DELAWARE DRAINAGE

The watershed management area includes watersheds draining to the lower portions of the Delaware River. The principal rivers here are the Big Timber Creek, Raccoon Creek and Oldmans Creek. The area overlies Salem and Gloucester Counties and includes the following watersheds:

Oldmans Creek
Maple Swamp
Mantua Creek
Wooping Creek
Raccoon Creek
Repaupo Creek
Woodbury Creek
Big Timber Creek

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
So. Br. Big Timber Creek at Blackwood Terrace	FW-2 Nontrout
Raccoon Creek near Swedesboro	FW-2 Nontrout
Oldmans Creek at Porches Mill	FW-2 Nontrout

OVERALL MANAGEMENT AREA ASSESSMENT

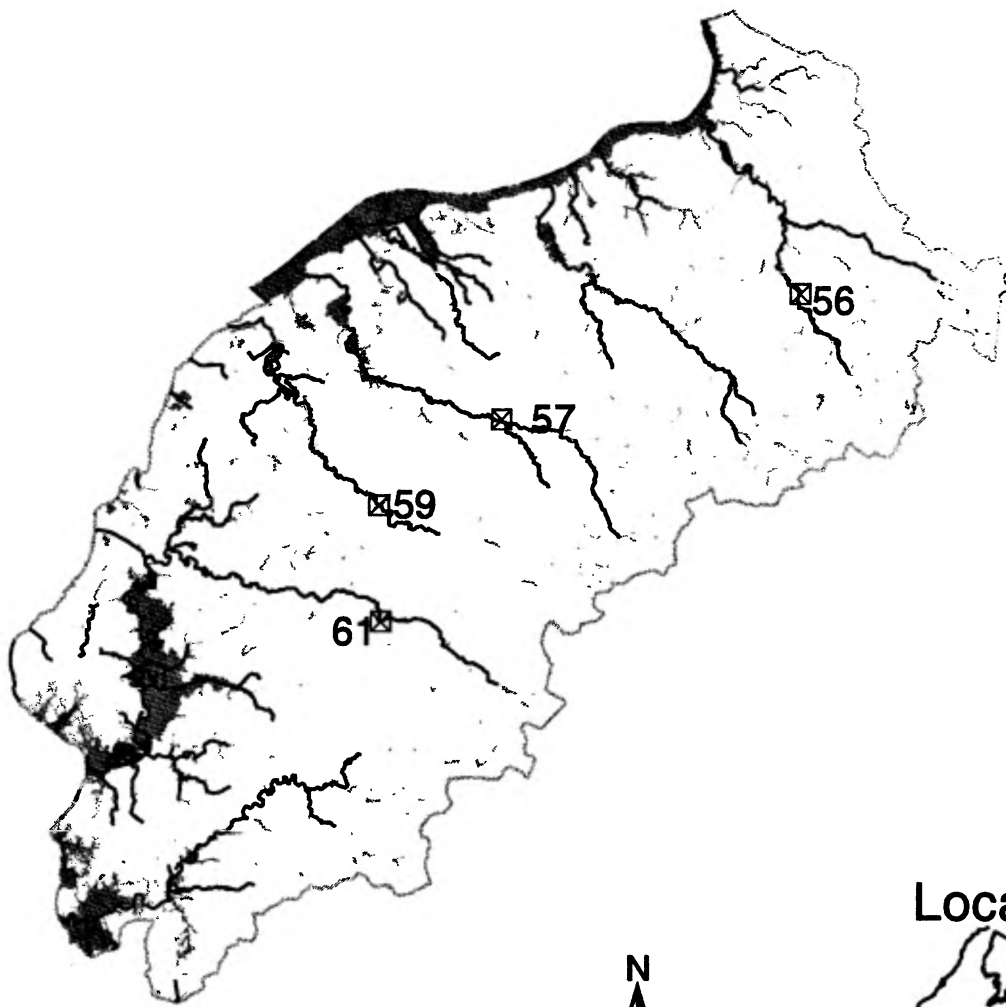
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
So. Br. Big Timber Ck	at Blackwood Terrace	No Support
Raccoon Creek	near Swedesboro	No Support
Oldmans Creek	at Porches Mill	Full Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 1 Mod. Impairment: 43 Severe Impairment: 9

Lower Delaware River Tributaries Watershed Management Area 18



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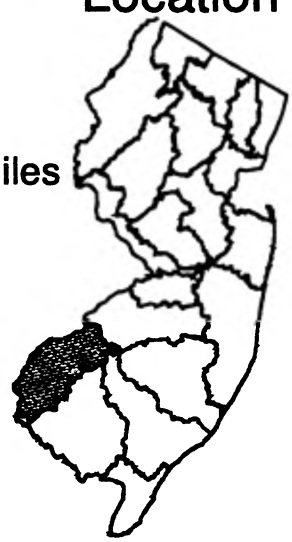

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Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary

56. South Branch Timber Creek, Blackwood Terrace, NJ
57. Raccoon Creek, Swedesboro, NJ
59. Oldmans Creek, Porches Mill, NJ
61. Salem River, Woodstown, NJ

OLDMANS CREEK

WATERSHED DESCRIPTION

Oldmans Creek drains an area of 44 square miles and flows on the Coastal Plain to the Delaware River. This creek, 20 miles long, marks the boundary between Gloucester and Salem Counties. Tidal marshes exist at the mouth of this creek, while the western third of the creek is tidal. Major tributaries include Kettle Run and Beaver Creek.

For the most part, this watershed is agricultural and forested, with some residential and industrial development. Only a few NJPDES permitted dischargers are located in the watershed; most if not all are industrial. Oldmans Creek and tributaries have been classified FW-2 Nontrout, except the tidal portions, which are classified SE-1.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Oldmans Creek at Woodstown

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: Slightly elevated levels are observed. Median inorganic nitrogen (NO_2 + NO_3) is 1.44 mg/l, with some values exceeding 2.0 mg/l. Total phosphorus is also mildly elevated, with a median of 0.065 mg/l and 30% of values exceeding the criterion of 0.10 mg/l. Some samples observed contained moderately elevated levels of oxygen-demanding material; BOD sometimes exceeded 3.0 mg/l.

Bacteria: Slightly elevated. The geometric mean is 119 MPN/100 ml and 10% of samples exceeded the 400 MPN/100ml criterion.

Summary: Chemical/physical water quality is relatively good, with nutrients and bacterial levels slightly elevated. Conditions closely resemble those found during the 1986 - 1991 period of review.

Biological Monitoring

Biological monitoring within the Oldmans Creek watershed indicates moderately impaired conditions throughout the freshwater portions. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Point source effects in this watershed are thought to be limited to the tidal portions of Oldmans Creek. No enforcement activities or hazardous waste sites were identified as impacting the watershed.

NONPOINT SOURCE ASSESSMENT

Nonpoint sources are reported to be the sole contributors to the water quality problems identified in Oldmans Creek. Agricultural sheet and rill erosion is considered a high priority in this region by the Natural Resources Conservation Service. Oldmans Creek is believed to be receiving nonpoint source pollution from agricultural runoff and suburban development. Sources of agricultural runoff include crop production, pasture land, and animal holdings. Suburban sources of pollution include runoff from road and housing construction, urban surfaces, mining activities and leachate from septic systems. All these sources are believed by local officials to be responsible for a decline in water quality and some minor habitat destruction, and are suspected to be threatening the health of the instream fisheries.

DESIGNATED USE ASSESSMENT

Monitored waters of Oldmans Creek will support the swimmable (primary contact) designated use based upon bacteria levels. The creek will partially support the "aquatic life support" designated use.

RACCOON CREEK

WATERSHED DESCRIPTION

The Raccoon Creek watershed contains approximately 40 square miles and drains central Gloucester County. The creek itself is 19 miles long and flows from Elk Township to the Delaware River, across from Marcus Hook, Pennsylvania. While there are several minor tributaries, the only significant one is the South Branch Raccoon Creek. Population centers of this rural area are Swedesboro and Mullica Hill. At the mouth of Raccoon Creek are tidal marshes, and much of the lower half of the Creek is tidal. Ewan Lake, Mullica Hill Pond, and Swedesboro Lake are among the many small lakes and ponds of this area.

The land use in this watershed is primarily agricultural/rural, with industries located along the creek's tidal section. However, there has been recent suburban residential and commercial development in much of the watershed. There are approximately six NJPDES permitted dischargers in the Raccoon Creek watershed; two are municipal and the remaining are industrial. Waters are classified as FW-2 Nontrout and SE-2.

WATER QUALITY ASSESSMENT

Locations: Raccoon Creek near Swedesboro

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: Moderately elevated. Median inorganic nitrogen ($NO_2 + NO_3$) is 1.5 mg/l. Total phosphorus is also elevated, with a median of 0.12 mg/l and 68% of values exceeding the criterion of 0.10 mg/l.

Bacteria: Moderately elevated. The geometric mean is 280 MPN/100 ml and 30% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: One of the five copper samples collected during the period of review approached but did not exceed the chronic aquatic life criterion.

Summary: Physical/chemical quality is fair to good, with nutrients and bacteria at moderately elevated levels. Sanitary quality is at the same level as that encountered during the last review period. We may be seeing, however, a slight decline in nutrient levels, particularly nitrogen, when compared to the earlier assessment.

Biological Monitoring

Most monitoring locations in the Raccoon, Repaupo, and Mantua Creek watersheds are moderately impaired (see the Biological Assessment Table

located at the end of this section). Exceptions are the South Branch Raccoon Creek in Harrison Township (nonimpaired) and Edwards Run, also in Harrison Township (severely impaired).

POINT SOURCE ASSESSMENT

Raccoon Creek is a moderately enriched waterway, based on the nutrient levels present. Agricultural runoff and municipal point discharges are possible sources of these nutrients. No dischargers are currently reported to be under enforcement action for inadequately treated wastewater within this watershed.

Chemical Leaman Tank Lines (Logan Township) waste site has in the past contaminated tidal waters in the western portion of the Raccoon Creek watershed with pesticides and organics.

NONPOINT SOURCE ASSESSMENT

Raccoon Creek receives nonpoint source pollution from agriculture as well as from suburban development. The agricultural sources include runoff from crop production, pasture lands, feed lots, and animal holding areas. Suburban, urban, and industrial development has led to impacts from housing construction, urban surface runoff, mining, septic systems, runoff from road maintenance, and occasional chemical spills.

DESIGNATED USE ASSESSMENT

In general, macroinvertebrate assessments indicate that the Raccoon, Repaupo, and Mantua Creeks all partially support the "aquatic life support" designated use. Raccoon Creek is not supporting the primary contact (swimmable) status due to elevated fecal coliform concentrations.

BIG TIMBER CREEK

WATERSHED DESCRIPTION

Big Timber Creek drains an area of 63 square miles. The mainstem and most of the South Branch divide Gloucester and Camden Counties before flowing into the Delaware River near Brooklawn, south of Camden. Aside from the North and South Branches (which are 10 and 11 miles long, respectively), major tributaries include Otter Creek, Beaver Brook, and Almonesson Creek. The mainstem is less than four miles long. The major impoundments are Blackwood Lake, Grenloch Lake, Hirsch Pond, and Nash's Lake.

This watershed is primarily urban/suburban with forests at the headwaters and cities at the mouth of Big Timber Creek. There are about 14 NJPDES permitted dischargers here, of which approximately 10 are municipal. The waters in the watershed are FW-2 Nontrout, with the exception of a small area in a headwater stream (Mason Run) classified as FW-2 Trout Production.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: So. Br. Big Timber Creek at Blackwood Terrace

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: Mildly elevated. Median inorganic nitrogen (NO_2 + NO_3) is 1.1 mg/l with no values exceeding 1.70 mg/l. Total phosphorus is also mildly elevated with a median of 0.1 mg/l and 40% of values exceeding the criterion of 0.10 mg/l.

Bacteria: Elevated. The geometric mean is 325 MPN/100 ml and 55% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: All five lead samples collected during the period of review exceeded the chronic aquatic life criterion.

Summary: Water quality is fair to good, with nutrients mildly elevated and bacteria elevated. Lead may be a problem with regard to aquatic life support. Conditions are similar to those found during the previous assessment using data collected between 1986 and 1991.

Biological Monitoring

Significant portions of the Big Timber watershed are found to be moderately impaired. Three tributaries were severely impaired - Pines Run in Hilltop Township, Almonesson Creek in Deptford Township, and an unnamed tributary in Erial Township. See the Biological Assessment Table located at

the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

Big Timber Creek is subject to a variety of potential pollution sources due to the large number of point sources within the watershed. An extensive regionalization has occurred in this watershed with the elimination of a significant number of treatment plants; hence, water quality is expected to improve with time.

Gems Landfill, a national Superfund hazardous waste site, was suspected to be contaminating Holly Run and Briar Lake with a variety of organic substances. Clean-up activities have been underway at this site. Fazzio Landfill also has been suspected of contaminating Big Timber Creek with organic chemicals.

The following nonpermitted wastewater discharges within the watershed were observed and enforcement actions taken:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Camden Co. MUA Chews Landing Pump Station	Camden Co.	No. Br. Big Timber Creek	raw sewage discharge	15 - 18 million gallons of raw sewage were discharged from a ruptured pipe A later assessment of the creek indicated a recovery of the affected area Enforcement action was taken 23 Dec. 1996.
Softee Realty Co.	Runnemede, Camden Co.	Beaver Branch	sewage/wastewater	Unpermitted discharge occurred for an unknown length of time. Temporary repairs have been made. and an ACO requiring the connection of Softee Realty's sewage disposal system to the Runnemede (in Camden Co) collection system was executed in October 1995.

NONPOINT SOURCE ASSESSMENT

Urban/suburban runoff is suspected of being an important contributor to the nutrients and bacteria in these streams. Big Timber Creek and Woodbury Creek were determined by local authorities to be receiving a wide range of pollutants from nonpoint sources. These include runoff from cropland and feed lots, road and housing construction, urban surfaces, surface mining, road maintenance, eight landfills, septic systems, waste storage tank leaks, and local spills.

DESIGNATED USE ASSESSMENT

The South Branch Big Timber Creek, in general, partially supports the "aquatic life" designated use. There are locations, however, where the use is not supported. Moderately high fecal coliform levels preclude the use of the South Branch for swimming (no support of the use).

BIOLOGICAL ASSESSMENT TABLE: AREA 18

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
18	64	AN0655	Stone Bridge Br trib	Waddell Farm	Erial	Oct 11, 1990	moderately impaired
18	64	AN0655	Stone Bridge Br trib	Waddell Farm	Erial	Feb 20, 1991	moderately impaired
18	64	AN0655	Stone Bridge Br trib	Waddell Farm	Erial	May 15, 1991	moderately impaired
18	64	AN0655	Stone Bridge Br trib	Waddell Farm	Erial	Jul 9, 1991	severely impaired
18	64	AN655A	Stone Bridge Br	abv Waddell's Bridge	Gloucester Twp	Oct 11, 1990	moderately impaired
18	64	AN655B	Stone Bridge Br	blw Waddell's Bridge	Gloucester Twp	Oct 11, 1990	moderately impaired
18	64	AN0656	Turners Run	Ganttown Rd	Bells Lk	Jul 18, 1995	moderately impaired
18	64	AN0657	Turners Run	Last Bridge Crossing	Grenloch Terrace	Jul 18, 1995	moderately impaired
18	64	AN0658	Bg Timber Ck S Br	Turnersville - Sicklerville Rd	Turnersville	Jul 18, 1995	moderately impaired
18	64	AN658A	Toms Dam Br	Peter Cheeseman Rd	Gloucester Twp	Oct 11, 1990	moderately impaired
18	64	AN0659	Bg Timber Ck S Br	Almonesson Rd	Blenheim	Jul 13, 1995	moderately impaired
18	64	AN0660	Pines Run	L Landing Rd	Hilltop	Jul 13, 1995	severely impaired
18	64	AN0661	Bg Timber Ck N Br	Park Ave	Lindenwold	Jul 13, 1995	moderately impaired
18	64	AN0662	Mason Run	Chews Landing Rd	Lindenwold	Jul 13, 1995	moderately impaired
18	64	AN0663	Bg Timber Ck N Br	Rt 168	Chews Landing	Jul 13, 1995	moderately impaired
18	64	AN0664	Bg Timber Ck	Clements Bridge Rd	Glendora	Jul 11, 1995	moderately impaired
18	64	AN0665	Almonesson Ck	Clements Bridge Rd	Deptford Twp	Jul 18, 1995	severely impaired
18	64	AN0666	Ltl Timber Ck	Devon Rd	Bellmawr	Jul 11, 1995	moderately impaired
18	65	AN0667	Woodbury Ck	Rt 45	Woodbury	Jul 18, 1995	moderately impaired
18	69	AN0668	Mantua Ck	Greentree Rd	Washington Twp	Jul 25, 1995	moderately impaired
18	69	AN0669	Mantua Ck	Lambs Rd	Mantua Twp	Jul 25, 1995	moderately impaired
18	69	AN0670	Chestnut Br	Lambs Rd	Pitman	Jul 20, 1995	moderately impaired
18	69	AN670A	Plank Run	Rt 322	Harrison Twp	Oct 16, 1990	severely impaired
18	69	AN0671	Chestnut Br	Mantua Blvd	Mantua	Jul 20, 1995	moderately impaired
18	69	AN0672	Mantua Ck	Mantua Ave	Mantua	Jul 20, 1995	moderately impaired
18	69	AN0673	Edwards Run	Pitman - Jefferson Rd	Harrison Twp	Jul 20, 1995	severely impaired
18	69	AN0674	Edwards Run	Jessups Mill Rd	Mantua Twp	Jul 20, 1995	moderately impaired
18	68	AN0675	Still Run	Quaker Rd	E Greenwich Twp	Jul 25, 1995	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
18	68	AN675A	Still Run	Union Rd	E Greenwich Twp	Jul 20, 1995	moderately impaired
18	68	AN0676	Rattling Run	Tomlin Rd	E Greenwich Twp	Jul 25, 1995	moderately impaired
18	68	AN0677	Pargy Ck	Swedesboro Ave	E Greenwich Twp	Aug 8, 1995	moderately impaired
18	68	AN0678	Ltl Timber Ck	Paulsboro Rd	Logan Twp	Aug 8, 1995	moderately impaired
18	72	AN0679	Raccoon Ck	Ellis Mill Rd	Elk Twp	Aug 17, 1995	moderately impaired
18	72	AN0680	Raccoon Ck	N Main St	Mullica Hill	Aug 8, 1995	moderately impaired
18	72	AN0681	Raccoon Ck S Br	Swedesboro Rd	S Harrison Twp	Oct 16, 1990	non-impaired
18	72	AN0681	Raccoon Ck S Br	Swedesboro Rd	S Harrison Twp	Aug 12, 1995	moderately impaired
18	72	AN0682	Raccoon Ck S Br	High St	Harrison Twp	Aug 8, 1995	non-impaired
18	72	AN0682	Raccoon Ck S Br	High St	Harrison Twp	Nov 1, 1995	moderately impaired
18	72	AN0683	Raccoon Ck	Tomlin Sta Rd	Harrison Twp	Aug 8, 1995	moderately impaired
18	72	AN0684	Raccoon Ck trib	Russell Mill Rd	Woolwich Twp	Aug 8, 1995	moderately impaired
18	72	AN0685	Raccoon Ck	Kings Hwy	Swedesboro	Aug 8, 1995	moderately impaired
18	74	AN0686	Oldmans Ck	Swedesboro-Monroeville Rd	Jessups Mill	Aug 17, 1995	moderately impaired
18	74	AN686A	Oldmans Ck	Rt 77	Elk Twp	Oct 17, 1990	moderately impaired
18	74	AN0687	Oldmans Ck	Lk Rd	Harrisonville	Aug 17, 1995	moderately impaired
18	74	AN0688	Oldmans Ck	Kings Hwy	Porches Mill	Aug 24, 1995	moderately impaired
18	74	AN0689	Oldmans Ck	Pointers - Auburn Rd (Rt 551)	Auburn	Aug 22, 1995	moderately impaired

WATERSHED MANAGEMENT AREA: 19
RANCOCAS CREEK DRAINAGE

The watershed management area includes watersheds draining the lower - middle portions of the Delaware River. The principal rivers here are the Rancocas, Cooper, and Pennsauken. The area overlies Burlington and Camden Counties and includes the following watersheds:

Cooper River
Newton Creek
Pennsauken Creek
Mill Creek
Rancocas Creek
Pompeston Creek
Baldwin Run
Mc Donald's Branch

Summary of ambient physical/chemical monitoring stations and classifications:

Station	Classification
No. Branch Rancocas Creek at Pemberton	FW-2 Nontrout/PL
So. Branch Rancocas Creek at Vincentown	FW-2 Nontrout/PL
McDonalds Br. in Lebanon State Forest	PL
So. Branch Pennsauken Creek at Cherry Hill	FW-2 Nontrout
No. Branch Pennsauken Creek near Moorestown	FW-2 Nontrout
Cooper River at Haddonfield	FW-2 Nontrout

Note: The North Branch Rancocas Creek at Pemberton and the South Branch Rancocas Creek at Vincentown both lie at the border of the Pinelands Commission's Protection Area, and hence will be assessed as both FW-2 Nontrout waters and as Pinelands (PL) waters.

The following monitoring locations have been discontinued as of 1991:

Cooper River at Lindenwold (FW-2 Nontrout)
Cooper River at Lawnside (FW-2 Nontrout)
So. Branch Rancocas Creek at Hainesport (FW-2 Nontrout)
No. Branch Rancocas Creek at Browns Mills (FW-2 Nontrout)
No. Branch Rancocas Creek at Mt. Holly (FW-2 Nontrout)

OVERALL MANAGEMENT AREA ASSESSMENT

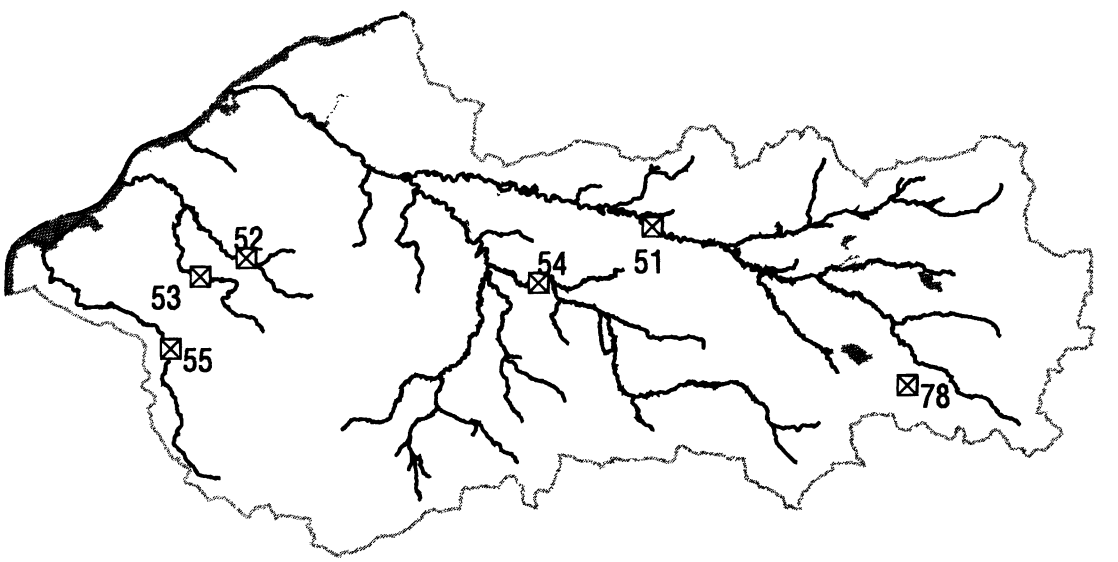
- Swimmable Support Status:

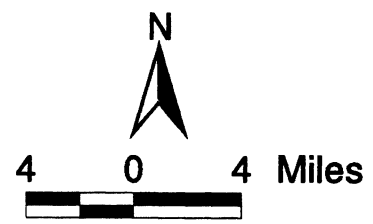
WATERWAY	LOCATION	STATUS
No. Br. Rancocas Ck	at Pemberton	Full Support
So. Br. Rancocas Ck	at Vincentown	Full Support
McDonalds Br.	Lebanon State Forest	Full Support
So. Br. Pennsauken Ck	at Cherry Hill	No Support
No. Br. Pennsauken Ck	near Moorestown	No Support
Cooper River	at Haddonfield	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 9 Mod. Impairment: 22 Severe Impairment: 8

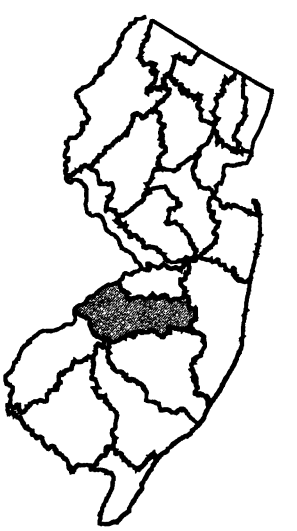
Rancocas Creek
Watershed Management Area 19





Monitoring Sites
Rivers and Streams
Water Bodies
Watershed Management Boundary

Location



51. North Branch Rancocas Creek, Pemberton, NJ
52. North Branch Pennsauken Creek, Moorestown, NJ
53. South Branch Pennsauken, Cherry Hill, NJ
54. South Branch Rancocas Creek, Vincentown, NJ
55. Cooper River, Haddonfield, NJ
78. McDonalds Branch, Lebanon State Forest, NJ

COOPER RIVER

WATERSHED DESCRIPTION

The Cooper River is 16 miles long and its watershed encompasses an area of 40 square miles. The river flows through Camden County to the Delaware River at Camden. The significant tributaries include the North Branch Cooper River and Tindale Run. There is intense development along the mainstem and the areas adjacent to the North Branch. The population centers are Camden, Pennsauken, Cherry Hill, Haddonfield, and Haddon Township. Major impoundments include Cooper River Lake, Kirkwood Lake, Evans Pond, Linden Lake, Hopkins Lake, and Square Circle Lake.

Overall land use in this watershed is primarily urban/suburban. The streams in the watershed have been classified FW-2 Nontrout. As of 1996, there are no longer any NJPDES permitted dischargers in the Cooper River watershed. Current discharges are limited to combined sewer (CSOs) and stormwater outfalls.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: Cooper River at Haddonfield

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: High levels of total phosphorus are observed. Median total phosphorus is 0.23 mg/l and 100% of values exceeded the criterion of 0.05 mg/l applied to locations upstream of impoundments. Inorganic nitrogen (NO_2 + NO_3) is at acceptable levels; the median is 0.45 mg/l with no values exceeding 0.55 mg/l. Some samples are high with oxygen-demanding material; BOD levels were on occasion above 3.0 mg/l and the median was 2.1 mg/l.

Bacteria: Elevated. The geometric mean is 904 MPN/100 ml and 67% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: All five lead samples collected during the period of review exceeded the chronic aquatic life criterion. In addition, arsenic was observed at 2 to 3 ug/l in all five samples which can cause concern for drinking water use.

Summary: This location is characterized by elevated total phosphorus, poor sanitary quality, and levels of arsenic and lead which could impair the water here for potable use and for aquatic life support, respectively. In spite of what is observed during this review period, water quality here has shown significant improvement over the prior review period (1986 through 1990).

Significant reductions in nitrogenous compounds and fecal coliform bacteria are observed. Reductions are also noted in levels of total phosphorus.

Biological Monitoring

All monitoring locations on the North and South Branches of the Cooper River, as well as Newton Creek, indicate severely impaired biota. See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed.

POINT SOURCE ASSESSMENT

The water quality problems of the Cooper River had been the result of excessive municipal and industrial wastewater discharges, combined with the effects of urban stormwater runoff, combined sewer overflows and the limited assimilative ability of the stream. The Camden County M.U.A. regional sewage system has eliminated all of the municipal discharges to the Cooper River. A total of thirty-nine individual sewage treatment plants that were discharging inadequately treated wastewater into the Cooper River, its tributaries, as well as neighboring watersheds, have now been taken off-line and the flow conveyed to the upgraded and expanded Camden Co. MUA facility located in Camden City. Fecal coliform levels have declined and overall surface water quality has improved as a result of this regionalization.

Enforcement action was taken by the Department on the following nonpermitted dischargers:

FACILITY	LOCATION	RECEIVING WATER	POLLUTANT	COMMENTS
Garden State Race Track	Cherry Hill	unnamed trib to Cooper River	contaminated stormwater	Stormwater runoff contaminated with horse manure and horse wash-down discharged to trib. An ACO requiring Best Management Practices and sampling was executed in June of 1991 but sampling results still show elevated fecal coliform and enterococci in the discharge.
National Realty Inc., Lions Head Plaza	Somerdale, Camden Co.	Cooper River	sewage discharge	Sewage discharged from malfunctioning pump station during 1994 and 1995. ACOs with penalties were issued in July 1994 and February 1995. A settlement agreement was executed in July 1995 requiring corrective measures.
Site Development, Inc.	Cherry Hill	Cooper River	sewage discharge	Malfunctioning pump station resulted in a discharge of sewage throughout 1994. An ACO was executed in February 1995 requiring upgrades to the pump station.
Audubon Borough	Camden Co.	Peter's Creek	leaking raw sewage	Damaged sewer mains and underdrain system leaking untreated sewage into storm drain. Repairs have been made, but a complete review of the system for additional problems is pending.

Enforcement action was taken by the Department continued:

JSL Trailer Park	Camden City, Camden Co.	Newton Creek	sewage	JSL had a discharge from a pipe connected to an onsite sewage disposal system. The discharge ended by establishing a connection to Camden City s collection system

NONPOINT SOURCE ASSESSMENT

The 16 mile long Cooper River is reported to receive nonpoint source pollution from roadways and housing construction as well as from croplands, storm sewers, combined sewers, suburban surfaces, highway maintenance, various spills, mining, and landfills. These, combined with point sources, are cited as contributing to impaired water quality and occasional fish kills in the river.

DESIGNATED USE ASSESSMENT

The Cooper River at Haddonfield does not support the swimmable (primary contact) designated use. The "aquatic life" designated use is not supported in either the Cooper River or the Newton Creek watersheds based upon macroinvertebrate monitoring.

PENNSAUKEN CREEK

WATERSHED DESCRIPTION

The Pennsauken Creek drains 33 square miles of southwestern Burlington County and northern Camden County. This creek flows into the Delaware River near Palmyra, New Jersey. The North Branch of the Pennsauken is in Burlington County, while the South Branch is the boundary between Burlington and Camden Counties. The tide affects the three mile mainstem and the first few miles up the branches. Populations are centered in Mt. Laurel, Maple Shade, Cherry Hill and downstream of Maple Shade. Industry is concentrated at the mouth of the Pennsauken Creek. Much of this watershed is developed urban/suburban area, with the remainder divided between farmland and forested land. There are more than 10 NJPDES permitted dischargers here, of which two are industrial and the rest municipal. Waters have been classified FW-2 Nontrout.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: South Branch Pennsauken Creek at Cherry Hill

Dissolved Oxygen: No violations of the lower criterion for non-trout waters are observed; however, daytime dissolved oxygen levels are frequently low and suggest that night-time conditions may be unacceptable.

Temperature: Acceptable.

Nutrients: Highly enriched. Inorganic nitrogen is very high, with a median value of 2.8 mg/l. Total phosphorous is also very high, with all samples exceeding the 0.1 mg/l criterion. The median value is 0.34 mg/l.

Bacteria: Sanitary quality is very poor; the geometric mean is 3567 MPN/100 ml and 95% of samples exceeded 400 MPN/100 ml.

Heavy Metals: One of five arsenic samples was recorded at 2 ug/l, which suggests that additional sampling may be warranted to determine if arsenic should be of concern if the waters are used for drinking.

Sodium: One violation of the criterion was recorded; the median equaled 23.5 mg/l.

Other: Biochemical oxygen demand is high at this location where several samples exceeded 5.0 mg/l.

Locations: North Branch Pennsauken Creek at Moorestown

Dissolved Oxygen: Acceptable.

Temperature: One violation of the upper criterion for non-trout waters was observed, and in-stream temperatures tend to run warm at this location.

Nutrients: Inorganic nitrogen is acceptable; median value is 0.37 mg/l. Total phosphorous is, in contrast, elevated, with 85% of samples exceeding the 0.05 mg/l criterion applied to locations upstream of impoundments. The median value of total phosphorus is 0.15 mg/l.

Bacteria: Mildly elevated bacterial levels were recorded at Moorestown. The geometric mean was 222 MPN/100 ml and 35% of samples exceeded the 400 MPN/100ml criterion.

Heavy Metals: As observed in the South Branch, one of four arsenic samples was recorded at 2 ug/l, suggesting that additional sampling may be warranted to determine if arsenic should be of concern if the waters are used for drinking. One of the four lead records exceeded the chronic criterion for aquatic life support.

Sodium: Two violations of the criterion were recorded; the median is 15 mg/l.

Other: Biochemical oxygen demand is relatively high; several samples exceeded 4.0 mg/l, two exceeded 8.0 mg/l.

Summary: In the South Branch of the Pennsauken, sanitary quality is poor and nutrient levels are very high. When compared to the previous assessment period (data collected from 1986 through 1990), there appear to have been reductions in levels of inorganic nitrogen and total phosphorus, and a notable decline in BOD. Sanitary quality, however, is the same as that observed in the last assessment.

In the North Branch, sanitary quality is fair. Nitrogen levels are acceptable while total phosphorus is elevated. BOD is elevated, although not to the degree observed in the South Branch. Spring and summer water temperatures may tend to be excessive. Water quality, as reflected in fecal coliform and nutrient levels, has notably improved here compared to the previous assessment (based upon data collected between 1986 through 1990).

Previous Inventory Reports have discussed high levels of chlordane and PCBs in fish that have been taken from the Pennsauken Creek mainstem and from the South Branch from Strawbridge Lake downstream. These levels were, and are still, regarded as posing a potential health hazard; as a result, recreational fishing continues to be banned in these waterways.

Biological Monitoring:

See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed. Macroinvertebrate community assessments indicated that the entire length of the South Branch of the Pennsauken Creek is severely impaired. The

North Branch is also severely impaired at its lower end near the confluence with the South Branch, and is moderately impaired along its remaining length.

Just north of the Pennsauken watershed are Pompeston Creek and Swedes Run. Pompeston is assessed to be moderately impaired; Swedes Run is moderately impaired in Moorestown and severely impaired in Delran.

POINT SOURCE ASSESSMENT

Currently no STPs discharge into the South Branch Pennsauken Creek. Several treatment plants in the North Branch Pennsauken are or have undergone upgrades. Both the Moorestown and Mapleshade plants have undergone upgrades, while the Woodstown STP upgrade is currently ongoing.

NONPOINT SOURCE ASSESSMENT

The North Branch of the Pennsauken is receiving pollution from several nonpoint sources. These include runoff from urban surfaces, roadways, bridge and highway construction sites, and leachate from landfills. These sources were assessed as being severe. Additional suspected sources include construction activities (declining), storm sewers, an industrial tract in Palmyra (oil runoff), septic systems, mining, and agricultural sources. Many of these sources are evaluated by the New Jersey Division of Fish, Game, and Wildlife as threatening the health of the fishery resources of the North Branch. Fish kills have occurred in Pennsauken Creek over the years.

Two lakes within the Pennsauken watershed have been reported as impaired by nonpoint sources. Strawbridge Lake receives urban runoff from a dense development of homes, offices, and light industry. This pollution is suspected as having contributed to fish and duck kills. A lake rehabilitation project for the lake, that includes draining and dredging, is nearing completion. The other lake, Memorial, also receives urban surface runoff which causes excess siltation.

DESIGNATED USE ASSESSMENT

Limited support of designated uses occurs in the Pennsauken watershed. Primary contact recreation is precluded in the waterways due to excess fecal coliform bacteria levels. The "aquatic life" use is either partially or not supported in the North Branch depending upon the location. The South Branch is considered to have a degraded fish community because of pollution sources and habitat destruction and a severely impaired macroinvertebrate community; hence, the river will not support the "aquatic life" designated use. Chlordane and PCB contamination of fish tissue has been detected in the past; hence, the South Branch Pennsauken along with the mainstem fail to support the "fish consumption use."

RANCOCAS CREEK

WATERSHED DESCRIPTION

The Rancocas Creek watershed is 360 square miles and the largest in south-central New Jersey. Of this area, 167 square miles is drained by the North Branch and 144 square miles is drained by the South Branch. The North Branch is 31 miles long and is fed by the Greenwood Branch, McDonalds Branch, and Mount Misery Brook. The major tributaries to the South Branch include the Southwest Branch Rancocas Creek, Stop the Jade Run, Haynes Creek, and Friendship Creek. The mainstem flows about eight miles and drains an area of approximately 49 square miles before emptying into the Delaware River at Delanco and Riverside. Tidal influence occurs for about 15 stream miles, extending the entire length of the mainstream to the dam at Mt. Holly on the North Branch, Vincentown on the South Branch, and Kirby Mills on the Southwest Branch. Population centers are Pemberton Township, Medford Township, Medford Lakes Borough, Evesham Township, Mount Holly, and Willingboro. Major impoundments include Medford Lake, Pine Lake, Browns Mills Lake, and Crystal Lake.

About half of this drainage basin is forested, with the remaining area divided between agricultural use and urban/suburban. Significant development is taking place in many former agricultural areas. The eastern part of this watershed drains the Pinelands Protection Area. There are approximately 20 to 25 NJPDES permitted dischargers here, of which some 17 to 20 are municipal and the rest industrial/commercial. This watershed has been classified FW-Central Pine Barrens; FW-1 for the waters within the state parks, state forests, and wildlife management areas; and FW-2 Nontrout.

Note: As stated previously, the North Branch Rancocas Creek at Pemberton and the South Branch Rancocas Creek at Vincentown both lie at the border of the Pinelands Commission's special Protection Area, and hence will be assessed as both FW-2 Nontrout waters and as Pinelands (PL) waters.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Locations: North Branch Rancocas Creek at Pemberton

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: When viewed as FW2-Nontrout waters, inorganic nitrogen and total phosphorous are both acceptable, with median values of 0.145 and 0.035 mg/l, respectively. From a Pinelands waters perspective, inorganic and organic nitrogen, and total phosphorous are all at levels characteristic of moderately disturbed Pinelands waters (Zampella, 1992).

North Branch Rancocas Creek at Pemberton continued:

Bacteria: Very mildly elevated bacterial levels were recorded at this location. The geometric mean was 22 MPN/100 ml and 10% of samples exceeded the 400/100ml criterion.

pH and Conductivity: The median pH and conductivity reflect moderately disturbed Pinelands waters (Zampella 1992).

Heavy Metals: Heavy metals violations were frequent in these acid waters. Three of five copper samples exceeded both the acute and chronic criteria. Of five lead samples, four exceeded both the chronic and acute criteria, while the fifth exceeded the chronic criterion. One violation of the acute and chronic criteria for zinc was recorded (out of five samples).

Locations: South Branch Rancocas Creek at Vincentown

Dissolved Oxygen: Daytime levels all lie within the FW2-NT criterion; however, warm weather levels are relatively low, suggesting stressful conditions at night.

Temperature: Although in-stream temperatures do not exceed the criterion for FW2-NT waters, they nonetheless tend to run warm in the summer at this location.

Nutrients: When viewed as FW2-Nontrout waters, inorganic nitrogen is acceptable and total phosphorous is mildly elevated, with median values of 0.55 and 0.11 mg/l, respectively. From a Pinelands waters perspective: inorganic and organic nitrogen, and total phosphorous are all at levels characteristic of disturbed Pinelands waters (Zampella, 1992).

Bacteria: Sanitary quality is very good at this location. The geometric mean was 61 MPN/100 ml and only 5% of samples exceeded the 400 MPN/100ml criterion.

pH and Conductivity: The median pH and conductivity reflect conditions observed in disturbed Pinelands waters (Zampella 1992).

Heavy Metals: The low hardness recorded in these acid waters renders the metals criteria very restrictive. As a result, one of four copper samples exceeded the chronic criterion for aquatic life support. Additionally, of four lead samples, all exceeded the chronic criterion, again for aquatic life support.

Location: McDonalds Branch in Lebanon State Forest

Dissolved Oxygen: Very depressed, more than half the samples below 4 mg/l.

Temperature: Acceptable.

Nutrients: The median inorganic nitrogen (NO_2 + NO_3), organic nitrogen, and total phosphorus are all characteristic of undisturbed Pinelands waters (Zampella 1992) and are consistent with levels observed between 1975 and 1986 (Zampella 1994).

McDonalds Branch continued:

pH and Conductivity: The median pH was characteristic of undisturbed conditions (Zampella 1992). Specific conductance was at the lower end of moderately disturbed conditions (Zampella 1992).

Bacteria: Fecal coliform levels were very low, with a geometric mean calculated to be less than 2 MPN/100ml.

Heavy Metals: This monitoring site is part of the USGS Hydrologic Bench-Mark network, a program for determining natural or background conditions. and as such does not sample for copper, lead, zinc and chromium.

Summary: When viewed as PL (Pinelands) waters, the North and South Branches of the Rancocas represent conditions reflective of moderately disturbed and disturbed Pinelands waters, respectively.

From the perspective of FW2-Nontrout waters, the North Branch represents good conditions with acceptable nutrient levels and relatively good sanitary quality. The problem here, as in other acid waters, lies in the severely restrictive heavy metals criteria calculated for these waters. As the result, the North branch appears to experience chronic exceedances of copper and lead, and occasional exceedances of zinc. Current nutrient and sanitary conditions are similar to those observed during the last assessment period using data collected between 1986 through 1990.

As FW2-Nontrout waters, the South Branch Rancocas represents fair conditions. Although inorganic nitrogen is acceptable, total phosphorous is mildly elevated, and sanitary quality is very good. Warm weather dissolved oxygen levels are suspected to be depressed at night, creating stressful conditions for aquatic life. As with the North Branch, this acid water experiences exceedances of copper and lead. As in the North Branch, present nutrient and sanitary conditions are similar to those observed during the last assessment period.

McDonalds Branch, a tributary of the North Branch Rancocas, is sampled in Lebanon State Forest in the heart of the Pinelands Area and represents unimpaired background physical and water quality characteristics indicative of the Pinelands Area. Dissolved oxygen saturation is low, due principally to the fact that groundwater is providing much of the base flow at this location, and that surface flow is often slack which in turn can slow aeration. The median pH, 4.2 SU, is typical of unimpacted Pinelands waters where nutrient inputs are very limited.

Biological Monitoring

See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed. The lower portions of the North Branch Rancocas are assessed as moderately impaired as are most of the tributaries to the North Branch. The upper portion of the North Branch itself as well as Mt. Misery Brook are

nonimpaired. A tributary to the mainstem, Mill Creek, was observed to be severely impaired. McDonalds Branch's assessment has alternated between moderately and severely impaired depending upon the date of the assessment.

Most monitoring locations in the South Branch Rancocas watershed are assessed as moderately impaired. There are, however, some locations that were assessed as either nonimpaired and severely impaired.

POINT SOURCE ASSESSMENT

The North and South Branches of Rancocas Creek suffer from low to moderate amounts of water pollution coming from both point and nonpoint sources. No facilities are reported to be under Department enforcement action as of the summer of 1996. In the tidal Rancocas Creek mainstem, a water quality modeling study had found excessive nutrients, elevated algae production, and highly fluctuating diurnal dissolved oxygen concentrations. The study also concluded that the principal sources of oxygen demand were more from sediment loading than from point source inputs.

NONPOINT SOURCE ASSESSMENT

Agricultural and suburban runoff is responsible for the pH, bacteria, and nutrient concentrations that are higher than natural background levels. It is expected that significant development pressures will further stress the streams in the Rancocas watershed. The Upper North Branch of the Rancocas receives nonpoint runoff from a wide assortment of sources; among these are dairy farms, croplands, road and housing construction, road salting, urban surfaces, and storm sewers. The fisheries in the lower reaches of the North Branch are evaluated as being threatened by runoff from housing construction, road maintenance, croplands, and the subsurface infiltration of septic wastes. The landfill in Pemberton has been described by local authorities as a threat to local water quality.

The fish population of Cranberry Branch, a tributary to the North Branch, is threatened by subsurface infiltration of septic wastes. In addition, this stream is believed to receive nonpoint source pollution from cropland runoff and from local housing construction. The upper South Branch Rancocas is suspected of suffering water quality degradation from sod farm runoff, road and housing construction, urban surface runoff, and septic tank leachate. Furthermore, a landfill in Lumberton is suspected of affecting water quality there.

The lower South Branch receives much of the same nonpoint source pollution as the upper reaches including runoff from housing construction, urban surfaces, croplands, septic systems, and surface mining activities. These are all believed to be associated with past fish kills which have occurred in this waterway.

Friendship Creek, Mason Creek and Mill Creek, all tributaries to the Rancocas, are suspected of being impacted by road and highway runoff. Friendship Creek is believed to be further impacted by a local sanitary landfill, while Mill Creek is suspected of being affected by urban runoff.

DESIGNATED USE ASSESSMENT

Bacterial monitoring indicates that the McDonalds Branch, the North Branch Rancocas at Pemberton, and the South Branch Rancocas at Vincentown all fully support primary contact (swimming) recreation.

Macroinvertebrate assessments indicate that the upper portions of the North Branch Rancocas fully support the "aquatic life support" designated use. The lower reach of the North Branch, along with some of the North Branch tributaries, only partially support the use. The South Branch also largely partially supports the use, however, significant portions do not support the use. Full support is limited within the South Branch watershed.

BIOLOGICAL ASSESSMENT TABLE: AREA 19

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
19	56	AN0143	Rancocas Ck N Br	blw Hanover Lk	Hanover Furnace	Feb 23, 1993	non-impaired
19	56	AN0144	Polebridge Br	blw Country Lk	Pemberton Twp	Feb 23, 1993	moderately impaired
19	56	AN0145	Mt Misery Bk	Rt 70	Pemberton Twp	Feb 23, 1993	non-impaired
19	56	AN0146	McDonalds Br	USGS gage	Lebanon St For	Apr 17, 1991	moderately impaired
19	56	AN0146	McDonalds Br	USGS gage	Lebanon St For	Jun 11, 1991	severely impaired
19	56	AN0146	McDonalds Br	USGS gage	Lebanon St For	Sep 24, 1991	moderately impaired
19	56	AN0146	McDonalds Br	USGS gage	Lebanon St For	Dec 10, 1991	moderately impaired
19	56	AN0147	Bisphams Mill Ck	New Lisbon Rd	nr Lower Mill	Feb 23, 1993	moderately impaired
19	56	AN0148	Greenwood Br	New Lisbon Rd	New Lisbon	Feb 23, 1993	non-impaired
19	56	AN0149	Rancocas Ck N Br	Main St	Pemberton	Jan 26, 1993	non-impaired
19	56	AN0149	Rancocas Ck N Br	Main St	Pemberton	Jul 9, 1993	non-impaired
19	56	AN0149	Rancocas Ck N Br	Main St	Pemberton	Oct 18, 1993	non-impaired
19	56	AN0149	Rancocas Ck N Br	Main St	Pemberton	Apr 13, 1994	moderately impaired
19	56	AN0150	Budds Run	Main St	Pemberton	Feb 23, 1993	moderately impaired
19	56	AN0151	Rancocas Ck N Br	Pine St Pk	Mt Holly	Jan 26, 1993	moderately impaired
19	58	AN0152	Friendship Ck	Friendship Rd	Friendship	Mar 2, 1993	non-impaired
19	58	AN0153	Burrs Mill Bk	Hedgerhouse Rd	Woodland Twp	Mar 2, 1993	severely impaired
19	58	AN0153	Burrs Mill Bk	Hedgerhouse Rd	Woodland Twp	Mar 14, 1996	moderately impaired
19	58	AN0154	Burrs Mill Bk	Sooy Pl Rd	Pemberton Twp	Mar 2, 1993	non-impaired
19	58	AN0155	Friendship Ck	Retreat Rd	Retreat	Mar 2, 1993	moderately impaired
19	58	AN0156	Rancocas Ck S Br	Buddtown - Beaverville Rd	nr Retreat	Mar 2, 1993	severely impaired
19	58	AN0157	Jade Run	off Rt 206	nr Vincentown	Mar 2, 1993	moderately impaired
19	58	AN0158	Ltl Ck	Rt 70	Chairville	Mar 2, 1993	non-impaired
19	58	AN0159	Bear Swamp R	Rt 70	Chairville	Mar 2, 1993	moderately impaired
19	58	AN0160	Ltl Ck	Eayrestown Rd	Eayrestown	Mar 2, 1993	moderately impaired
19	58	AN0161	Rancocas Ck S Br	Mt Holly - Eayrestown Rd	Eayrestown	Apr 14, 1993	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
19	58	AN0162	Rancocas Ck SW Br	Elmwood Rd	Evesham Twp	Apr 14, 1993	severely impaired
19	58	AN0163	Barton Run	Braddock Mill Rd & Rt 73	Kresson	Apr 14, 1993	moderately impaired
19	58	AN0164	Black Run	Kettle Run Rd	Evesham Twp	Apr 10, 1991	moderately impaired
19	58	AN0164	Black Run	Kettle Run Rd	Evesham Twp	Jun 11, 1991	non-impaired
19	58	AN0164	Black Run	Kettle Run Rd	Evesham Twp	Sep 24, 1991	non-impaired
19	58	AN0164	Black Run	Kettle Run Rd	Evesham Twp	Dec 10, 1991	non-impaired
19	58	AN0165	Black Run trib	Braddock Mill Rd	Evesham Twp	Apr 10, 1991	severely impaired
19	58	AN0165	Black Run trib	Braddock Mill Rd	Evesham Twp	Jun 11, 1991	severely impaired
19	58	AN0165	Black Run trib	Braddock Mill Rd	Evesham Twp	Sep 24, 1991	moderately impaired
19	58	AN0165	Black Run trib	Braddock Mill Rd	Evesham Twp	Dec 10, 1991	moderately impaired
19	58	AN0166	Barton Run	Tuckerton Rd	Hoot Owl Estates	Apr 14, 1993	severely impaired
19	58	AN0167	Kettle Run	Hopewell Rd	Evesham Twp	Apr 14, 1993	moderately impaired
19	58	AN0168	Haynes Ck	Himmelein Rd	Oliphant Mills	Apr 14, 1993	non-impaired
19	58	AN0169	Rancocas Ck SW Br	Rt 70	Medford	Apr 14, 1993	moderately impaired
19	58	AN0170	Sharps Run	Rt 541	Medford	Apr 14, 1993	moderately impaired
19	58	AN0171	Bobbys Run	Newbolds Cor Rd	Lumberton	Apr 14, 1993	moderately impaired
19	58	AN0172	Masons Ck	Ark Rd	Lumberton	Apr 10, 1991	moderately impaired
19	58	AN0172	Masons Ck	Ark Rd	Lumberton	Jun 11, 1991	severely impaired
19	58	AN0172	Masons Ck	Ark Rd	Lumberton	Sep 24, 1991	moderately impaired
19	58	AN0172	Masons Ck	Ark Rd	Lumberton	Dec 10, 1991	severely impaired
19	58	AN0173	Masons Ck	Rt 38	Union Mills	Apr 14, 1993	moderately impaired
19	54	AN0174	Parkers Ck	Creek Rd	Centerton	Apr 14, 1993	moderately impaired
19	54	AN174A	Parkers Ck	Rt 603	Mt Laurel	Apr 10, 1991	severely impaired
19	54	AN0175	Mill Ck	Levitt Pkwy	Willingboro	Jan 26, 1993	severely impaired
19	55	AN0176	Swedes Run	Rt 130	Delran	Apr 15, 1993	severely impaired
19	55	AN176A	Swedes Run	Garwood Rd	Moorestown	Oct 4, 1990	moderately impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
19	55	AN0177	Pompeston Ck	Rt 130	Cinnaminson	Apr 15, 1993	moderately impaired
19	55	AN177A	Pompeston Ck	New Albany Rd	Moorestown	Nov 14, 1990	moderately impaired
19	57	AN0178	Pennsauken Ck N Br	Church Rd	Mt Laurel	Oct 4, 1990	moderately impaired
19	57	AN0178	Pennsauken Ck N Br	Church Rd	Mt Laurel	Mar 18, 1992	moderately impaired
19	57	AN0179	Pennsauken Ck N Br	Fellowship Rd	Mt Laurel	Mar 18, 1992	moderately impaired
19	57	AN0180	Pennsauken Ck N Br	Rt 537	Maple Shade	Mar 18, 1992	moderately impaired
19	57	AN0181	Pennsauken Ck N Br	Fork Landing Rd	Maple Shade	Mar 18, 1992	severely impaired
19	57	AN0182	Pennsauken Ck S Br	Greentree Rd	Cherry Hill	Mar 18, 1992	severely impaired
19	57	AN0183	Pennsauken Ck S Br	Rt 41	Maple Shade	Mar 18, 1992	severely impaired
19	57	AN0184	Pennsauken Ck S Br	Rt 537	Maple Shade	Mar 18, 1992	severely impaired
19	57	AN0185	Pennsauken Ck S Br	Fork Landing Rd	E Pennsauken	Mar 18, 1992	severely impaired
19	60	AN0186	Cooper R N Br	Kresson Rd	Kresson	Apr 15, 1993	severely impaired
19	60	AN0187	Cooper R N Br	Springdale Rd	Cherry Hill Twp	Apr 15, 1993	severely impaired
19	60	AN0188	Cooper R N Br	River Dr	Erlton	Apr 15, 1993	severely impaired
19	60	AN0189	Cooper R S Br	Gibbsboro Rd	Gibbsboro	Apr 15, 1993	severely impaired
19	60	AN0190	Cooper R S Br	Evesham Rd	Magnolia	Apr 15, 1993	severely impaired
19	60	AN0191	Cooper R S Br	Rt 41	Haddonfield	May 15, 1991	severely impaired
19	60	AN0191	Cooper R S Br	Rt 41	Haddonfield	Apr 15, 1993	severely impaired
19	61	AN0653	Newton Ck	Rt 168	W Collingswood	Jul 11, 1995	severely impaired
19	61	AN0654	Newton Ck S Br	Rt 168	Mt Ephraim	Jul 11, 1995	severely impaired

WATERSHED MANAGEMENT AREA: 20
CROSSWICKS CREEK DRAINAGE

The watershed management area includes watersheds drained by waters principally in northern Burlington County that flow into the Delaware River. The principal rivers here are Crosswicks, Doctors and Assiscunk Creeks. The waters here drain sections of Ocean, Burlington, Monmouth, and Mercer Counties and include the following watersheds:

Crosswicks Creek
Duck Creek
Crafts Creek
Assiscunk Creek
Black Creek

Summary of ambient physical/chemical monitoring stations and classifications

Station	Classification
Crosswicks Creek at Extonville	FW-2 Nontrout
Doctors Creek at Allentown	FW-2 Nontrout

OVERALL MANAGEMENT AREA ASSESSMENT

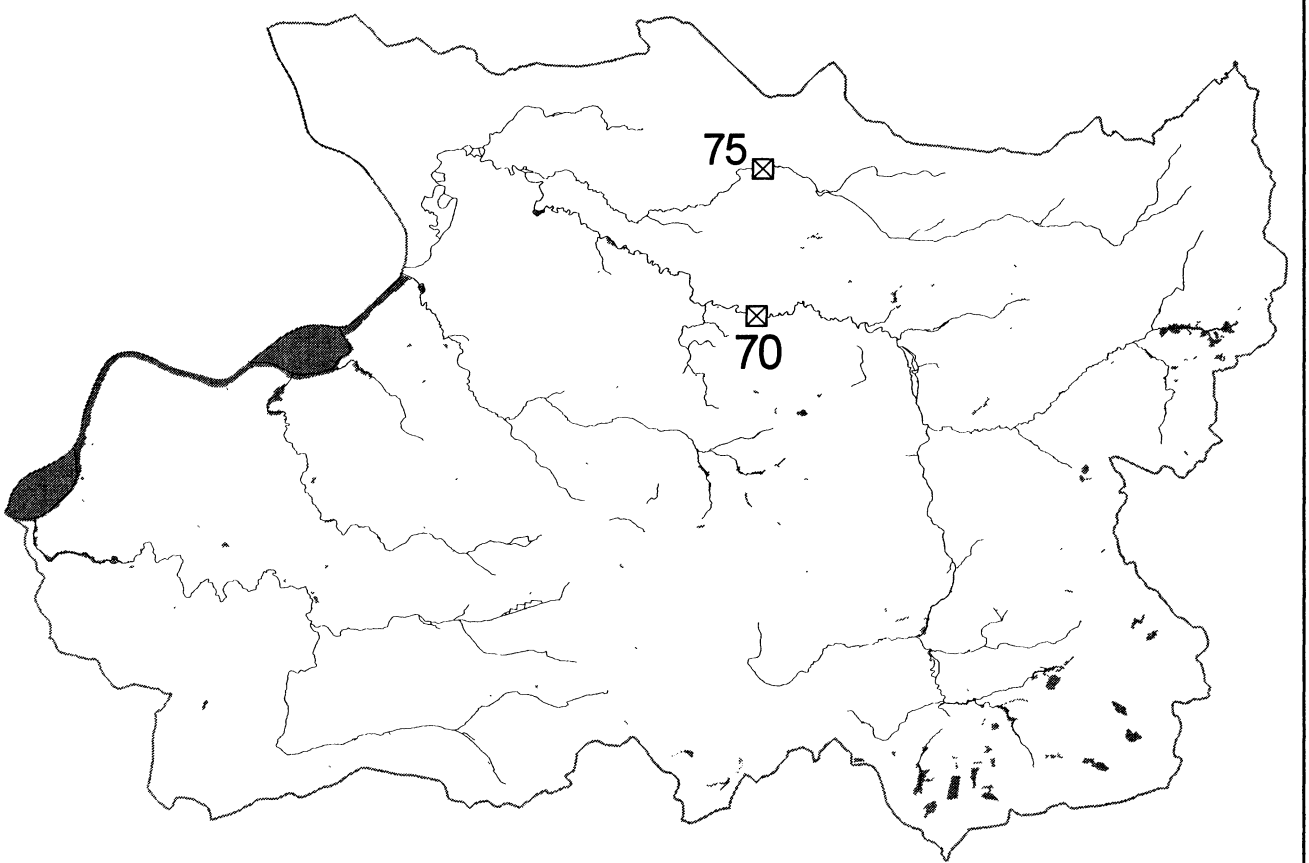
- Swimmable Support Status:

WATERWAY	LOCATION	STATUS
Crosswicks Creek	at Extonville	No Support
Doctors Creek	at Allentown	No Support

- Summary of Aquatic Life Support Status (Number of stations within each assessment category). Note: See the Biological Assessment Table located at the end of this section for details regarding macroinvertebrate assessments within the watershed management area.

No Impairment: 1 Mod. Impairment: 16 Severe Impairment: 7

Crosswicks Creek
Watershed Management Area 20



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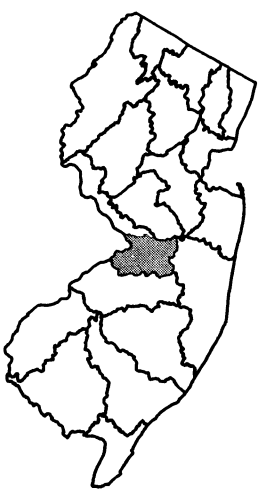

N

0 4 Miles

Monitoring Site
Rivers and Streams
Water Bodies
Watershed Management Boundary

70. Crosswicks Creek, Extonville, NJ
75. Doctors Creek at Allentown, NJ

CROSSWICKS CREEK

WATERSHED DESCRIPTION

Crosswicks Creek is 25 miles long and drains an area of 146 square miles to the Delaware River at Bordentown. It drains sections of Ocean, Burlington, Monmouth, and Mercer Counties. The two main population centers here are Yardville in Mercer County and Bordentown in Burlington County. Major tributaries include Jumping Brook, Lahaway Creek, North Run, and Doctors Creek. Tides affect this stream up to the Crosswicks Mill Dam. Allentown Lake, Oxford Lake, Prospertown Lake, and Imlaystown Lake are the major impoundments in the Crosswicks Creek watershed.

Important land uses in this watershed include agricultural, forested, residential/commercial and military installations. Crosswicks Creek and tributaries have been classified as FW-1 from the headwaters of Lahaway Creek in the Colliers Mill Wildlife Management Area and FW-2 Nontrout for the rest of the Crosswicks Creek system.

WATER QUALITY ASSESSMENT

Physical/Chemical Water Quality

Location:. Crosswicks Creek at Extonville

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Nutrients: Total phosphorous is elevated, with seventy percent of samples in violation of the criterion. The median phosphorous level was 0.15 mg/l. Nitrate+Nitrite levels were acceptable, having a median value of 0.78 mg/l as N.

Bacteria: Sanitary quality at this location is fair. The geometric mean of fecal coliform samples was 257 MPN/100 ml, with 30% of samples exceeding 400 MPN/100ml.

Heavy Metals: One of the three lead samples exceeded the chronic criterion for lead. One of four arsenic samples was recorded at 4 ug/l, which may be of concern if the waters are used for drinking.

Location:. Doctors Creek at Allentown

Dissolved Oxygen: Acceptable.

Temperature: Acceptable.

Doctors Creek continued:

Nutrients: Total phosphorous is mildly elevated, with 55% of samples in violation of the criterion. The median phosphorous level was 0.12 mg/l. Nitrate+Nitrite levels were also mildly elevated, having a median value of 1.13 mg/l as N.

Bacteria: Sanitary quality is fair to poor at this location. The geometric mean of fecal coliform samples was 399 MPN/100ml, with 50% of samples exceeding 400 MPN/100ml.

Heavy Metals: Acceptable.

Summary: Crosswicks Creek as assessed at Extonville shows fair sanitary quality and elevated total phosphorus, and may have problems with lead and arsenic impairing aquatic life support and potability, respectively. Doctors at Allentown shows somewhat poorer sanitary quality compared to Crosswicks. In addition, Doctors Creek shows some elevation in nitrogen as well as total phosphorus. No violations were recorded in heavy metal sampling. Water quality may have undergone some improvement in the Crosswicks/Doctors Creek watershed since 1990 with regard to total phosphorus levels. In addition, biochemical oxygen demand (BOD) at the Crosswicks station appears to have declined, with current values very rarely exceeding 3 mg/l. In the previous assessment (data from 1986 through 1990), BOD values sometimes exceeded 5 mg/l.

Biological Monitoring

Most macroinvertebrate monitoring stations in the Crosswicks/Doctors Creek watershed indicate either moderate or severe impairment (see the Biological Assessment Table located at the end of this section). In the upper portions of the Crosswicks subwatershed, North Run and Jumping Brook show severe impairment. The upper Crosswicks itself shows a mix of moderate along with severe impairment. The lower reaches of Crosswicks show moderate impairment. Lahaway Creek, a tributary to the upper Crosswicks, is moderately impaired. The upper reaches of Doctors Creek also show moderate impairment. Only the lower portion appears nonimpaired.

In the lower portions of the management area, Blacks Creek and its tributaries are moderately impaired. Crafts Creek is a mix of moderate and severe impairment. Assicunk Creek largely shows moderate impairment with some severe impairment in some of its eastern most monitoring locations. Refer to the Biological Assessment Table at the end of this section for details.

POINT SOURCE ASSESSMENT

Historically, sewage treatment plant effluent, runoff and other nonpoint sources have been suspected of causing nutrient enrichment in the headwaters of Crosswicks Creek. No facilities are currently under enforcement action within the watershed.

A number of hazardous waste sites are present in the upper watershed that may be contaminating local surface waters. They include: McGuire Air Force Base (aromatic hydrocarbons to South Run), Hopkins Farm site (volatile organics and unknown substances to unnamed tributary), Wilson Farm site (volatile organics and unknown substances to Bordens Run), and Goose Farm (volatile organics to unnamed tributary).

NONPOINT SOURCE ASSESSMENT

The upper 15 miles of Crosswicks Creek receives pollution from agriculture and suburban development. The Natural Resources Conservation Service has found agricultural sheet and rill erosion to be high in the Crosswicks Creek basin. Severe runoff from cropland and housing construction is reported to be responsible for turbidity, high total dissolved solids, and excessive phosphorus levels in the Creek. Rising rates of suburban development in New Egypt have brought about severe problems with septic tank leachate and surface runoff. These have resulted in reports of elevated ammonia and coliform bacteria, as well as depressed dissolved oxygen levels. The lower reaches of Crosswicks Creek, some 7 miles, are known to receive fertilizer, herbicides, pesticides, and silt loads from crop land runoff. In addition, stream bank erosion is suspected in Crosswicks Creek along stretches of pasture land. Severe runoff from suburban construction sites, storm sewers, as well as road maintenance are reported problems. Local septic systems are suspected to be causing rising levels of coliform contamination.

Doctors Creek receives severe levels of crop land runoff carrying fertilizer, herbicides, pesticides, and silt. Housing and road construction in the upstream reaches are suspected to be contributing additional silt loads to the stream. North Run receives agricultural and road runoff, which are believed to be causing water quality degradation from the effects of nutrient enrichment and oil and grease. Duck Creek is reported to receive storm sewer effluent. Back Creek is believed to be receiving large quantities of runoff from road and housing construction in addition to runoff from suburban surfaces. Imlaystown and Allentown Lakes receive high levels of siltation from local plant nursery stock operations.

DESIGNATED USE ASSESSMENT

The Crosswicks Creek Watershed Management Area in general either partially supports or fails to support the" aquatic life" designated use. A pocket of full support is located in the lower portion of Doctors Creek. Crosswicks and Doctors Creek fail to support primary contact recreation (swimming) based upon the fecal coliform bacterial levels recorded at the two respective monitoring locations.

BIOLOGICAL ASSESSMENT TABLE: AREA 20

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
20	45	AN0119	Jumping Bk	Bunting Bridge Rd	Cookstown	Jan 19, 1993	severely impaired
20	45	AN0120	N Run	Main St	Cookstown	Jun 19, 1984	moderately impaired
20	45	AN0120	N Run	Main St	Cookstown	Jan 19, 1993	severely impaired
20	45	AN120A	N Run trib	Highland Ave	Wrightstown	May 20, 1991	moderately impaired
20	45	AN0121	Crosswicks Ck	Rt 537	New Egypt	Jun 21, 1984	severely impaired
20	45	AN0121	Crosswicks Ck	Rt 537	New Egypt	Jan 19, 1993	severely impaired
20	45	AN121A	Moorhouse Bk trib S	Moorhouse Rd	New Egypt	May 20, 1991	moderately impaired
20	45	AN121B	Crosswicks Ck trib S	Cookstown - New Egypt Rd	Cookstown	Jun 14, 1984	severely impaired
20	45	AN121B	Crosswicks Ck trib S	Cookstown - New Egypt Rd	Cookstown	Jun 20, 1984	severely impaired
20	45	AN121C	Crosswicks Ck trib N	Cookstown - New Egypt Rd	Cookstown	Jun 14, 1984	severely impaired
20	45	AN121C	Crosswicks Ck trib N	Cookstown - New Egypt Rd	Cookstown	Jun 20, 1984	severely impaired
20	45	AN121D	Crosswicks Ck	Rt 528 (blw Oakford Lk)	New Egypt	Jun 21, 1984	severely impaired
20	45	AN0122	Lahaway Ck	Rt 537	Jackson Twp	Jan 19, 1993	moderately impaired
20	45	AN0123	Ivanhoe Bk	Millers Mill Rd	Prospertown	Jan 19, 1993	moderately impaired
20	45	AN0124	Lahaway Ck	New Egypt - Allentown Rd	U Freehold Twp	Jan 19, 1993	moderately impaired
20	45	AN0125	Crosswicks Ck	Extonville Rd	Extonville	Jan 19, 1993	severely impaired
20	45	AN125A	Miry Run	Meirs Rd	Cream Ridge	Oct 29, 1990	moderately impaired
20	45	AN0126	Crosswicks Ck	Main St	Groveville	Jan 20, 1993	moderately impaired
20	45	AN0127	Doctors Ck	Red Valley Rd	U Freehold Twp	Jan 19, 1993	moderately impaired
20	45	AN127A	Doctors Ck	Spring Rd	Millstone Twp	Oct 29, 1990	moderately impaired
20	45	AN0128	Negro Run	Red Valley Rd	Allentown	Jan 19, 1993	moderately impaired
20	45	AN0129	Doctors Ck	Breza Rd	Allentown	Jan 19, 1993	moderately impaired
20	45	AN0130	Doctors Ck	Rt 130	Groveville	Jan 20, 1993	non-impaired

BIOLOGICAL ASSESSMENT TABLE continued:

Mgt Area	Watershd	Site ID	Water Body	Location	Municipality	Sample Date	Biological Impairment Rating
20	45	AN0131	Crosswicks Ck	Point Breeze	Bordentown Twp	Jan 20, 1993	moderately impaired
20	49	AN0132	Blacks Ck	Chesterfield - Georgetown Rd	Chesterfield	Jan 25, 1993	moderately impaired
20	49	AN0133	Bacon Run	White Pine Rd	Chesterfield Twp	Jan 25, 1993	moderately impaired
20	49	AN133A	Bacon Run	Georgetown - Bordentown Rd	Georgetown	Oct 2, 1990	moderately impaired
20	49	AN133A	Bacon Run	Georgetown - Bordentown Rd	Georgetown	Feb 19, 1991	moderately impaired
20	49	AN0134	Blacks Ck	Rt 130	Bordentown	Jan 25, 1993	moderately impaired
20	50	AN0135	Crafts Ck	Gaunts Bridge Rd	Georgestown	Oct 2, 1990	moderately impaired
20	50	AN0135	Crafts Ck	Gaunts Bridge Rd	Georgestown	Jan 25, 1993	severely impaired
20	50	AN0136	Crafts Ck	Island Rd	Columbus	Oct 2, 1990	moderately impaired
20	50	AN0136	Crafts Ck	Island Rd	Columbus	Jan 25, 1993	moderately impaired
20	50	AN0137	Crafts Ck	Old York Rd	nr Roebling	Jan 25, 1993	severely impaired
20	51	AN0138	Assiscunk Ck	Columbus - Georgetown Rd	nr Georgetown	Oct 2, 1990	moderately impaired
20	51	AN0138	Assiscunk Ck	Columbus - Georgetown Rd	nr Georgetown	May 22, 1991	severely impaired
20	51	AN0138	Assiscunk Ck	Columbus - Georgetown Rd	nr Georgetown	Jan 25, 1993	severely impaired
20	51	AN0139	Anaricken Bk	Island Rd	Springfield Twp	Jan 25, 1993	moderately impaired
20	51	AN0140	Barkers Bk N Br	Juliustown Rd	Springfield Twp	May 22, 1991	moderately impaired
20	51	AN0140	Barkers Bk N Br	Juliustown Rd	Springfield Twp	Jan 25, 1993	severely impaired
20	51	AN0141	Assiscunk Ck	Hedding Rd (nr Jacksonville)	Springfield Twp	Jan 26, 1993	moderately impaired
20	51	AN0142	Assiscunk Ck	Neck Rd	nr Sutton Chapel	Jan 26, 1993	moderately impaired

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