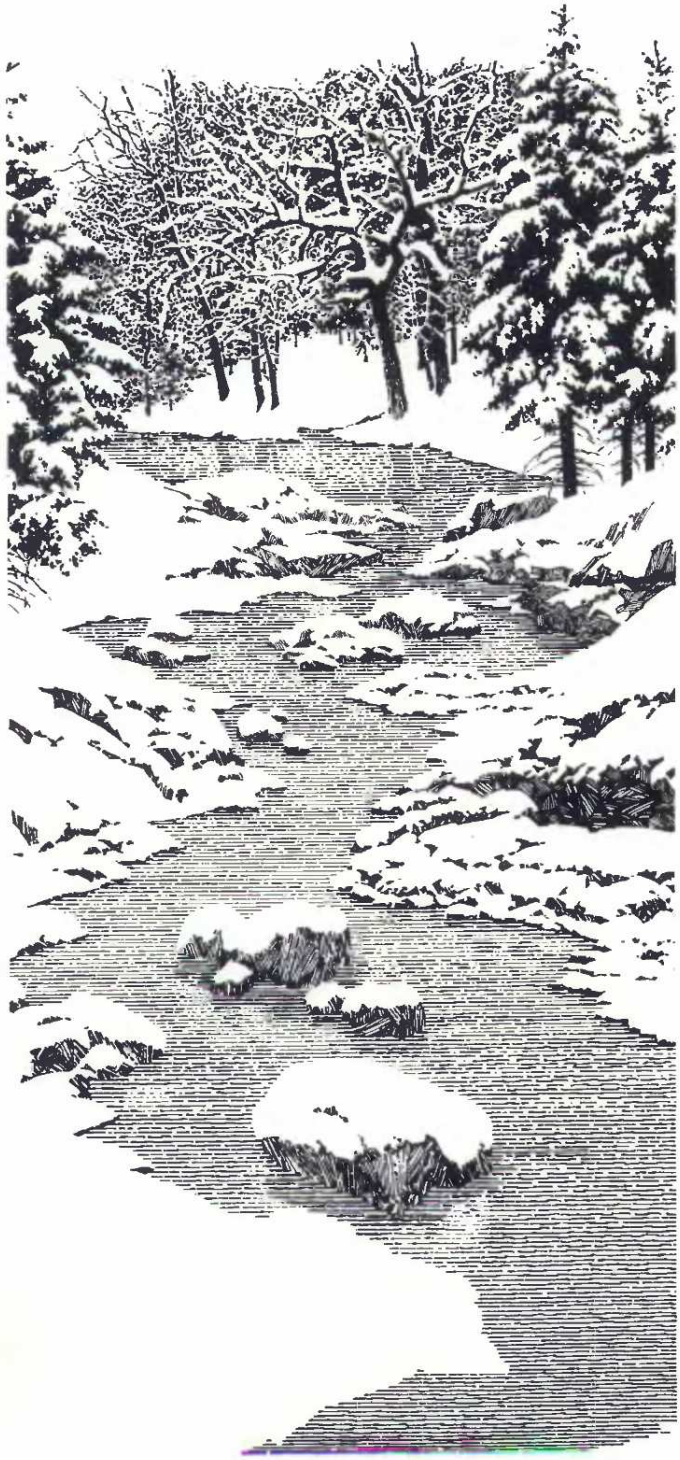
New Jersey 1994
State Water Quality Inventory Report



New Jersey Department of
Environmental Protection
Office of Environmental Planning

NEW JERSEY 1994 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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CHAPTER I

EXECUTIVE SUMMARY AND RECOMMENDATIONS FOR IMPROVING WATER QUALITY

A. EXECUTIVE SUMMARY

The New Jersey 1994 State Water Quality Inventory Report is a summary assessment of current water quality conditions in the State's major rivers, lakes, estuaries, ocean waters, and ground water. In addition, the report describes which waters are attaining state designated water uses, identifies pollution problems and discusses the suspected and known sources of water pollution. Waters assessed in this report are limited to New Jersey state waters; no interstate waters are assessed. An assessment of the Delaware River is reported to USEPA through the 305(b) submittal of the Delaware River Basin Commission. The interstate waters between New Jersey and New York are assessed through submittals to USEPA provided by the Interstate Sanitation Commission.

This 1994 edition serves to update the more detailed and extensive 1992 Inventory Report. Much of the waterbody specific information presented in the 1992 edition is not included in this edition, but will instead be revised, updated, and republished in the 1996 Inventory Report. This 1994 edition focuses, instead, on water quality in summary form, and presents detailed updated information on the department's water quality management programs. Some waterbody specific data, based upon biological monitoring, is presented in the Appendix.

This report is prepared every two years pursuant to Section 305(b) of the federal Clean Water Act and is the eleventh in a series of state water quality inventory reports since 1975. Water quality assessments presented here are current through 1993; descriptions of programs are current through early 1994. The following is an overview of the 1994 State Water Quality Inventory Report including major conclusions and findings.

CHAPTER II:

- New Jersey has 6,450 miles of rivers, 24,000 acres of public lakes, 900,000 acres of freshwater and tidal wetlands, 120 miles of ocean coastline, and 420 square miles of open estuarine waters. New Jersey had 7.5 million residents in 1990.

- It is the goal of the federal Clean Water Act that freshwaters of the state should support primary contact recreation (swimming), and support the maintenance and propagation of natural and introduced biota. Most estuarine and ocean waters should also meet these goals (and uses), as well as support the harvesting of uncontaminated shellfish. However, certain interstate waters between New Jersey and New York, as well as portions of the lower Delaware River, do not have to have sufficient water quality to support these goals (uses).

CHAPTER III:

- **The methodologies used to assess water quality** and pollution sources in this report are divided into two categories: monitored assessments (based on actual in-stream monitoring) and evaluated assessments (based on professional judgment, land uses, monitored data that is older than five years, known pollution sources, and other non-water quality information).

- **The Department regards all waters of the state as threatened, even when designated uses are fully supported.** This is because of the extensive development within our state, the large and concentrated population density, and the high intensity of land use even within protected watersheds. This differs from earlier Inventory Reports where the "threatened" category was classified as a subset of "fully meeting use". In response to USEPA's 1992, and 1994 305(b) Guidelines, "threatened" is now its own category, separate from "fully meeting use".

- **Water quality, in fresh water rivers and streams, has been assessed** for aquatic life use support in 1,617 linear miles. Primary contact use support is assessed in 525 linear miles. Some public lakes are monitored (53 since 1989), but most are evaluated. Over 600 square miles of estuarine waters are monitored; and 440 square miles of ocean are monitored.

- **Fifteen percent of the total fresh water stream miles monitored for primary contact use fully support the use but are threatened.** Another 8 percent of assessed waters partially support the use. Primary contact use is not supported in 77 percent of waters. High fecal coliform concentrations are the principal reason why so many waterways are not of swimmable quality.

- **Waters classified as swimmable** (but threatened) **are often in protected watersheds** or directly downstream of an impoundment where the settling action of the impoundment is likely to reduce the instream bacteria levels.

- **Sixty-eight percent of approximately 1,617 stream miles assessed for aquatic biota are believed to be fully supporting the aquatic life use** (fish propagation and maintenance designated use). As stated above, these waters are regarded as threatened. Waters which have moderately degraded fish communities are considered to be partially meeting the aquatic life use; 19 percent of the assessed waters fall into this category. Only 13 percent are classified as not meeting the use.

- **Different assessment methodologies are now employed to determine aquatic life use attainment than were used in past Inventory Reports,** hence, comparisons with prior reports of the proportion of waters supporting the use in freshwaters are not encouraged. Extensive macroinvertebrate assessments have replaced many of the older finfish surveys used in several of the last few Inventory Reports. Still earlier editions of this report have relied principally on water chemistry data before moving to fisheries surveys. Slight changes in the assessment of the primary contact use have also made comparisons difficult. The department has changed its criteria to conform to USEPA's "standardized" nationwide assessment procedure for primary contact recreation. Although these

changes are not significant, they nonetheless make comparisons with previous assessments misleading.

- **104 fixed monitoring stations located on freshwater river reaches were examined for changes in water quality** in terms of chemical/physical parameters during the period of 1983 through 1990. A little more than half the stations (66) indicated little or no change in water quality. Of the remaining 44 stations, half showed signs of some improvement while half indicated some decline. This suggests that in terms of water quality management of fresh waters, management programs have had success; however, there are indications that there are limits to the effectiveness of the department's water pollution management efforts in these waters.

- **All of New Jersey's public lakes are classified as threatened for support of the primary contact recreational use.** Current monitoring information on public lakes is limited to about fifty lakes. Based upon information on the lakes which have been assessed, it is determined that the most frequent pollution problems are nutrients, siltation, depressed dissolved oxygen levels, and excess primary productivity. Nonpoint source pollution is cited as the principal source of contaminants.

- **Generalizations regarding the support of primary contact use in New Jersey's estuaries are difficult** because of the manner in which beach closures in bay regions occur. It can be said that back-bay beach closures are a serious problem on a local basis. Many 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 primary contact use and would not support the use if they were designated swimming areas. Bacterial contamination in estuarine waters is closely tied with stormwater discharges.

- **New Jersey ocean 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. 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.

- **New Jersey ocean waters fully support aquatic life use**, yet are threatened from the continued inputs of treatment plant effluent, stormwater inputs, the deposition of dredge spoils, and the outflow from the Hudson/Raritan estuary.

- **Seventy-three percent of the estuary waters monitored for sanitary quality fully support shellfish harvesting but are regarded as threatened.** Another 20 percent are classified as partially supporting this use, and 7 percent do not support the use. When compared to the previous assessment (1991), waters fully supporting harvesting have increased by a percentage point. Along the same trend, waters categorized as not supporting the use have declined by 2 percent, having been upgraded to partial support. **These same monitored estuarine waters fully support the aquatic life use** but are regarded as threatened.

- **Seventy-six percent of total ocean waters assessed fully support shellfish harvesting.** Twenty-four percent do not support the use.

- **There has been a clear increase in the harvestable waters (bay and ocean) in New Jersey over the past 18 years.** 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 over 85 percent as of 1994.

- **Recreational fishing advisories are in effect for an undetermined number of square miles of coastal waters in the northern portion of the state,** directly adjacent to the New Jersey/New York interstate waters. High levels of PCBs and certain pesticides have been found in finfish taken in these waters. As a result, these waters are classified as partially supporting the fish consumption use.

- **Most common water quality problems** occurring in the state's fresh water rivers and streams include total and fecal coliform bacteria (in 81 percent of the freshwaters), nutrients (also in 81 percent), depressed dissolved oxygen levels, siltation, road salts, and oil and grease. Other types of known or suspected water quality problems found statewide include thermal modification/elevated stream temperatures, habitat alterations, pH fluctuations, and rising chloride and sodium levels.

- **Levels of PCBs and pesticide residues in finfish and crustacean tissue are generally found in acceptable levels in the state, although in certain regions they exceed recommended levels.** Areas with higher than recommended concentrations of these substances include New Jersey/New York interstate waters, rivers in the urbanized northeast part of the state, and certain tributaries to the Delaware River in the Camden area.

- **In general, knowledge of the presence and overall impacts of toxic substances in state waters is limited.** The presence and impacts of toxic substances on aquatic biota may be more widespread than originally thought (see below). In addition, a clear understanding of the presence of heavy metals within the environment is clouded by evidence that indicates that a percentage of the historical record for metals may contain inflated values. This high bias is the product of sample collection and preservation methods that had been used until very recently. Significant changes regarding how metals should be sampled are being discussed by the department, USEPA and the USGS, with some changes having already been put into effect.

- **The department has issued public health consumption advisories on chain pickerel and largemouth bass from numerous freshwater bodies where elevated levels of mercury have been found in fish tissue.** It is important to note that although data show elevated levels of mercury in fish taken from the waterbodies listed, waters from the drinking water sources included on the list remain safe to drink.

- **Point source discharges** of wastewater still have a significant effect on many of the state's waterways.

- **Nonpoint sources of pollution are a major factor in the impairment of coastal waters and freshwater lakes. Nonpoint sources are also suspected of being a significant factor in the impairment of freshwater rivers and streams.** Nonpoint sources include stormwater outfalls; construction, urban, and agricultural runoff; land disposal practices; hydrologic/habitat modification; and marinas located in lakes and coastal waters.

- **Available evidence suggests that sensitivity to acid precipitation in New Jersey is restricted to undisturbed portions of the Pinelands area in the southern part of the state, and to portions of the Highlands and Ridge and Valley Physiographic Provinces of northern New Jersey.** In northern New Jersey, some lakes are thought to be experiencing increased acidity through acid precipitation. In the Pinelands, some small declines in pH are suspected; however, evidence is not conclusive. Studies suggest that acid rain may be shifting the principal acid producing constituents in the undisturbed portions of Pinelands from organic to mineral acids. The former chelate with toxic metallic ions, reducing their toxicity; the latter facilitate the release of free metallic ions, increasing their toxicity. This topic is discussed in detail in the 1990 edition of New Jersey's Water Quality Inventory Report.

CHAPTER IV:

- **Ground water quality is considered naturally good in the state; however, treatment for some undesirable constituents of natural origin is warranted in some areas** due to the physical/chemical nature of the geologic materials constituting the aquifer. The most common of these naturally occurring contaminants include iron, dissolved solids, sulfate and hardness. Other less common yet significant contaminants are radon, radium, lead, and barium.

- **There are currently over 6,000 ground water pollution investigations underway in New Jersey.** Based upon a detailed analysis conducted in 1989, the most common pollutants encountered were volatile organic compounds (VOCs), metals, base neutrals, acid extractables, and PCBs/pesticides. Other contaminants included miscellaneous landfill contaminants, undifferentiated petroleum hydrocarbons, gasoline, and fuel oil. Of the pollution sources determined, underground storage tanks (USTs) accounted for the largest percentage of known sources. Landfills, surface spills, and industrial/commercial septic systems all made up the next most common source of contaminants.

- **The full extent of anthropogenic impacts to ground water quality is unclear.** Detailed data assessments have not been performed since 1989. It is the opinion of members of the department that USTs may still be responsible for the greatest number of ground water pollution cases within the state. All sources most likely have declined in number as a result of efforts to replace leaking tanks as well as to clean up all categories of contaminated sites. Industrial/commercial septic systems cited in the 1989 data base have largely been eliminated due to the liability associated with contaminated ground water and the restrictions on permits for these systems. It is believed 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 1989.

- The 1989 database indicates that **there appears to be a direct correlation between population density throughout the state and the distribution of ground water pollution investigations.**

- **Present data suggest that there is an ample supply of good quality ground water in the state to meet supply needs.** Local/regional quantity problems do exist and they are usually in areas where the greatest demands on ground water supplies occur. Demand can lead to overpumping which, in turn, can lead to aquifer recharge from undesirable sources such as seawater, or contaminated shallow ground water.

- **New ground water quality standards were adopted early in 1993.** The standards contain a new system for classifying ground waters of the state, numerical criteria for many pollutants, and a policy which protects good quality ground water from significant degradation due to future discharges. These standards are fundamental to the implementation of the New Jersey Water Pollution Control Act.

- In 1990, **the department prepared a guidance document for voluntary municipal use in mapping and protecting local aquifer recharge areas** and is preparing maps of major aquifer recharge areas, as required by state law.

CHAPTER V:

- **Since 1972, New Jersey has obligated more than $3.4 billion in federal and state funds for the construction of wastewater treatment works.** But approximately $4.75 billion is still necessary to meet current state wastewater treatment needs.

- **New Jersey has instituted a wastewater loan fund program.** Low interest loans were issued in state fiscal years 1991, 1992, 1993, and 1994 for approximately $170 million, $131 million, $78 million, and $120 million, respectively. In the past seven years, loans of over $1.1 billion have been awarded.

- **New Jersey has issued permits for approximately 1,400 surface water wastewater discharges.** Two-thirds of these are industrial. There are also about 330 permitted ground water discharges.

- **The Clean Water Enforcement Act (CWEA), was adopted in 1990** amending the N.J. Water Pollution Control Act. 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. The CWEA requires the department to impose mandatory minimum penalties against a permittee that is guilty of a serious violation or found to be in SNC.

- **The Clean Water 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 department has embarked on numerous nonpoint source (NPS) control initiatives.** Current programs designed to control NPS pollution include the following:

New Jersey Sewage Infrastructure Improvement Act (SIIA): The state mandate for nonpoint source control in the coastal region is currently directed under the SIIA. The SIIA program developed by NJDEP is being implemented in three phases: a preliminary mapping and inventory (of stormwater/sanitary sewer systems) phase; a final mapping and monitoring phase; and a pollution abatement phase. General funds for the final phase were deleted from the FY 1995 budget; a 1989 bond fund is available to replace most of the lost funding.

Nonpoint Source Pollution Control Strategy: The department is preparing a detailed Nonpoint Source Pollution Control Strategy that identifies specific tasks necessary for controlling nonpoint source pollution. The strategy is designed to formulate a consistent, comprehensive, and coordinated approach to NPS policy implementation within the department. The strategy identifies all NPS management offices within the department and assigns roles to be coordinated in an intra-departmental effort. As part of this Strategy, the department will place an emphasis on integrating water resources management planning on a watershed basis.

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. This manual will expand eventually to include retrofitting solutions for existing development as new techniques for controlling stormwater and NPS pollution are discovered. Also included in the manual are BMP guidelines for road construction and maintenance. Completion of this section of the manual is expected to occur within 1994.

Barnegat Bay Management Plan (BBMP): The BBMP is a comprehensive land use and environmental management plan for the Barnegat Bay watershed. In July 1993, the NJDEP released A Watershed Management Plan for Barnegat Bay. This 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.

Section 6217(a) of the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA): Section 6217(a) of the CZARA requires each coastal state with a federally approved coastal zone management program under section 306 of the Coastal Zone Management Act (CZMA) to develop and submit to the National Oceanic and Atmospheric Administration (NOAA) and USEPA a coastal nonpoint source pollution control program for approval. The central purpose of section 6217 is to improve state and local government's capability to control and manage land use activities that affect the quality of coastal waters.

Industrial Stormwater Permitting: This program issues permits to stormwater discharges associated with certain industrial activities. An important objective of the program is to utilize pollution prevention strategies and source controls that minimize or eliminate contact between rainfall and potential pollution sources, thus minimizing the need for stormwater treatment.

Musconetcong Watershed Project: The department, in cooperation with an Interagency NPS Committee, is initiating a demonstration project within the Musconetcong River watershed that is designed to develop and implement management measures in a comprehensive manner for nonpoint sources of ground and surface water pollution. The focus of the project is to develop and implement management measures watershed-wide through a coordinated effort between all relevant institutions and programs.

Public Education: Nonpoint source education is one of the most important aspects of department's NPS management program. These public education programs describe the NPS problems in the state and are designed to heighten public awareness regarding NPS issues.

- **The NJDEP has begun instituting a watershed management approach** into the water quality/quantity management process. A watershed approach represents an effort to shape, integrate and coordinate all regulatory/management efforts directed towards water supply, water quality, wellhead protection, stormwater, stream encroachment, wetlands and habitat protection, and to integrate these efforts on the basis of surface watersheds. The goal of the watershed management approach is to:

- improve program integration including the improved coordination of monitoring, modeling, planning, permitting and enforcement through a regional geographic focus that will serve to streamline the resource management process through reductions in bureaucratic duplication and program conflicts;

- build an environmental management process that is based upon consensus, thereby avoiding adversarial relationships with either the environmental or regulated communities; and

- make better use of sound technical information when evaluating resource status and in defining management goals.

- **The department is currently conducting a watershed protection pilot project** in the Whippany River watershed. The project will help the department 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 also will demonstrate how the integration of planning, permitting, monitoring, modeling, financing and enforcement can better protect water resources.

- In coordination with the developing watershed-based approach within the department, **the NJDEP is identifying priority watersheds** in order to provide a basis for the coordinated implementation of both point and nonpoint source pollution control programs.

- **Modifications were formally adopted to the New Jersey Surface Water Quality Standards** in October 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.

B. RECOMMENDATIONS FOR IMPROVING WATER QUALITY IN NEW JERSEY

Introduction:

Water quality in New Jersey has improved in some streams and declined in others, but overall has generally held steady on a statewide basis. How then, can greater improvements in water quality take place across the state?

Listed below are a series of recommendations based on the conclusions in this report. Improving water quality conditions, in the face of extensive residential and commercial development, will be a major challenge for all of the state's citizens, industries, and the various levels of government.

1. Move Forward Towards a Watershed Approach to Water Resource Management Activities

This report strongly recommends that a coordinated watershed-based approach be used when dealing with water pollution control and water resource management. Such an approach would greatly increase overall efficiency and increase the precision with which pollution control measures could be applied. This coordination should involve local, county, regional, state, and federal agencies, as well as local non-governmental interest groups.

Many of the recommendations listed below in this section would, in a sense, automatically become "standard operating procedures" if a watershed approach was fully adopted by the department. A watershed approach can require intensive site-specific monitoring designed to assess pollution sources and loading, and fill data gaps. Point source effluent limitations can be based upon the total maximum loading capacity of receiving waters which should lessen the overall impacts that large concentrations of dischargers can have on receiving waters in developed areas. Detailed assessments of pollution sources, both point and nonpoint, on a local basis would allow management efforts to institute pollution controls on a finely detailed level. Working with local governmental agencies and environmental/citizen groups can provide the department with enormous amounts of information regarding local activities, land uses, and point sources that either can potentially, or are known to, impair local water quality. These same agencies and groups can act to change land uses, zoning regulations, agricultural practices etc., so as to minimize the impacts that poor land use planning and agricultural practices can have on regional waterways.

Because water quality decisions ultimately affect drinking water supplies, wastewater policies need to be developed that more appropriately reflect the need to conserve and protect our dwindling freshwater supplies. The extensive regionalization of municipal treatment plants, and their subsequent discharge to the lower portions of watersheds or to the ocean, are suspected of reducing the recharge of critical water supply areas, especially ground water based supplies. Efforts should be made to integrate water supply management and planning with wastewater management planning in

both statewide and areawide Water Quality Management Plans, so that water supply issues are correlated with wastewater planning and thereby reduce depletive uses. For example, proposals for new wastewater discharges should be made with an effort to aid in the recharge of water supplies within corresponding basins. Concurrently, planning for the discharge of potentially harmful substances should be made so as to avoid any potential contamination of drinking water supplies.

Additional activities that could benefit from a coordinated watershed-based approach include water quality monitoring, water use identification, location and recognition of pollution sources, special protection directed towards waters of high resource value, and generation of public support for water quality management activities.

2. Increased Water Quality Monitoring Activities

Much of the current physical/chemical water quality monitoring conducted in New Jersey by this department is in the form of fixed-station networks. These networks, such as the DEP/USGS Cooperative Water Monitoring Network, utilize a fixed number of monitoring stations located on the larger streams in the state. The major purpose of these networks is to determine long-term water quality trends and general water quality conditions for use in the Water Quality Inventory reporting process. However, these programs do not identify specific sources of water pollution, the assimilation or removal of pollution by the stream environment, and the effectiveness of specific water pollution control activities. If public resources are to be used in the most efficient manner, then specific sources of pollution, which can be controlled, must be properly identified and analyzed for impacts on the receiving waters.

To accomplish these objectives, it is recommended that a broad-based intensive survey monitoring program be implemented in the state. This program would supplement the existing ambient monitoring networks being conducted by NJDEP and other agencies under contract. Watersheds or segments of watersheds would be intensively sampled on a periodic basis. The number of monitoring sites within a watershed would be dependent upon the existing water quality, land uses, known and potential pollution sources, and the amount of available historical data.

An intensive survey program would have as its specific objectives the following: detailed profile of water quality over 24 hour periods; identification of pollution sources; quantification of pollution impacts on receiving waters (from both point and nonpoint sources); comparison of water quality data to flow conditions; modeling to determination the assimilative capacity of the waterbody (TMDL process); and statistical analysis of the data gathered. In addition, such assessments should provide detailed use-support profiles for such designated uses as primary contact recreation and aquatic life support. 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.

3. Increased Identification and Management of Nonpoint Sources of Water Pollution

Nonpoint source pollution has been identified in this report as a significant impediment to achieving designated uses and the water quality objectives of the Clean Water Act within both fresh and coastal waters. In order to implement nonpoint source control measures, nonpoint sources must be identified. The first step must be to segregate nonpoint source (NPS) from point source pollution. This would require a substantial upgrade of monitoring efforts in some instances. When necessary, monitoring should be directed to locate specific nonpoint sources, to the extent possible, in order to provide the focus necessary for nonpoint source control measures to be effectively implemented.

In order to manage nonpoint pollution sources, this report recommends that the department continue to strongly support its nonpoint source (NPS) control programs. To be effective, nonpoint source control should maintain its strong two-fold effort: education and source control. Education is directed to specific audiences: from the general public to local officials to special user groups. Public education will highlight such issues as proper septic tank maintenance; proper disposal of household chemicals, motor oils, pet wastes; and the proper use of chemicals employed in lawn and garden care. Education efforts will also work to make the public more aware of local and state ordinances or laws. The general public needs to be made aware of the contribution which they make to NPS pollution. Source controls focus on programs and policies which prevent or minimize the contact between a pollutant and its principal transport vehicle: stormwater.

NPS controls should be established as part of routine road and stormwater infrastructure systems. The incorporation of municipal stormwater management requirements (that include water quality control features) into local and county planning ordinances is necessary in the state for both new construction activities and existing infrastructure (retrofitting). Routine maintenance and inspections of such structures are also necessary.

4. 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 includes the provision of wildlife habitat, public recreation, source of food, source of commercial activity, and aesthetics. 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 current, and much needed, ambient monitoring effort.

5. Achieving Necessary Effluent Quality from Point Sources

Due to the density of point sources in many of New Jersey's watersheds, wastewater can often have profound impacts on stream water quality. If clean water goals are to be met in New Jersey, it is imperative that all point sources be in compliance with their discharge permit limitations.

Efforts should be made to have all effluent limitations be based upon the water quality standards applicable to the respective receiving waters. 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 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, should significantly aid the department in establishing effective discharge permit limits.

CHAPTER II

INTRODUCTION AND BACKGROUND

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A. INTRODUCTION

The New Jersey 1994 State Water Quality Inventory Report, commonly referred to as the 305(b) report, is the eleventh 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 1994 edition serves to update the more detailed and extensive 1992 Inventory Report. Much of the waterbody specific information presented in the 1992 edition is not included in this edition, but will instead be revised and republished again in the 1996 Inventory Report. This 1994 edition focuses, instead, on water quality in summary form and presents detailed updated information on the Department's water quality management programs. Some waterbody specific data, based upon biological monitoring, are presented in the Appendix of the Report

Readers interested in detailed descriptions of the quality of specific waterways are referred to the 1992 edition.

This current Report covers issues and programs up to the end of 1993. The Report 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, and the estimated costs of such actions.
- A description of the Department's principal water quality management programs.

The State 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.

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 an intensive trophic assessment of public lakes and the results are presented in this report.

This Report contains five chapters: Chapter I - Executive Summary and Recommendations for Improving Water Quality; Chapter II - Introduction and Background; Chapter III - Surface Water Assessment; Chapter IV - Ground Water Quality and Management; and Chapter V - New Jersey's Pollution Control Programs. The information provided in this report has been requested in USEPA's Guidelines for the Preparation of the 1994 State Water Quality Assessment. Much of the narrative in this report was originally prepared for previous reports, and has been updated accordingly.

Chapter I - Executive Summary and Recommendations offers a summary of the material contained within this Report. This chapter also contains a series of recommendations on how to improve water quality within the State based upon the information gathered from this Report.

Chapter III - Surface Water Assessment presents major conclusions regarding the quality of the State's waterways, and summarizes water quality conditions in the State's major rivers and streams using physical/chemical data as well as instream biological monitoring. The quality of the State's lakes, estuaries and ocean waters are assessed 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 new Water Quality Act of 1987, is 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 water-bodies in New Jersey currently under investigation, and their most recent findings.

Chapter V - New Jersey's Water 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.

B. 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 lakes 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 are presented in Table I-1 below:

Table I-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 Figure

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. Figure II-1 shows these basins and the many smaller watersheds within the State: Delaware Bay as the southern border, Delaware River as the western border and the Atlantic Ocean, Raritan Bay, Arthur Kill, Kill Van Kull and Hudson River as the eastern boundary.

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 and Energy 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.

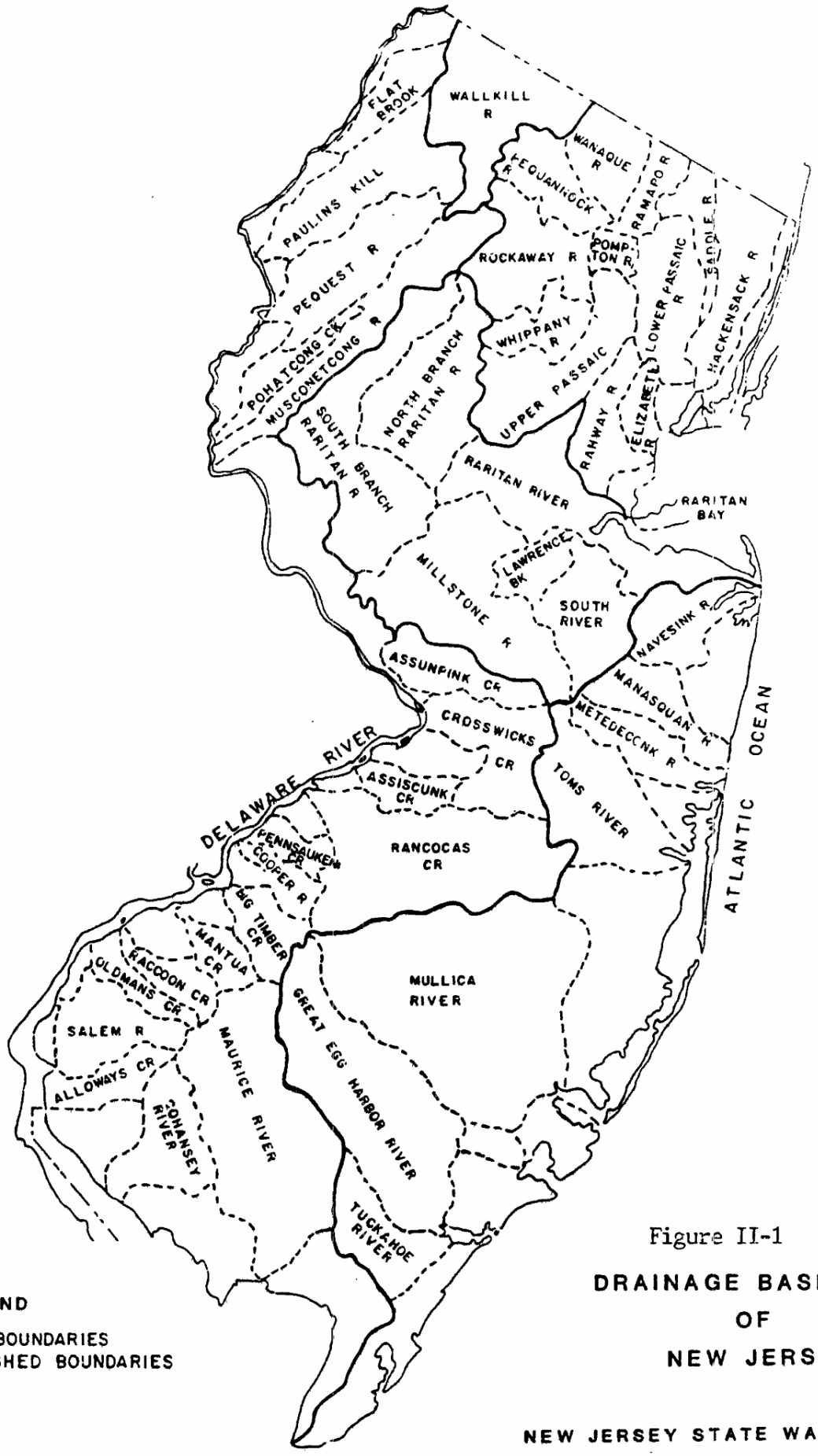

Figure II-1

DRAINAGE BASIN MAP
OF
NEW JERSEY

Accurate figures on the percentage of the various land uses that currently exist in New Jersey are not available. Undeveloped forests and other vacant lands are still the predominant land uses in the State. The remainder is divided fairly equally 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 has also been occurring in an intense manner in New Jersey. Along the Lower Hudson River and the Delaware River, former piers and docks are being 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-2 indicates the extent of Trout Production waters, that is waters designated for trout spawning and nursery purposes within the State (NJDEP, 1983). Figure II-3 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. 7:9-4.1 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.

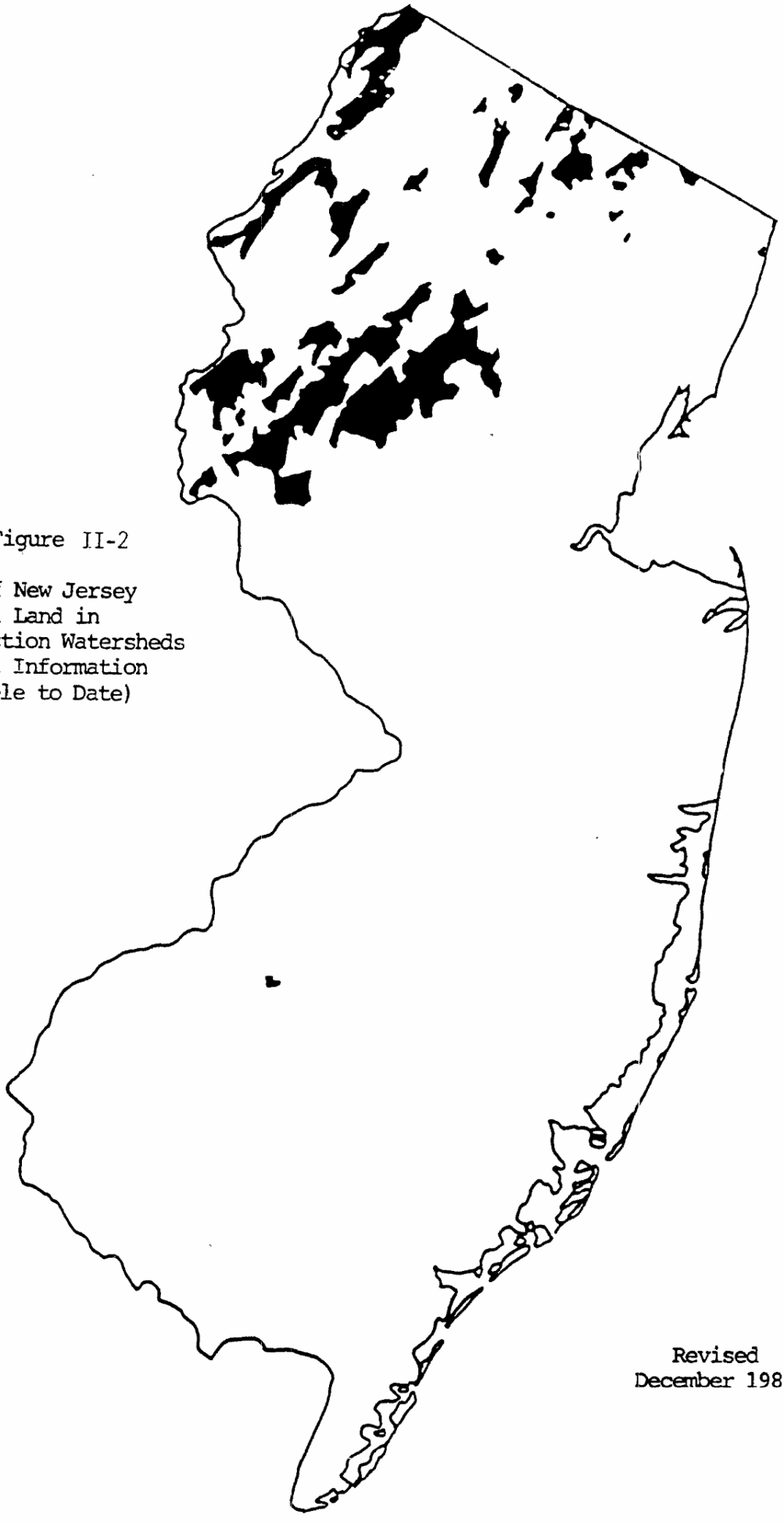

Figure II-2

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

Revised
December 1987

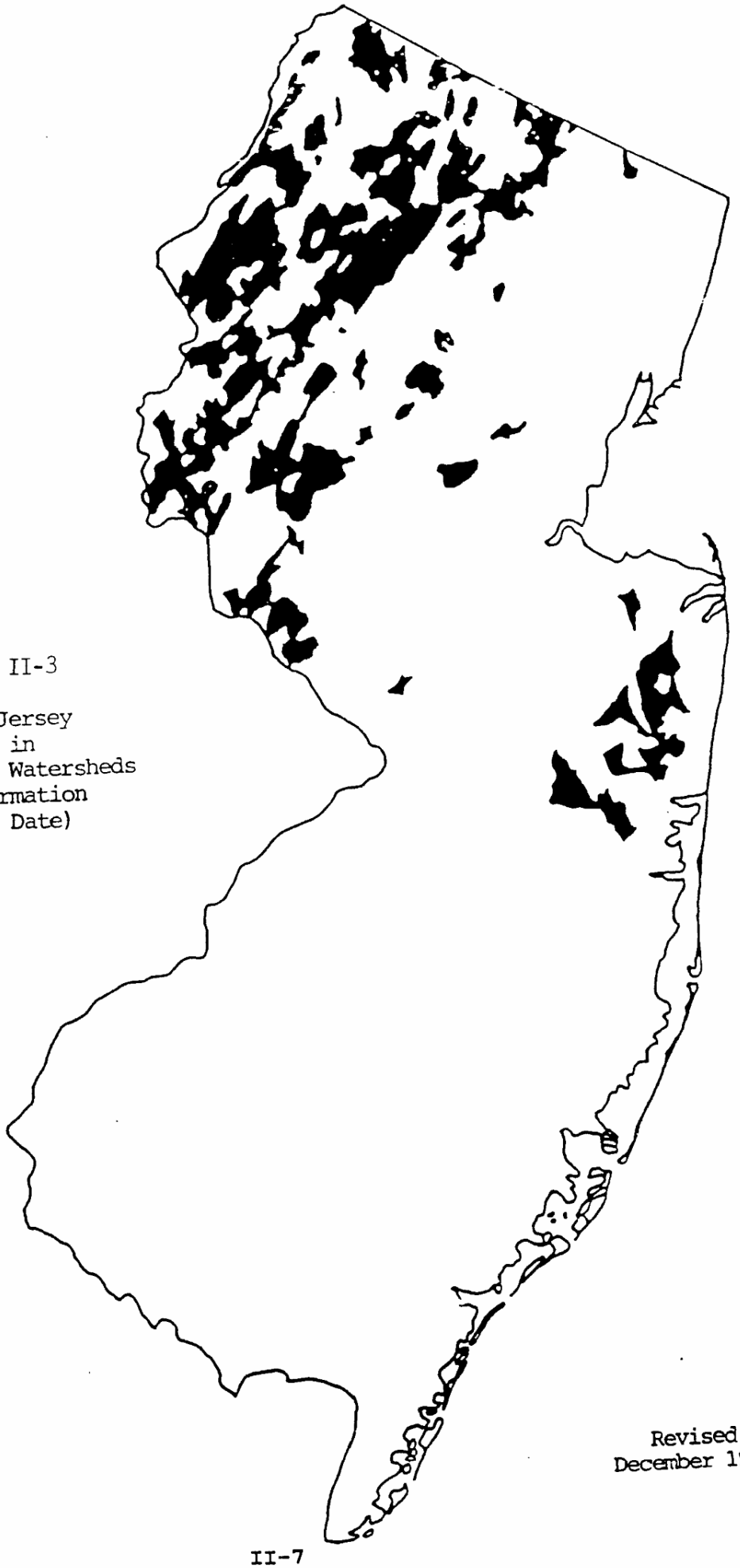

Figure II-3

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

Revised
December 1987

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 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 50 percent of the State's potable water, with 39 percent coming from public-supply wells and 11 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. 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.

Water Classifications and Designated Uses in New Jersey

In New Jersey, all surface waters have been assigned a set of "designated uses" that the waters should be able to support throughout the year (Table II-2). These designated uses are defined in the State's Surface Water Quality Standards regulations (N.J.A.C. 7:9 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 fish propagation and maintenance 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 fish propagation and maintenance goal is designed to have all possible waters supporting healthy and reproducing aquatic biota (usually both indigenous and introduced).

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 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 criteria established by the Delaware River Basin Commission.

Table II-2 SELECTED DESIGNATED USES AND THEIR ASSOCIATED WATER 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.

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CHAPTER III

SURFACE WATER ASSESSMENT

CHAPTER III

SURFACE WATER ASSESSMENT

A: SURFACE WATER ASSESSMENT METHODOLOGY

Introduction

This chapter presents a review of current 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 Commission (DRBC, 1992) and the Interstate Sanitation Commission (ISC, 1992). Hence, the reader is referred to these reports for more detailed information regarding these interstate waters.

Chapter III is divided into 6 sections; they include:

A: Surface Water Assessment, B. Surface Water Monitoring Programs, C. River and Stream Water Quality, D: Lake Water Quality Assessment, E: Coastal Water Quality, F. Toxic Substances.

Surface Water Quality Assessment Methodologies

In New Jersey, all freshwaters are assigned designated uses which reflect federal Clean Water Act clean water swimmable and fishable goals. 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. This is the **aquatic life support designated use**.

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; Water Classifications and Designated uses in New Jersey, 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 is unavailable.

A host of water quality indicators are analyzed at each site. Indicators used in this report to characterize water quality conditions include: stream temperature, dissolved oxygen (concentration and percent saturation), biochemical oxygen demand, pH, fecal coliform, total phosphorus, nitrogen-containing compounds (ammonia, nitrite-nitrate and total Kjeldahl nitrogen), total dissolved solids, and metals (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 1986 and 1990, inclusive. A new assessment will be presented in the 1996 Inventory Report.

Ambient chemical monitoring is supplemented by biological assessments of in-stream macroinvertebrate communities and, in some cases, finfish analyses. 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.

The results of monitoring were 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), bay and ocean phytoplankton monitoring. Also included is USEPA's summer ocean monitoring program. In addition, the interstate agencies perform monitoring of their respective waters which border on New Jersey.

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 USEPA's recommendations as published in its guidelines for the preparation of State Water Quality Inventory Reports. If, over the five year period of monitoring (1986 to 1990, inclusive), fecal coliform levels exceed the State criterion of 200 MPN/100 ml in less than or equal to 10 percent of measurements, then the waters are deemed as **supporting swimmable use**. If fecal coliform values exceed the criterion in 11 to 25 percent of measurements, then waters are classified as **partially supporting swimmable use**. Violations of criterion that are greater than 25 percent of measurements indicates that waters are **not supporting swimmable use**. Waters that are regarded as **threatened** fully support use, however, present or future land uses have the potential to increase the bacterial loading to the point where the water may not support swimmable use in the future.

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, 1992).

Achievement of the aquatic life use is based primarily on information regarding the aquatic biota, but water chemistry analyses are utilized in some situations. Beginning with the 1992 Inventory Report, watershed-specific intensive macroinvertebrate monitoring surveys have been used whenever possible to assess the aquatic life designated use. Macroinvertebrate communities are examined using USEPA's Rapid Bioassessment Protocols (Protocols). From this, evaluations regarding the overall health of instream biota are estimated. In addition, careful recordings of the physical abnormalities observed in the individuals collected are made and used as indicators of possible toxic contamination. These rapid bioassessments have been performed for thirteen watersheds and their results are incorporated into the summary information presented in this report. Summary tables of the most recent five assessments (as of March 1994) are also presented within the Appendix of this report. It is hoped that these assessments will continue and that they will supplement the fishery surveys as determinants of the aquatic life use.

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, are now judged to be partially supporting, and vice versa.

As in past Inventory Reports, this year's report uses fisheries resource information as an assessment tool for determining if the aquatic life use is being met at locations where Rapid Assessment Protocols have not yet been performed. These fisheries assessments are provided by regional biologists of the NJDEP's Division of Fish, Game, and Wildlife and describe the type of fish communities present in the State's waterways and the health of these communities (healthy, moderately degraded, degraded, or threatened). These health classifications are defined as follows:

Healthy (fully supporting Aquatic Life Use): Adequate game fish reproduction and/or adequate species diversity in relation to the natural characteristics of the water. If present, carp or goldfish compose only a minor segment of the population.

Moderately Degraded (partially supporting Aquatic Life Use): Minimal to no game fish reproduction and/or less than adequate species diversity and/or carp or goldfish a major segment of the population.

Degraded (no support of Aquatic Life Use): Population dominated by carp, goldfish, or killifish; or fish population absent or virtually absent.

Threatened: fully supporting Aquatic Life Use, however, present or future land uses have the potential to increase pollution loading to the point where the water may not support Aquatic Life Use in the future.

In the absence of biomonitoring or fisheries surveys, the presence of stressful and/or toxic conditions are used to determine if the environment was stressful to aquatic life. In-stream temperature, dissolved oxygen levels, and deviations from natural pH are used following USEPA's recommended procedures for assessing aquatic life use attainment. Fully supporting the use is established if and when violations occur in 10 percent or less of the samples taken over the 5-year period of assessment. A classification of partially supporting the use results when criteria are exceeded in 11 to 25 percent of the samples. Criteria exceedances of more that 25 percent result in the waterway being classified as not meeting the aquatic life support use.

When regarding metals data; a waterway or segment was judged to be fully supporting aquatic life use if no violations of acute criteria were observed within the 5-year period of assessment. If one violation was recorded during the assessment period, the waterway was judged to be partially meeting use. If two or more violations were noted, the waterway was assessed to be not meeting use. When assessing ammonia toxicity (un-ionized ammonia), a waterway is regarded as fully supporting the use if and when samples indicate zero to one violation of criteria. More than one violation results in the waters being classified as not supporting the use.

The fitness of aquatic life for human consumption is also an aspect of the aquatic life criteria. 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.

It should be noted that many factors affect the ability of a waterway to support a healthy aquatic community. Only a limited range of parameters which cause stress to aquatic life are reviewed during ambient chemical monitoring in New Jersey. Therefore, community conditions may be rated as "not supporting aquatic life use" based upon chemical monitoring, but actual biological conditions could be quite different from what this use support rating implies. New Jersey regards such assessments (those based upon chemical analyses alone) as being designed for USEPA's use for the purpose of performing nation-wide comparisons. We do not regard an assessment of "no aquatic life support" based upon even a few transgressions of water quality criteria of such parameters as un-ionized ammonia as necessarily reflecting the true biotic conditions within a stream. The only accurate method of assessing the successful support of aquatic biota is to examine the aquatic community itself.

It is important to note at this point that because of the intensity of land use within New Jersey, the dense population, economic pressures for development, and the ubiquitous nature of nonpoint source pollution throughout the State; all waters assessed as fully supporting designated use in this report are classified as threatened. This applies to both the primary contact recreation use and the aquatic life support use statewide.

B: SURFACE WATER MONITORING PROGRAMS

Introduction

What follows is a discussion of the water quality monitoring activities which are being conducted in the State. Monitoring data is 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 1980's, there has been a gradual shift in the emphasis of the Office of Water Monitoring's monitoring activities. One such trend has been a significant expansion of biological monitoring. A second trend has been a greater emphasis on the coastal area where the monitoring emphasis is expanding from just sanitary assessments to a broader based water quality assessment. The present emphasis in the State's inland monitoring activities is still focused on point sources, however, some nonpoint source-related monitoring data is now becoming available. In coastal regions, most sources of contamination are nonpoint (including storm-sewers); hence, in these regions nonpoint source monitoring are regarded as extensive.

The present and anticipated water quality monitoring activities in New Jersey are summarized in the following paragraphs. For the purposes of this discussion, the activities are divided into the following categories: state-wide routine fresh water monitoring, estuarine and ocean monitoring, biological monitoring, and regional intensive surveys/special studies. It should be understood that although an activity falls within a particular category within the discussion, there may be aspects of the project which overlap with other categories. 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

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 Primary/Basic 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 regards to the location of sampling sites, the frequency of sample collection, and the parameters monitored. Twenty-five 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 Primary and Basic systems were combined and treated as one system with common parameters and sampling schedules. A total of eighty-three sampling sites now exist 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. All water column constituents are sampled five times a year. Dissolved metals continue to be sampled twice per year during high and low base flows. Bottom sediment samples are taken once a year during low flows in October. Three stations located with in protected watersheds (state parks, etc.) that had shown stable water quality over time were selected to have their sampling frequency reduced.

The six National Stream Quality Accounting Network (NASQUAN) stations maintained by USGS remains a separate network and were not included in the monitoring changes described here. The NASQUAN system is described in detail below.

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
nitrite + nitrate	TKN	total phosphorus
fecal coliform bacteria	fecal strep bacteria	TOC

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

Supplemental water column parameters include:

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

Supplemental sediment parameters include:

metals	organic pesticides	herbicides	PCBs

The parameter list also includes the analysis of dissolved as well as total constituents. These additions will provide a more detailed level of nutrient assessment, allowing a better understanding of the cycling, transport, and fate of nutrients and organic carbon in State waters. The following water column analyses have been added to the existing system of analyses: suspended solids, dissolved nitrate/nitrite, dissolved Kjeldahl nitrogen, dissolved phosphorus, BOD, and COD (the later two at selected sites).

National Stream Quality Accounting Network (NASQUAN), and National Hydrologic Benchmark Network: These are USGS water quality monitoring programs. The purpose of the NASQUAN network is to determine the quality of the Nation's waters. There are six NASQUAN network stations in New Jersey. Samples are analyzed for several conventional parameters, although at one station (Delaware River at Trenton) samples receive radiochemical analysis.

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.

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 end 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.A.C. 7:18 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 (see NJDEP, 1992) is overseen by the New Jersey Department of Environmental Protection and the Department of Health 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

Coastal helicopter overflights: Daily helicopter observations are performed by the Department's Office of Enforcement Policy 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. In the 1989 summer season there were approximately 120 such low level flights along the New Jersey coast.

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.

NJDEP Ambient Biomonitoring Program: These studies involve the intensive collection, analysis, and reporting of macroinvertebrate data for candidate freshwater streams using EPA's Rapid Assessment Protocol as applied to macroinvertebrate communities. Data from these assessments, in concert with fin-fish data, provide the basis for the determination of aquatic life support within the freshwater rivers and streams presented in this report.

Compliance Monitoring

NJPDES Compliance Sampling: This is a continuing program of 24-hour compliance sampling at selected NJPDES permittees 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 in cooperation with the participating county health departments maintain a regional pinelands surface water quality monitoring and data management program (N.J. Pinelands Commission, 1991). 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.

Navesink River Water Quality Improvement Project: Both the Navesink River and the Shrewsbury River represent the only significant commercial source of soft shell clams in the State. The Navesink, in addition, supports a large population of hard clams. Because of excessive bacterial contamination, these shellfish resources have been closed to direct harvesting since the 1960's. The Navesink River Water Quality Improvement Project is part of the Department's overall Water Quality Management Program Plan pursuant to the New Jersey Water Quality Planning Act, and the Federal Clean Water Act. The major goal of this project is to reduce bacterial pollution brought about by nonpoint source pollution to a degree sufficient to allow the direct harvesting of shellfish from the Navesink. In 1986 the USEPA, U.S. Department of Agriculture, the NJDEP, the N.J. Department of Agriculture, and eleven local agencies and academic institutions signed a Memorandum of Understanding, pledging support to the project.

The primary focus of the program since 1980 has been to assess the sources of fecal coliform contamination in the Navesink River. Towards that end, numerous intensive surveys assessing bacterial contamination, land use analysis, and shoreline surveys have been performed. These studies represent cooperative efforts between this Department, local health departments, as well as other local, state, and federal agencies.

Efforts to identify pollution sources are now evolving towards the institution of nonpoint source control measures throughout the watershed. The most notable move toward pollution control at this point in time is a comprehensive $1.3 million Watershed Plan established by the U.S. Department of

Agriculture and administered by the Soil Conservation Service and the Freehold Soil Conservation District.

Interest in improving the water quality of the Navesink River continues to grow, especially on the local level. An Implementation Plan guiding the institution of best management practices, further monitoring, and research has been developed. Success of this plan will rely on the continued cooperation of many agencies at all levels, with significant input from local interest groups.

C: 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 525 monitored freshwater miles for primary contact use (swimming). Aquatic life support assessments are based upon 545 monitored miles and approximately 1070 evaluated stream 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-C1.

TABLE III-C1

	DESIGNATED USE:	
ASSESSMENT CATEGORY	Primary Contact Recreation	Aquatic Life Support
Fully Supports Not Threatened:	0	0
Fully Supports But Threatened:	80 (15.2%)	1,101 (68%)
Partially Supports:	40 (7.6%)	306 (19%)
No Support:	405 (77%)	210 (13%)
Total Miles Assessed:	525	1,617

Note: Figures indicate linear stream miles. Percentages denote proportions taken from the total miles assessed for each designated use.

In view of the level of development within our State, the population density, and the intensity of land use even within protected watersheds; the Department regards all waters of the State as "Threatened," even when designated uses are fully supported. In applying the guidelines provided by USEPA in 1992, waters in New Jersey fully meeting designated uses are classified as "fully supporting use but threatened" in this Report. This differs from earlier Inventory Reports where the "threatened" category was classified

as a subset of "fully meeting use." In response to USEPA's Guidelines, "threatened" is now its own category, separate from "fully meeting use."

Of the total 525 linear stream miles monitored for primary contact use, 80 miles or 15 percent fully support the primary contact (swimmable) use but are threatened (Table III-C1). Another 40 linear miles (8 percent of assessed waters) partially support the use. Primary contact use is not supported in 405 miles (77 percent). High fecal coliform concentrations are the principal reason why so many waterways are not of swimmable quality. Waters classified as swimmable are those often in protected watersheds or directly downstream of an impoundment where the settling action of the impoundment is likely to reduce the instream bacteria levels.

The proportion of New Jersey's freshwaters supporting healthy and reproducing fish populations is considerably better (Table III-C1). Of the approximately 1,600 stream miles evaluated and monitored, 1,101 or 68 percent of assessed waters are believed to be fully supporting the aquatic life use. But again, these miles are regarded as threatened. Waters which have moderately degraded fish communities are considered to be partially meeting the aquatic life use; nineteen percent of the assessed waters fall into this category. Only 13 percent are classified as not meeting the use, or in other words have severely degraded communities. As a rough generalization, one can say that streams classified as fully supporting the primary contact recreation use are of sufficient quality that they also fully support the aquatic life use.

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. Extensive macroinvertebrate assessments are replacing 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. Slight changes in the assessment of the primary contact use have also made comparisons difficult. The Department has changed its criteria to conform to USEPA's "standardized" nation-wide assessment procedure for primary contact recreation. Although these changes are not significant, they none-the-less 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-C2 summarizes which pollutants are found in the State and their relative impact, based upon a 1988 assessment. The table shows that nutrients and pathogens/bacteria are excessive in 81 percent 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 from road salts, and oil and grease.

TABLE III-C2. SUMMARY OF POLLUTANTS FOUND IN NEW JERSEY'S FRESHWATERS
Numbers denote percentages of monitored freshwaters containing the pollutant in what the Department regards as elevated levels. Based on a total of 590 monitored miles.

Pollutant Categories	Major/Statewide Impacts	Moderate/Localized/Minor Impacts
Unknown Toxicity		?
Pesticides		3
Priority Organics		3
Nonpriority Organics		?
Metals		1
Ammonia		14
Chlorine		?
Nutrients	81	
pH		8
Siltation	?	
Organic Enrichment/Dissolved Oxygen	11	
Salinity/Road Salts	?	
Thermal Modification		13
Flow Alteration		?
Habitat Alterations		?
Pathogens	81	
Radiation		?
Oil and Grease	?	

Key:
? = Impact is suspected; a lack of monitoring data exists 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, ammonia, pH deviations, and temperature or thermal modifications. These problems have been detected in monitoring activities, and they range from being elevated in one percent of the monitored waters (metals) to 14 percent (ammonia). Most other categories of pollutants, as defined by EPA (Table III-C2), 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.

The actual source of these water quality problems is very difficult to assess. Table III-C3 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 can not be correctly made. Even when modeling activities are

conducted in New Jersey they are usually directed towards specific applications such as wasteload allocations. As such, they analyze low flow conditions and hence are focused principally towards point source contributions.

TABLE III-C3. 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: Insufficient information exists 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, illegal discharges, and facilities in permit noncompliance are all fairly common sources of water pollution in New Jersey. 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

The database that this and previous Water Quality Inventory Reports utilizes for water assessments employs a water quality indexing procedure developed by the USEPA Region X for assessing water quality conditions and trends for regional and national environmental profiles. This Water Quality Index

(WQI) is a modified version of a index first developed and described by the National Sanitation Foundation in 1970 (Brown, et. al., 1970).

The Water Quality Index transforms water data to a value between 0 (best or no pollution) and 100 (worst case conditions or gross pollution) through the use of severity curves. The severity curve is a plot of the water quality constituent concentration (i.e. dissolved oxygen, phosphorus, etc.) versus pollution assessment (the 0 to 100 scale or index). The indices for each data value are then averaged and aggregated with the indices for the other indicators assessed to get a single WQI value for a location over time. The Pollution Categories and Components used to prepare the WQI for New Jersey's waters are as follows:

Criteria Category	Component	(Index Value of 20)
Temperature	Temp. Cold-water fishery	19°C
	Temp. Warm-water fishery	28°C
Oxygen	Dissolved Oxygen-Trout Production	7 mg/l
	Dissolved Oxygen-Trout Maintenance	5 mg/l
	Dissolved Oxygen-Nontrout	4 mg/l
	D.O. Saturation	80, 120 %
pH	pH-Non-acidic waters	6.5 - 8.5 SU
	pH-Pinelands naturally acidic	3.5 - 5.5 SU
	pH-Non-Pinelands naturally acidic	4.5 - 7.5 SU
Bacteria	Fecal Coliform	200 MPN/100ml
	Total Coliform	2400 MPN/100ml
Nutrients	Total Phosphorus-Free flowing waters	0.10 mg/l
	Total Phosphorus-Above impoundment	0.05 mg/1
	Total Kjeldahl Nitrogen	2.5 mg/l
	Total Inorganic Nitrogen	2.0 mg/l
Solids	Total Dissolved Solids	500 mg/l
	Conductivity	750 micromhos
Ammonia	Un-ionized-Warm waters	0.05 mg/l
	Un-ionized-Trout waters	0.02 mg/l
Metals	Total Lead	50 ug/l
	Total Copper	50 ug/l
	Total Mercury	0.50 ug/l
	Total Cadmium	4.0 ug/l
	Total Chromium	50 ug/l

Between the extremes of 0 and 100, the WQI scale is divided into excellent, good, fair, poor, and very poor conditions as follows:

WQI	Classification/ Condition	Description
0-10	Excellent	No or minimal pollution; water uses met throughout year.
11-25	Good	Generally low amounts of pollution; water uses periodically not met.
26-60	Fair	Pollution amounts vary from moderate to high levels; certain water uses prohibited.
61-80	Poor	Pollution in high amounts; water uses not met.
81-100	Very Poor	Pollution occurs at extremely high levels causing severe stress to streamlife, water uses not met.

An index of 20 is equivalent to the level of water quality criteria.

Separate WQI values are calculated for all data of each component in a category. The water quality indicators (components) are then aggregated to determine the final WQI value for each station. Total station WQI values are given for the entire period of review, five years in this case. Two aggregation methods are available: an "additive", and a "synergistic" aggregation. The synergistic procedure is used for this report as it tends to better represent actual conditions. The synergistic aggregation procedure takes the average of each category and then adds additional index "points" based on how much the data exceeds respective criterion and at what time of year the exceedances occur.

In order to estimate the changes in water quality status within New Jersey's fresh water rivers and streams over the past ten years; a simple comparison was performed between the WQI values originally reported in the 1988 305(b) Report and the Indices subsequently calculated and reported in the 1992 305(b) Report (Table III-C4). The Indices reported in the 1988 Report are based upon data collected at 104 ambient monitoring stations throughout the State between 1983 and 1987, inclusive. The Indices reported in the 1992 Report are derived from data collected from the same stations between 1986 through 1990.

It was decided that differences in the 1988 and 1992 Indices of less than five would be regarded as due to random fluctuations in the Index through time, a sort of "background noise." Differences equal to or greater than five were noted and tabulated.

Of the 104 stations compared; 60 showed either no change or a difference of less than five. Eleven stations showed changes of exactly five and of these six showed some improvement in water quality while five exhibited some decline in quality. Thirty-three stations revealed differences greater than five and out

of these; 16 showed some improvement and 17 revealed some decline in water quality.

At this point the reader must keep in mind two important points.

- The WQI values being compared here are based upon a synergistic aggregation as discussed above. This means that additional weight is given to months that have multiple parameters occurring at unacceptable levels. Hence, changes in the Index can occur when a series of parameters that formerly occurred in excess levels, each in different months during one 5-year series, then begin to occur at high levels during the same month in a subsequent 5-year series. The WQI can go down if the reverse occurs when two or more indicators that formerly occurred at unacceptable levels within one month then shift temporally, causing the violations to instead occur in separate months.

- The WQI values and their corresponding changes should be applied only to conditions occurring immediately at the sampling stations listed in the table. Conclusions should not be applied or extrapolated beyond the immediate station locations to other portions of the corresponding rivers, watersheds, and/or basins.

The comparisons performed here suggest that in terms of water quality management of fresh waters, management programs have had success; however, there are indications that there are limits to the effectiveness of the Department's water pollution management efforts in these waters. The causes underling these changes in the Indices are currently unclear. Additional analysis is being performed in an effort to further clarify and substantiate these observed trends as well as to understand the causes behind them. These analyses should lead to more effective water quality management on the part of the Department.

TABLE III-C4. Comparisons of Water Quality Index (WQI) values obtained between two periods of review: 1983 through 1987 and 1986 through 1990. Resulting differences [Δ] contained within parentheses indicate a negative number suggesting a decline in the water quality at that particular station. Differences not contained in parentheses are positive values and point toward improvements in water quality as reflected in the WQI.

WATERWAY	STATION	Overall WQI 1988	Overall WQI 1992	Δ WQI	WATER QUALITY CHANGE (>5)	WATER QUALITY CHANGE (= 5)
WALLKILL R.	Franklin	24	19	5		Improvement
	Sussex	16	16	0		
	Unionville	23	23	0		
PAPAKATING CR.	Sussex	35	33	2		
BLACK CR.	Vernon	32	24	8	Improvement	
FLAT BROOK	Flatbrookville	12	12	0		
PAULINS KILL	Balesville	39	41	(2)		
	Blairstown	17	18	(1)		
PEQUEST R.	Pequest	19	23	(4)		
POHATCONG CR.	New Village	37	39	(2)		
MUSCONETCONG R.	Lake Hopatcong	14	18	(4)		
	Lockwood	19	17	2		
	Beattystown	21	19	2		
	Bloomsbury	30	14	16	Improvement	
	Riegelsville	34	25	9	Improvement	
WICKECHEOKE CR.	Stockton	29	20	9	Improvement	
ASSUNPINK CR.	Clarksville	16	16	0		
	Trenton	54	55	(1)		
CROSSWICKS CR.	Extonville	24	29	(5)		Decline
DOCTORS CR.	Allentown	32	31	1		
NB RANCOCAS CR.	Browns Mills	14	9	5		Improvement
	Pemberton	11	10	1		
	Mt. Holly	20	19	1		
SB RANCOCAS CR.	Vincentown	20	24	(4)		
	Hainesport	44	47	(3)		
SB PENNSAUKEN CR.	Cherry Hill	80	81			
NB PENNSAUKEN CR.	Moorestown	50	49	1		

WATERWAY	STATION	Overall WQI 1988	Overall WQI 1992	Δ WQI	WATER QUALITY CHANGE (>5)	WATER QUALITY CHANGE (= 5)
COOPER RIVER	Lindenwold	20	15	5		Improvement
	Lawnside	95	78	17	Improvement	
	Haddonfield	90	76	14	Improvement	
SB BIG TIMBER CR.	Blackwood Terrace	27	23	4		
RACCOON CR.	Swedesboro	16	22	(6)	Decline	
OLDSMAN CR.	Porches Mill	20	22	(2)		
SALEM RIVER	Woodstown	25	35	(10)	Decline	
	Courses Landing	45	52	(7)	Decline	
COHANSEY RIVER	Seeley	38	40	(2)		
MAURICE RIVER	Norma	7	8	(1)		
	Millville	18	23	(5)		Decline
GR EGG HARBOR R.	Sicklersville	78	75	3		
	Blue Anchor	43	34	9	Improvement	
	Folsom	49	50	(1)		
	Weymouth	27	19	8	Improvement	
W. BR WADING R.	Maxwell	4	6	(2)		
OSWEGO RIVER	Harrisville	5	5	0		
E. BR BASS RIVER	New Gretna	10	13	(3)		
MULLICA RIVER	Atsion Lake	5	10	(5)		Decline
BATSTO RIVER	Batsto	6	9	(3)		
HAMMONTON CR.	Westcoatville	84	91	(7)	Decline	
MULLICA RIVER	Green Bank	19	50	(31)	Decline	
TOMS RIVER	Toms River	14	6	8	Improvement	
MANASQUAN RIVER	Squankum	33	14	19	Improvement	
MARSH BOG BROOK	Squankum	28	14	14	Improvement	
JUMPING BROOK	Neptune City	7	10	(3)		
SHARK RIVER	Neptune	11	14	(3)		
SB RARITAN RIVER	Middle Valley	19	21	(2)		
	High Bridge	20	22	(2)		
SB RARITAN RIVER	Stanton Station	26	22	4		
	Three Bridges	28	24	4		
MULHOCKAWAY CR.	Van Syckel	14	34	(20)	Decline	

WATERWAY	STATION	Overall WQI 1988	Overall WQI 1992	Δ WQI	WATER QUALITY CHANGE (>5)	WATER QUALITY CHANGE (= 5)
SPRUCE RUN	Glen Gardener	17	30	(13)	Decline	
	Clinton	12	14	(2)		
NESHANIC RIVER	Reaville	54	44	10	Improvement	
LAMINGTON RIVER	Ironia	41	37	4		
	Pottersville	18	18	0		
	Burnt Mills	15	18	(3)		
ROCKAWAY CREEK	Whitehouse	16	29	(13)	Decline	
N BR RARITAN R.	Chester	27	30	(3)		
	Burnt Mills	16	24	(8)	Decline	
	North Branch	15	26	(11)	Decline	
MILLSTONE RIVER	Manalapan	22	12	10	Improvement	
	Grovers Mill	60	57	3		
	Kingston	22	19	3		
	Blackwells Mills	31	36	(5)		Decline
	Weston	28	29	(1)		
STONY BROOK	Princeton	31	32	(1)		
BEDENS BROOK	Rocky Hill	27	26	1		
SOUTH RIVER:						
MANALAPAN BROOK	Manalapan	24	19	5		Improvement
	Spotswood	18	14	4		
MATCHAPONIX BROOK	Spotswood	30	32	(2)		
RARITAN RIVER	Raritan	16	18	(2)		
	Manville	17	26	(9)	Decline	
	Queens Bridge	31	26	5		Improvement
W BR. RAHWAY R.	West Orange	41	43	(2)		
RAHWAY RIVER	Springfield	43	45	(2)		
	Rahway	29	26	3		
ELIZABETH RIVER	Ursino Lake	59	55	4		
U.PASSAIC RIVER	Millington	35	30	5		Improvement
	Chatham	44	51	(7)	Decline	
	Two Bridges	70	56	14	Improvement	
WHIPPANY RIVER	Morristown	69	33	36	Improvement	
	Pine Brook	52	49	3		
ROCKAWAY RIVER	Boonton	14	21	(7)	Decline	
	Pine Brook	41	37	4		

WATERWAY	STATION	Overall WQI 1988	Overall WQI 1992	Δ WQI	WATER QUALITY CHANGE (>5)	WATER QUALITY CHANGE (= 5)
PEQUANNOCK RIVER	Macopin Intake	12	16	(4)		
WANAQUE RIVER	Wanaque	3	13	(10)	Decline	
RAMAPO RIVER	Mahwah	32	22	10	Improvement	
POMPTON RIVER	Packanack Lake	20	25	(5)		Decline
L.PASSAIC RIVER	Singac	31	38	(7)	Decline	
	Little Falls	23	30	(7)	Decline	
	Elmwood Park	59	54	5		Improvement
SADDLE RIVER	Fair Lawn	68	66	2		
	Lodi	70	68	2		
HACKENSACK RIVER	River Vale	23	21	2		
	New Milford	15	30	(15)	Decline	

D: LAKE WATER QUALITY ASSESSMENT

Clean Lakes Program

The Clean Lakes program 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 is implemented by the Department under the guidance of USEPA. In New Jersey there are 380 public lakes representing 24,000 acres.

The restoration projects are 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 be awarded, as funds allow, according to a ranking list that is developed according to the methodology developed for the N.J. Lake Classification Study Priority Ranking System, submitted to EPA Region II in September 1984. To be considered for a grant award, a candidate project proposal must be submitted to the Department's Bureau of Water Monitoring. All proposals should conform to the "Requirements for Diagnostic-Feasibility Studies", as defined in 40 CFR Part 35, Appendix A.

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 Soil Conservation Districts. Over the years the program has amassed a useful body of information regarding the sources and causes of lake impairments across the State as a result of the numerous Phase I studies that have been performed.

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.

Grants are be awarded according to the lake prioritization or ranking system mentioned above, with this ranking being reevaluated every year. 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.

Projects are funded through available USEPA and N.J. Clean Lakes Program funds, and require some contribution from local funding sources. Current funding formulas, as defined in N.J.A.C. 7:9-15 et seq. are listed below. Note that if State funds are not available, the applicant must provide that portion of the funds that are non-federal. For a Phase I project this translates into

30% of the total project costs; for a Phase II project, this would be 50% of total project costs.

Phase I
1) 70% USEPA, 15% State, 15% Local
2) 50% State, 50% Local (if federal funding is not available)

Phase II
1) 50% USEPA, 40% State, 10% Local
2) 75% State, 25% Local (if federal funding is not available)

Note: Projects that are funded by special appropriations may have a different funding formula.

As stated in the beginning of this chapter, 126 lakes, with a total of 11,172 acres, have been evaluated for trophic status in New Jersey through the Clean Lakes Program so 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.

Lake Quality Statewide

Most lake monitoring in New Jersey is conducted under the umbrella of the Clean Lakes program. The Clean Lakes program, as implemented by The Department's Bureau of Monitoring Management under the guidance of USEPA, monitors public lakes for the purpose of assessing trophic status. In New Jersey there are 380 public lakes with a total acreage of 24,000 acres. Of these to date, 126 lakes, with a total of 11,172 acres, have been evaluated through a combination of state funded intensive surveys, and federally funded lake assessment projects.

Trophic assessments are based on Trophic State Criteria, as described in USEPA's Clean Lakes Program Guidance Manual. Parameters used in the assessment are total phosphorus, chlorophyll a, and Secchi disk transparency. Trophic status may also be determined by documented recreational use impairments caused by excessive macrophyte populations, bacterial contamination, and sedimentation. A lake is 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.

As with rivers and streams, 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.

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, 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 Robert K. Tucker, Director, Division of Science and Research, NJDEP. A summary of the findings are presented in part F "Toxic Substances" of this chapter.

With regards 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.

Lakes Water Quality Assessment For 1992

The objective of Lake Water Quality Monitoring Program for 1992 was to acquire limited limnological data from specific public lakes so that a baseline trophic status could be determined for each. This information will also be used to monitor future lake water quality trends. This project represents an on going lake assessment process that has existed for several years now. The study for 1992 was supported by an extension to the FY89 Lake Water Quality Assessment Grant by the United States Environmental Protection Agency (USEPA) Clean Lakes Program.

Sixteen lakes totaling 662 acres were monitored during 1991. Lakes selected must provide public access as defined in 40 CFR part 35 (USEPA Program Regulations). Candidate lakes then are ranked, the higher priority lakes being -

Lakes that provide primary contact recreation and high quality fisheries.

Lakes that are regarded as important to the community and that may participate in a NJDEP or USEPA managed Clean Lakes Restoration Project at some time in the future.

The survey was performed from April through October, 1992. Lakes were monitored three times, once each during the spring, summer, and fall. Lake samples were obtained at a site that best represented the lake as a whole. Samples were also taken at main tributaries. Samples were analyzed for the following parameters:

- Total phosphorus
- Algal identification (in-lake only)
- Secchi disk (in-lake only)
- Chlorophyll a (in-lake only)
- Ortho phosphorus
- Dissolved oxygen (D.O.)
- Aquatic macrophytes
- Temperature

- Bacteria (fecal & total coliform, fecal streptococcus or enterococcus)

- Alkalinity and pH

Lakes were considered eutrophic if

- total phosphorus was equal to or greater than 0.02 mg/L;
- macrophyte growth was significant enough to impair recreational usage;
- chlorophyll a levels exceeded 10 ug/L.

It should be noted that since each lake was monitored for only three seasons, assumptions are being made as to the lakes year-round status.

All sixteen lakes exceeded at least one of the criteria listed above and therefore are considered eutrophic. However, three of the lakes are considered to be borderline eutrophic because of mitigating factors. Lake Oswego, Tuckahoe Lake, and Malaga Lake had low nutrient and chlorophyll a levels in the water columns. Each lake is naturally shallow and therefore will support macrophyte growth with a minimal amount of nutrients present. In addition, these lakes had macrophyte growth which impaired recreational usage in some areas, however, all three still had significant percentage of their areas fully usable for boating and fishing.

None of the lakes in the project had any known point source discharges, therefore, nonpoint source pollution is believed to be the cause of water quality degradation in all of the lakes. Nonpoint sources may have included runoff from agricultural, urban or construction areas or any combination of there of.

Heavy macrophyte growth imposed the greatest impairment to recreational usage. Those lakes most affected included Ghost, Harrisonville, Hooks Creek, Sawmill, Shenandoah, Steenykill, and Stony. *Myriophyllum spp.* (watermilfoil) and *Utricularia spp.* (bladderwort) were the most prevalent nuisance species. The heaviest algal blooms were found in Amwell Lake, Grenloch Lake, Stone Tavern Lake and Shenandoah Lake. By far, the lake with the heaviest algal blooms was Amwell whose watershed is mainly agricultural. Stone Tavern Lake's watershed is also mainly agricultural. Grenloch and Shenandoah's watersheds are a combination of agricultural and developed areas.

The brief summations of each lake examined in the project and the problems found to be impairing their use are listed in Appendix A of this report.

Toxic Substances in Finfish Tissue: 1993 Lake Monitoring Project

In 1993, the Bureau of Water Monitoring (BWM), within the Division of Science and Research, began a fish tissue collection and analysis survey designed to provide a baseline for bioaccumulation of various parameters in selected lakes. 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. As of this writing (April 1994) the results of the survey are still pending.

A total of 5 lakes were selected for the initial year of the fish tissue project, all located within the Passaic River Watershed/Basin. The following lakes have been sampled during the summer of 1993;

LAKE	COUNTY	LAKE	COUNTY
Boonton	Morris	Speedwell	Morris
Greenwood	Passaic	Splitrock	Morris
Shepherd	Passaic		

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		

E: 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, 1992). 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, 1992, 1993). 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 initialed. 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 Office of Enforcement Coordination.

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 1980's up to 1991 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 (NJDEP, 1989a, 1992, 1993a).

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. Many 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 (NJDEP, 1989, 1992, 1993a).

Bacterial monitoring along the coast for evaluating water quality in the light of the surface water quality standards is performed during the beach season and is summarized as the geometric mean of all samples collected during a season at each station. Expressed in these terms, 99.4 percent of the ocean stations and 92.5 percent of the bay stations met water quality standards in 1992. In 1993, 100 percent of the ocean stations and 97.9 percent of the bay stations met standards. The data indicate that a substantial portion (all ocean in 1993) 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 ever 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	**1993**	**1992**	**1991**	**1990**	**1989**	**1988**
Bacteria	34	27	10	22	35	784
Floatables	0	0	0	10	9	19
Total	34	27	10	32	44	803

BAY CLOSINGS:

Reasons	**1993**	**1992**	**1991**	**1990**	**1989**	**1988**
Bacteria	54	84	97	202	232	52

Table from the Draft CCMP Report for 1993.

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 1990, a total of 439 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:

Estuary/bay and ocean waters (as square miles) assessed for sanitary fitness for shellfish harvesting as of 1994:

BAY AND ESTUARY (as square miles):

Fully Supporting	No Support	Partially Supporting	Total
450	44	120	614

OCEAN (as square miles):

Fully Supporting	No Support	Total
334	105	439

See Chapter V for a detailed discussion of the overall shellfish monitoring program. Appendix A of this Report presents detailed information regarding shellfish resources and recent changes in harvesting area classifications. Restrictions and alerts regarding the consumption of finfish due to toxic contamination are presented in section F: Toxics, under "Fish Advisories" within this Chapter.

Regional Use Attainment Status of New Jersey's Shellfish Growing Waters

For the purpose of this Report, New Jersey has been divided into four major basins which are subject to shellfish growing water classification regulations. These basins are the Raritan River Basin, the New Jersey North Coastal Basin, the New Jersey South Coastal Basin, and the Delaware River Basin Commission Zones 5 and 6, and the Atlantic Ocean.

Raritan River Basin

Only a small portion of the Raritan River itself is relevant here, as most of the upper basin consists of freshwater habitats. Areas of consideration are Raritan Bay, Lower New York Bay, Sandy Hook Bay, Navesink River, Shrewsbury River and their tributaries. There are no waters in this basin classified as Approved.

Seventy-five percent of that portion of the Raritan River Basin under the jurisdiction of the Department's Bureau of Marine Water Classification and Analysis partially support the shellfish harvesting designated use based upon criteria established by the National Shellfish Sanitation Program (NSSP). The remaining twenty-five percent do not support the use.

New Jersey North Coastal Basin

This basin consists of a large portion of the Atlantic Ocean coastal environment in New Jersey. Most of the acreage classified in this basin is in Barnegat Bay which comprises the largest percentage of the total acreage available for shellfish harvesting in this basin. The remainder of the basin is comprised of a number of smaller bays, rivers, creeks and their tributaries. These include Shark River, Manasquan River, Metedeconk River, Toms River, Forked River, Oyster Creek, Manahawkin Bay, Little Egg Harbor, Cedar Run, Westecunk Creek, Tuckerton Creek, Big Thorofare, and Big Creek.

Based upon criteria established by the National Shellfish Sanitation Program (NSSP); 63 percent of the shellfish waters in the North Coastal Basin fully support the designated use for shellfish harvesting, 13 percent partially support the use, and 24 percent do not support the use.

New Jersey South Coastal Basin

The New Jersey South Coastal Basin includes Great Bay, Mullica River, Reed Bay, Absecon Bay, Lakes Bay, Great Egg Harbor, Great Egg Harbor River, Ludlam Bay, Great Sound, Jenkins Sound, Grassey Sound, Richardson Sound, and Cape May Harbor.

Based upon criteria established by the Department's BMWC&A; 61 percent of the shellfish waters in the South Coastal Basin fully support the designated use for shellfish harvesting, 12 percent partially support the use, and 27 percent fail to support the use.

Delaware River Basin - Zones 5 and 6

Delaware Bay contains 97 percent of the total classified acreage in the basin and is the only area in the basin that contains waters classified as Approved for shellfish harvesting. The remaining areas are classified either Special Restricted, Prohibited, or Seasonally Approved. Problem areas include the Maurice River and Cove area, the Cohansey River area, the Back Creek area, the Cedar Creek area and the Nantuxent Creek area.

Based upon criteria established by the NSSP; 86 percent of the shellfish waters in the Delaware River Basin fully support the shellfish harvesting designated use, 13 percent partially support the use, while about 1 percent fail to support this use.

Atlantic Ocean

None of the basins previously discussed included figures on the Atlantic Ocean. There are 280,708 acres of marine waters which are regulated by the BMWC&A. Of this total area 76 percent of the waters are classified as Approved (support the use) while the remainder is classified as Condemned (do not support the use).

Trends in Shellfish Harvesting Classifications

There has been a clear increase in the harvestable waters in New Jersey over the past 18 years. Figure III-E1 illustrates the trends in approved acres expressed as a percentage of total acres harvestable. Table III-E1 lists the yearly shellfish harvesting classifications as acres 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 over 85 percent as of 1994.

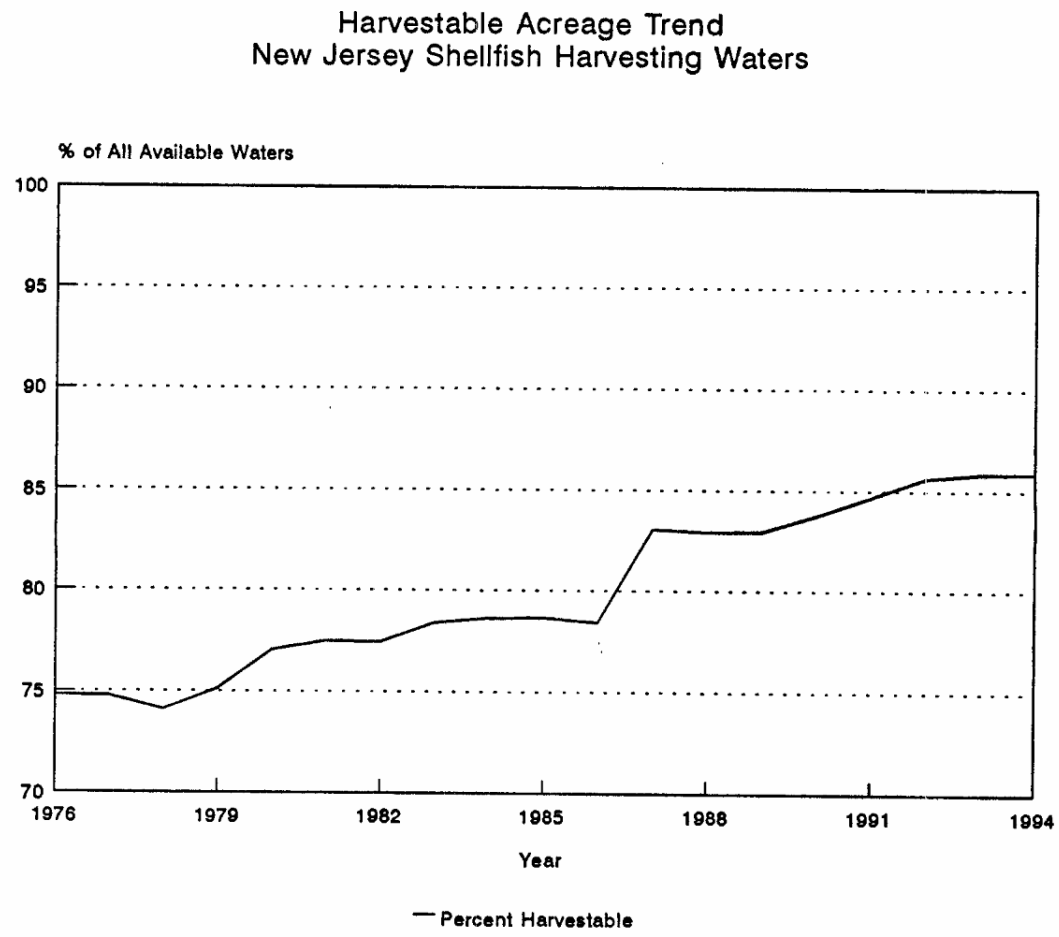
Sources and Causes of Water Quality Degradation

Tables III-E2 and III-E3 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-E4 and III-E5.

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, 1989a; 1992; 1993a, D. Rosenblatt personal communication). The significance of sanitary conditions in beach closures can be seen in the CCMP report for the summer of 1992. During that summer, 22 of the 27 ocean beach closures were reported to be due to stormwater discharges during rain events that resulted in elevated ambient coliform levels. Three closures were brought about by large concentrations of birds roosting along a pier in Seaside Heights (bird feces causing elevated fecal coliform levels). Of the remaining two, one in Cape May City was a precautionary closure due to a sewage line backup, and the other, in Long Branch, was due to excessive bacterial concentrations from an unknown

Figure III - E1: Percent of total acres monitored for shellfish harvesting that are classified as harvestable (includes acres classified as Approved, Restricted, Special Restricted, and Seasonal Restricted).



NJDEP Water Monitoring Management, 1994

Table III - E1

Classification Trends - Acreage Classifications in New Jersey Bays

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

Classification Trends - Acreage in New Jersey Ocean Waters

DATE	APPROVED	PROHIBITED	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

TABLE III-E2: 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				
pH				270
Siltation				
Organics Enrichment/DO				
Salinity/Road salts				270
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-E3: 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 Impact (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-E4: SUMMARY OF POLLUTANTS FOUND IN NEW JERSEY'S ESTUARIES (SQUARE MILES)

Pollutant Categories	Major/Statewide Impacts Monitored	Suspected	Moderate/Localized/Minor Impacts Monitored	Suspected
Unknown toxicity				?
Pesticides	70			
Priority Organics	70			
Nonpriority Organics				?
Metals				?
Ammonia				
Chlorine				
Nutrients	70	?		
pH				
Siltation		140		
Organic 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 substantitae the conclusion

TABLE III-E5: SUMMARY OF THE SEVERITY OF POLLUTANT SOURCES IMPACTING NEW JERSEY'S ESTUARIES (SQUARE MILES)

Source Categories	Major/Statewide Impacts (Suspected)	Moderate/Localized/Minor Impact (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: ? = Insufficient information exists to quantify the extent of these suspected pollutant source categories.

source. A similar pattern was observed in 1993. No closures were the result of floatable debris washing up on beaches in 1991, 1992, or 1993.

The regionalization of sewage treatment along the New Jersey coast has improved bay and estuary water quality, yet is 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 in the summer, and to phytoplankton blooms of ever increasing intensity and frequency.

Estuarine Waters

The severely 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 and primary treated wastewaters still being discharged to these waters. A use attainability study (NJDEP, 1985b) 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, are closely tied with stormwater discharges (NJDEP, 1989a, 1992) and overland nonpoint source runoff. All of the bay beach closures that occurred in 1992 and 1993 were 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 their 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, none-the-less, 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.

F: 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." Table 9 below represents the current list of these waterbodies. Use impairment in these waters is currently only suspected; these are not necessarily waters with known problems. 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.

TABLE III-F1: Waters where designated use impairment is suspected due to toxic discharges from point sources.

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.
Whippany River	From the headwaters to the confluence with the Rockaway 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.

Table III-F2: 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 Advisories

Ocean:

The NJDEP 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 issued by the State for striped bass and bluefish taken in New Jersey territorial ocean waters from Barnegat Inlet northward.

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:

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 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 has been extended to include 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 (PCB's in carp), Raccoon Creek near the Delaware River (PCB's in one Brown Bullhead), and a stretch of the Atlantic Ocean between Seaside Park and Brigantine (PCB's 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.

It should be noted that PCB's are not widely distributed in high concentrations statewide, but are encountered in high concentrations in the sediments within the New Jersey metropolitan areas. The sources of these PCBs in the State's

waters include direct discharges, tributary loads, dredged spoils, and ocean dumped sewage sludge. Sewage sludge and dredged materials dumping are reported to be the principal sources of PCBs in the New York Bight apex waters.

The Department has also recently issued consumption advisories on pickerel and large mouth bass in certain freshwater bodies listed below (Table III-F3) 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.

It should be noted that 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 have many origins and because it is an element, it does not degrade with time but can instead can 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, 1994b).

TABLE III-F3: Studies have indicated that pickerel and largemouth bass from the following waterways have elevated levels of mercury in their tissue (NJDEP, 1994b).

WATERWAYS WITH ADVISORIES ON LARGEMOUTH BASS:

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)
Passaic R. (Great Piece)
Round Valley Reservoir
Spruce Run Reservoir
Crystal Lake
Cooper River Park
Rockaway River
Mirror Lake
Big Timber Creek
Canistear Reservoir
Shadow Lake
Lake Hopatcong
Alcyon Lake
Crosswicks Creek

WATERWAYS WITH ADVISORIES ON CHAIN PICKEREL:

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

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CHAPTER IV

GROUND WATER QUALITY AND MANAGEMENT

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A. INTRODUCTION

Ground water is an extremely important resource for the people of New Jersey. It provides approximately 50 percent of the State's potable water, with 39 percent coming from public-supply wells and 11 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 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.

Ground Water Hydrology

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 then confined units may also be affected.

Sources of ground water pollution are thought of as either **point** or **nonpoint sources**. These terms are defined somewhat differently in this chapter as 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.

Ground Water Quality Standards (GWQS)

New Jersey's new Ground Water Quality Standards (NJAC 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 standards for ground water pollutants. These standards in turn provide the primary basis for setting numerical criteria for limits on discharges to ground water and standards for ground water cleanups. These constituent standards also form the basis for the Department's regulation of impacts to ground water quality from all discharges directly to ground water or to land surface that can impact 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 standards 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 criteria as well as upon analytical factors and water treatment factors. 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 (1985b the New Jersey Safe Drinking Water Act, 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.

Because much of the ground water quality data analysis performed for this chapter was completed before the Ground Water Quality Standards were promulgated, discussions of pollution levels here will be based upon criteria established by the New Jersey Safe Drinking Water Act and its subsequent amendments unless otherwise stated.

B. GENERAL GROUND WATER QUALITY AND QUANTITY

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 overpumping are usually concentrated in areas with high suburban population densities as well as in some agricultural areas. Overpumping 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

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, corrosivity, and chloride.

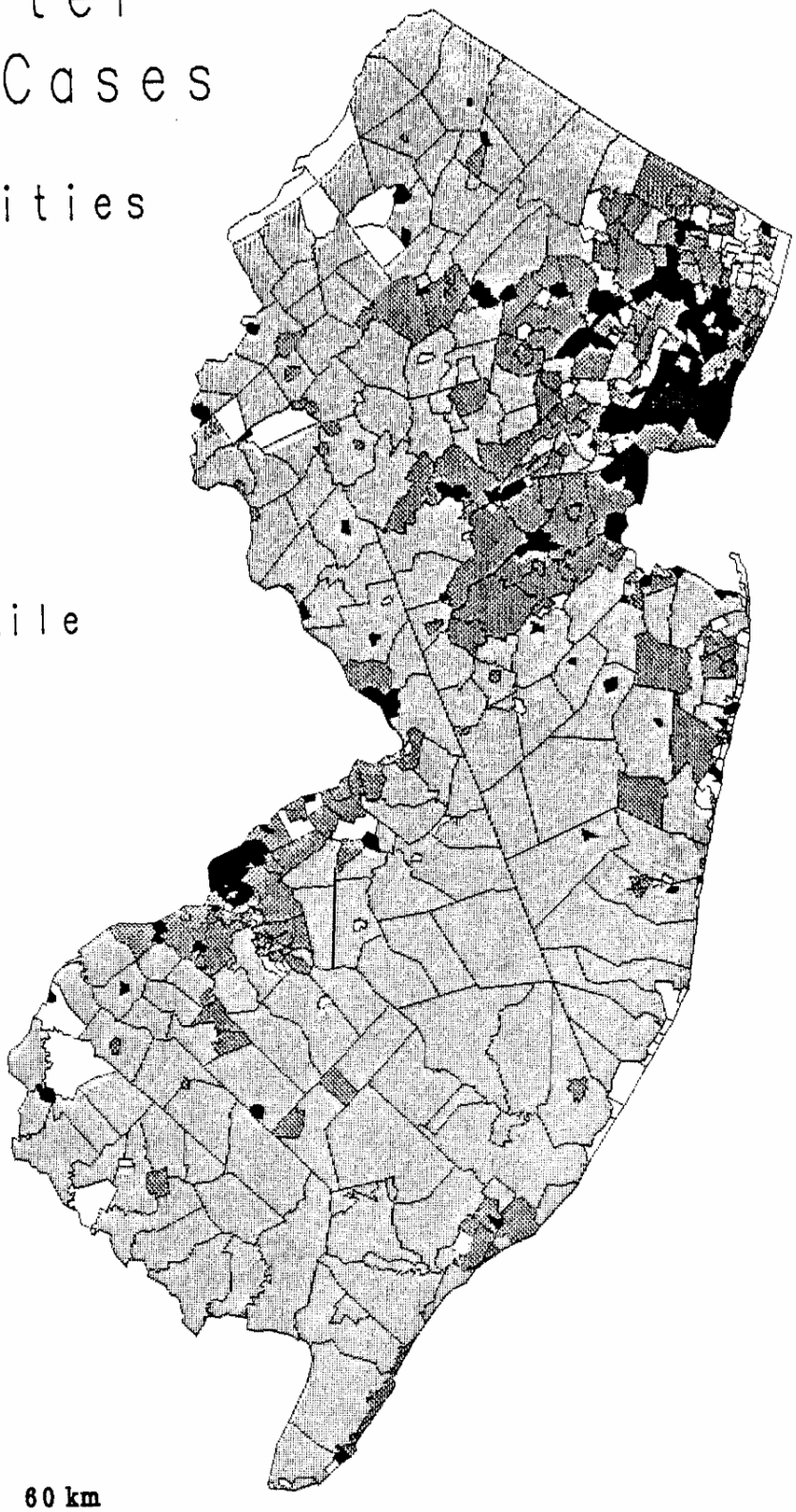
Anthropogenic contaminant discharges to ground water do occur and have an impact upon ground water quality, the full extent of which is not yet fully determined. In order to gain an understanding of the principal anthropogenic contaminants to ground water and their sources; an extensive database was developed in the late 1980's and continued up until 1991 that cataloged contaminated wells, the associated pollutants, and the pollution sources when known. In 1989, there were 3,086 ground water pollution investigations in the State that could supply information for the database (figure IV-1a). However, only 7 of the State's 21 counties (representing 1,200 pollution cases) were assessed. There are now, as of October 1994, over 6,000 ground water investigations underway in the State, twice the number that existed in 1989. When the distribution of the pollution cases in 1989 (figure IV-1a) was compared to the population density throughout the State (figure IV-1b), the two were directly related.

The database was compiled by the Bureau of Wellfield Remediation; the seven counties were Hunterdon, Morris, Passaic, Somerset, Camden,

Figure IV-1a

Ground-water Pollution Cases

NJ Municipalities



cases per sq. mile

- 0
- 0.01 - 0.50
- 0.50 - 2.00
- over 2.00

0 10 20 40 60 km

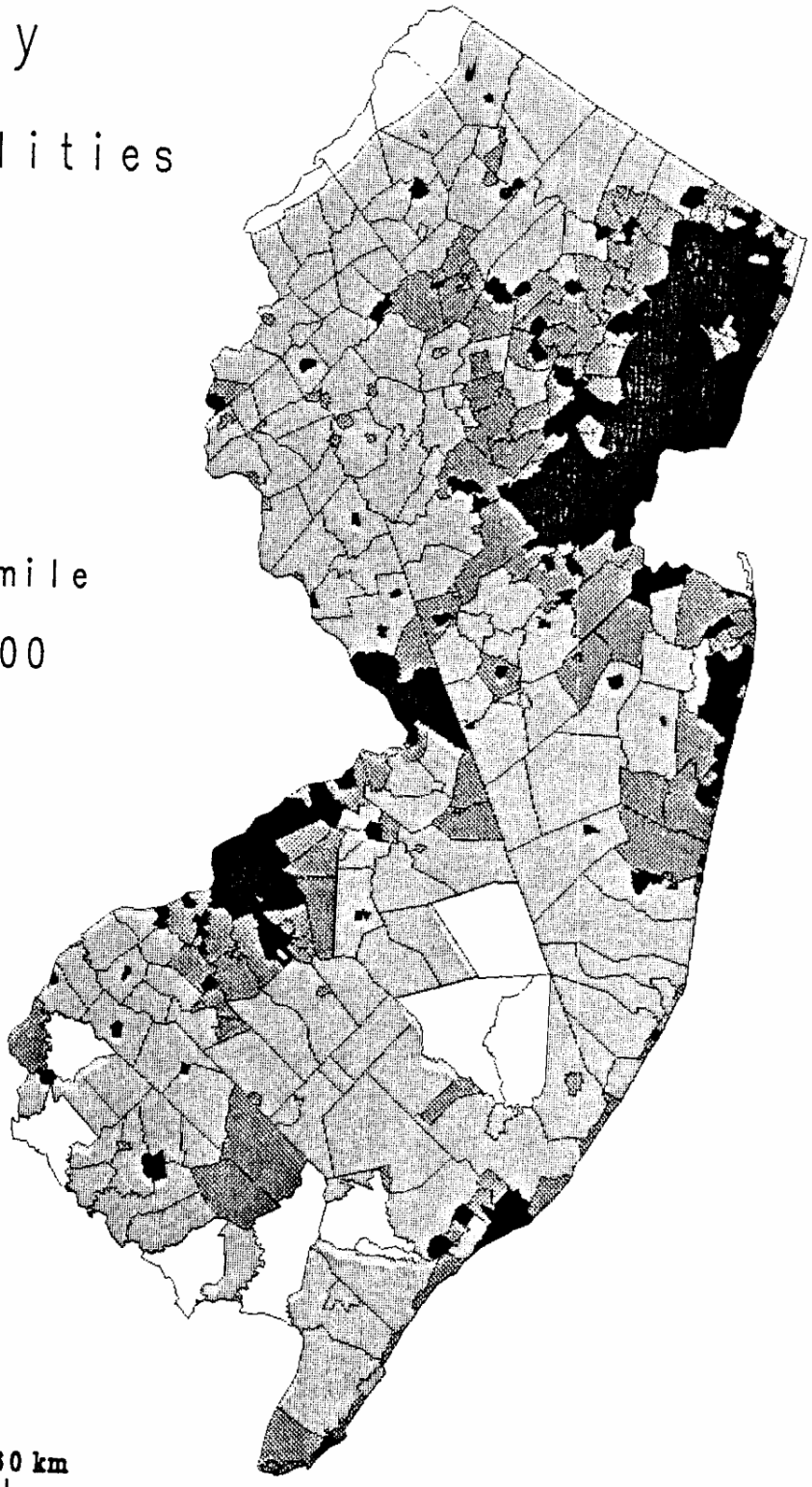
0 10 20 40 mi

source: NJDEP, Bureau of Ground Water Pollution Assessment, 1989.

Figure IV-1b

Population Density

NJ Municipalities



source: US Dept. of Labor, Bureau of the Census, 1980.

Monmouth, and Ocean. The database included such information as the number of ground water pollution investigations by major source, type of site, remedial program, and pollutant type(s). The database also had included the following items: estimated volume of polluted ground water, number of private and community wells affected/threatened by ground water pollution, the monitor wells, and the well restriction and ground water impact areas. Figure IV-2 shows the distribution of ground water pollution cases in the seven counties.

The seven completed counties were diverse in terms of geographic distribution, hydrogeologic setting, population density, and land use/land cover. Hunterdon, Morris, Passaic, and Somerset lie north of an imaginary line (known as the "fall line") separating the hard rock Piedmont Province from the lower lying Coastal Plain Province. Camden, Monmouth, and Ocean Counties are located south of the "fall line" (see figure IV-3a). Infiltration rates, aquifer characteristics, and ground water flow patterns varied significantly between northern and southern counties. Land use/land cover characteristics were similarly diverse in these two areas. Both have significant industrial, urban, and suburban areas, as well as farmlands, forests, and wetlands. The different land uses and land covers in these two regions created a variety of ground water pollution settings. It was believed in 1990 that the ground water pollution situation in these seven counties was somewhat indicative of Statewide conditions.

Of the 1,200 pollution cases in the seven counties assessed as of 1990, more than 40 percent had unknown sources. Of those sources that were identified, the number of underground storage tank (UST) cases was highest with 236 (19.7 percent of the total number of cases). Landfills, surface spills, lagoons, and industrial or commercial septic systems each accounted for at least 5 percent of all cases. Table IV-1a shows the major sources of ground water pollution, the number of cases by source, and their percentage of the total. Table IV-1b ranks the major sources based on the number of threatened and affected wells per case. All of the contamination sources listed in Tables IV-1a and IV-1b are based on data from the ground water pollution investigation database of 1991.

There were discrepancies in the relative importance of some pollution sources. In some instances, the actual number of ground water contaminant investigations associated with a particular major source may have been much less than the potential number of cases from that source. For example, only one agricultural pollution case was listed out of a total of 1,200 cases for the seven counties. 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.

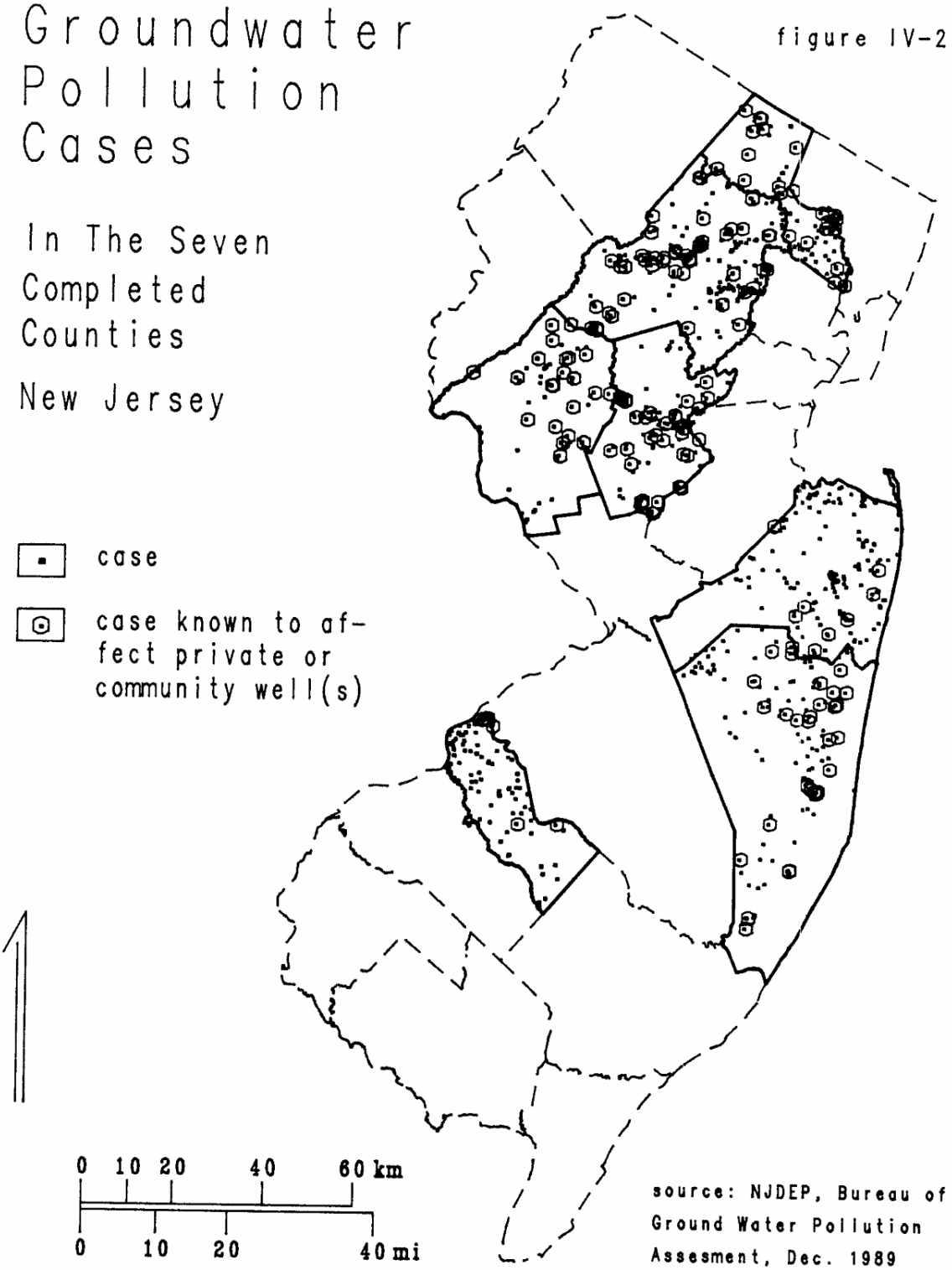
The most common pollutants encountered at the 1,200 ground water investigations at that time were: volatile organic compounds (VOs), metals, base neutrals, acid extractables, and PCBs/pesticides. Table IV-2a summarizes the sampling results of the five pollutants. Of all the investigations where ground water was sampled for VOs, 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

figure IV-2

Groundwater Pollution Cases

In The Seven Completed Counties

New Jersey



source: NJDEP, Bureau of Ground Water Pollution Assesment, Dec. 1989

Table IV- 1a: Major Sources of Ground Water Pollution Based Upon NJDEP, Bureau of Ground Water Pollution Assessment, 12/89.

Source	No.of Cases	% of Total Cases
Agriculture	1	0.08
Above Ground Storage Tank	4	0.33
Coal Tar	8	0.67
Drums	11	0.92
Lagoon	72	6.00
Land Spray Application	1	0.08
Landfill	159	13.25
None	4	0.33
Other	16	1.33
Road Salt Pile	1	0.08
Septic System	67	5.58
Surface Spill	134	11.17
Unknown	486	40.50
Underground Storage Tank	236	19.67
Total	1200	100.00

Table IV- 1b: Ground Water Contamination Sources, Ranked; Based Upon NJDEP, Bureau of Ground Water Pollution Assessment, 2/90.

Source	Relative Priority	Wells Per Case
Underground Storage Tanks	1	22.1
Industrial/Commercial Septic Systems (incl. class V injection wells)	2	11.2
Surface Spills	3	7.4
Landfills (incl. municipal, industrial, and other)	4	6.1
Unidentified and Miscellaneous Sources	5	4.7
Drums	6	2.6
Above Ground Storage Tanks	7	2.5
Road Salt Piles	8	2.0
Lagoons (incl. surface impoundments)	9	1.2
Residential Septic Systems	10	unknown
Coal Tar Discharges	11	0
Agricultural Activities	11	0
Land Spray Application/Treatment	11	0
Salt Water Intrusion	11	0
Injection Wells (class I-IV)	11	0
Oil and Gas Brine Pits	11	0

*Rank is based on the number of private and community wells affected or threatened per case with identified specific major sources of pollution in the seven counties for which data is available.

contaminants, undifferentiated petroleum hydrocarbons, gasoline and fuel oil also ranked high in the long list of ground water pollutants. The contaminants found in the State's ground water are listed and assigned relative priority in Table IV-2b.

Table IV-3 lists the number of private and community wells affected by major pollution sources as recorded in 1989. A total of 1,610 wells in the seven counties were known to be affected by ground water pollution. Of this total, 1,519 were private wells and 91 were community supply wells. As is the case in Table IV-1a (number of cases by major source of pollution), unknown sources topped the list with 737 affected wells. An unknown source was one that was affecting wells but had either not yet been identified or had not yet been investigated. Data collected in 1991 identifies 1,723 wells in the seven county study area, and a total of 4,650 wells in New Jersey, as being affected by major pollutants.

Of the known sources, USTs affected the most wells (405) according to the 1991 data base. Industrial and commercial septic systems affected a disproportionately large number of wells (202), considering the number of septic system cases reported (Table IV-1a).

Table IV-4 shows the number of ground water pollution cases, as of 1990, in the seven counties by major source of pollution and by county. Morris County, which is north of the Fall Line, had the highest number of ground water pollution cases (282) at that time while Monmouth, in the Coastal Plain, had the second highest (192). These two counties are similar not only in their high numbers of pollution cases, but also in terms of their land use characteristics which range from moderately high density town centers to large-lot residential areas. Both have large rural areas as well, and lack the large, very dense cities and heavy industrial areas that are found in, for example, Camden and Passaic Counties. They are also similar in population and population density. Like most New Jersey counties, both have experienced high rates of growth during the 1970's and 1980's. As of April 1992, the number of ground water pollution cases listed by county was as follows:

County	Number of Pollution Cases	County	Number of Pollution Cases
Atlantic	231	Middlesex	399
Bergen	445	Monmouth	255
Burlington	205	Morris	400
Camden	240	Ocean	199
Cape May	94	Passaic	237
Cumberland	104	Salem	72
Essex	301	Somerset	270
Gloucester	179	Sussex	152
Hudson	196	Union	266
Hunterdon	122	Warren	115
Mercer	168		

Table IV-2a: Most Commonly Encountered Ground Water Pollutants Based Upon NJDEP, Bureau of Ground Water Pollution Assessment, 12/89.

Pollutant	Totaled Wells Sampled	Number Of Wells Where Contaminant Was Detected*	Percent Of Wells Where Contaminant Was Detected*
Volatile Organics(VOs)	595	520	87.4
Metals	327	180	55.0
Base Neutrals	295	172	58.3
Acid Extracbles	234	83	35.5
PCBs/Pesticides	192	39	20.3

* For metals - a detection means that the contaminant was found to be in violation of State groundwater quality standards existing at the time of the study. For the four other categories detection means that the contaminant was simply above the level of contamination.

Table IV-2b: Ground Water Contamination Substances, Priority Checklist Based Upon NJDEP, Bureau of Ground Water Pollution Assessment, 1/90.

Substance	Relative Priority
Volatile Organic Chemicals (incl. volatile petroleum hydrocarbons)	1
Metals (incl. chromium, mercury, and lead)	2
Radionuclides	2
Inorganic Miscellaneous (excluding metals)	3
Base Neutral Chemicals (incl. base neutral petroleum hydrocarbons)	3
Other Metals	4
PCB/Pesticides	4
Acid Extractable Chemicals	4
Asbestos	4
Dioxin	5
Bacteria	5
Other Substances	5

Highest Priority = 1 Lowest Priority = 5

*Relative Priority based on several factors including number of private and community wells affected or threatened by each substance and the number of cases reporting identification of the substance in the ground water in the seven counties for which data is available.

TABLE IV-3: Number of Private and Community Wells Affected by Major Pollution Sources. Values Represent Both The Absolute Number of Cases And The Percentage of Total Cases. Based Upon NJDEP, Bureau of Ground-Water Pollution Assessment, 1/90.

MAJOR SOURCES OF POLLUTION	PRIVATE WELLS AFFECTED		PRIVATE WELLS THREATENED		COMMUNITY WELLS AFFECTED		COMMUNITY WELLS THREATENED	
	#	%	#	%	#	%	#	%
AGRICULTURE	0	0.0	0	0.0	0	0.0	0	0.0
ABOVE GROUND STORAGE TANK	3	0.2	7	0.1	0	0.0	0	0.0
COAL TAR	0	0.0	0	0.0	0	0.0	0	0.0
DRUMS	8	0.5	21	0.2	0	0.0	0	0.0
LAGOON	38	2.5	44	0.5	0	0.0	6	5.1
LAND SPRAY APPLICATION	0	0.0	0	0.0	0	0.0	0	0.0
LANDFILL	89	5.9	868	10.0	0	0.0	14	11.9
NONE	2	0.1	0	0.0	0	0.0	1	0.8
OTHER	10	0.7	2	0.0	0	0.0	0	0.0
ROAD SALT PILE	2	0.1	0	0.0	0	0.0	0	0.0
SEPTIC SYSTEM	178	11.7	536	6.2	23	25.3	15	12.7
SURFACE SPILL	105	6.9	852	9.8	10	11.0	28	23.7
UNKNOWN	689	45.4	1590	18.3	48	52.7	31	26.3
UNDERGROUND STORAGE TANK	395	26.0	4776	54.9	10	11.0	23	19.5
TOTAL	1519	100.0	8696	100.0	91	100.0	118	100.0

Note: Based upon the 1990 US Census, there were a total of 139,374 private drinking wells within the seven counties comprising this study.

TABLE IV-4: Major Sources of Anthrpogenic Pollution Listed By County. Values Represent Both The Absolute Numbers of Cases and The Percentage of Total Cases. Based Upon NJDEP, Bureau of Ground-Water Pollution Assessment, 1/90.

MAJOR SOURCES OF POLLUTION	COUNTY							
	CAMDEN		HUNTERDON		MONMOUTH		MORRIS	
	#	%	#	%	#	%	#	%
AGRICULTURE							1	100.0
ABOVE GROUND STORAGE TANK			1	25.0				
COAL TAR			1	12.5				
DRUMS			1	9.1	5	45.5		
LAGOON	10	13.9	5	6.9	25	34.7	13	18.1
LAND SPRAY APPLICATION			1	100.0				
LANDFILL	24	15.1	6	3.8	38	23.9	21	13.2
NONE			1	25.0			2	50.0
OTHER			3	18.8	4	25.0	1	6.3
ROAD SALT PILE								
SEPTIC SYSTEM	2	3.0	8	11.9	4	6.0	30	44.8
SURFACE SPILL	11	8.2	10	7.5	30	22.4	11	8.2
UNKNOWN	88	18.1	37	7.6	45	9.3	152	31.3
UST	28	11.9	15	6.4	36	15.3	51	21.6
TOTAL	**163**		**89**		**192**		**282**	

TABLE 4: continued.

MAJOR SOURCES OF POLLUTION	COUNTIES						
	OCEAN		PASSAIC		SOMERSET		7-COUNTY TOTALS
	#	%	#	%	#	%	
AGRICULTURE	2	50.0					1
ABOVE GGROUND STORAGE TANK	2	25.0			1	25.0	**4**
COAL TAR	3	27.3	1	9.1			**8**
DRUMS	5	6.9	6	8.3	1	9.1	**11**
LAGOON					8	11.1	**72**
LAND SPRAY APPLICATION	43	27.0	7	4.4			1
LANDFILL					20	12.6	**159**
NONE	7	43.8			1	25.0	**4**
OTHER					1	6.3	**16**
ROAD SALT PILE	9	13.4	7	10.4	1	100.0	**1**
SEPTIC SYSTEM	13	9.7	37	27.6	7	10.4	**67**
SURFACE SPILL	61	12.6	53	10.9	22	16.4	**134**
UNKNOWN	19	8.1	26	11.0	50	10.3	**486**
UST					61	25.8	**236**
TOTAL	**164**		**137**		**173**		**1200**

One can see that Morris County was surpassed in 1992 by Bergen County with respect to the greatest number of ground water pollution cases. Salem County had the least number: 72 cases.

With respect to current ground water quality conditions, the status is unclear. Since these data were reported in 1990, five years of remediation efforts have been instituted by this Department. Arnold Schiffman, special projects manager within the Division of Publicly Funded Site Remediation, (personal communication) feels that UST's 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 sources have declined in number as a result of efforts to replace leaking tanks as well as to cleanup all categories of contaminated sites. Industrial/commercial septic systems sited in the 1991 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 has 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 1989.

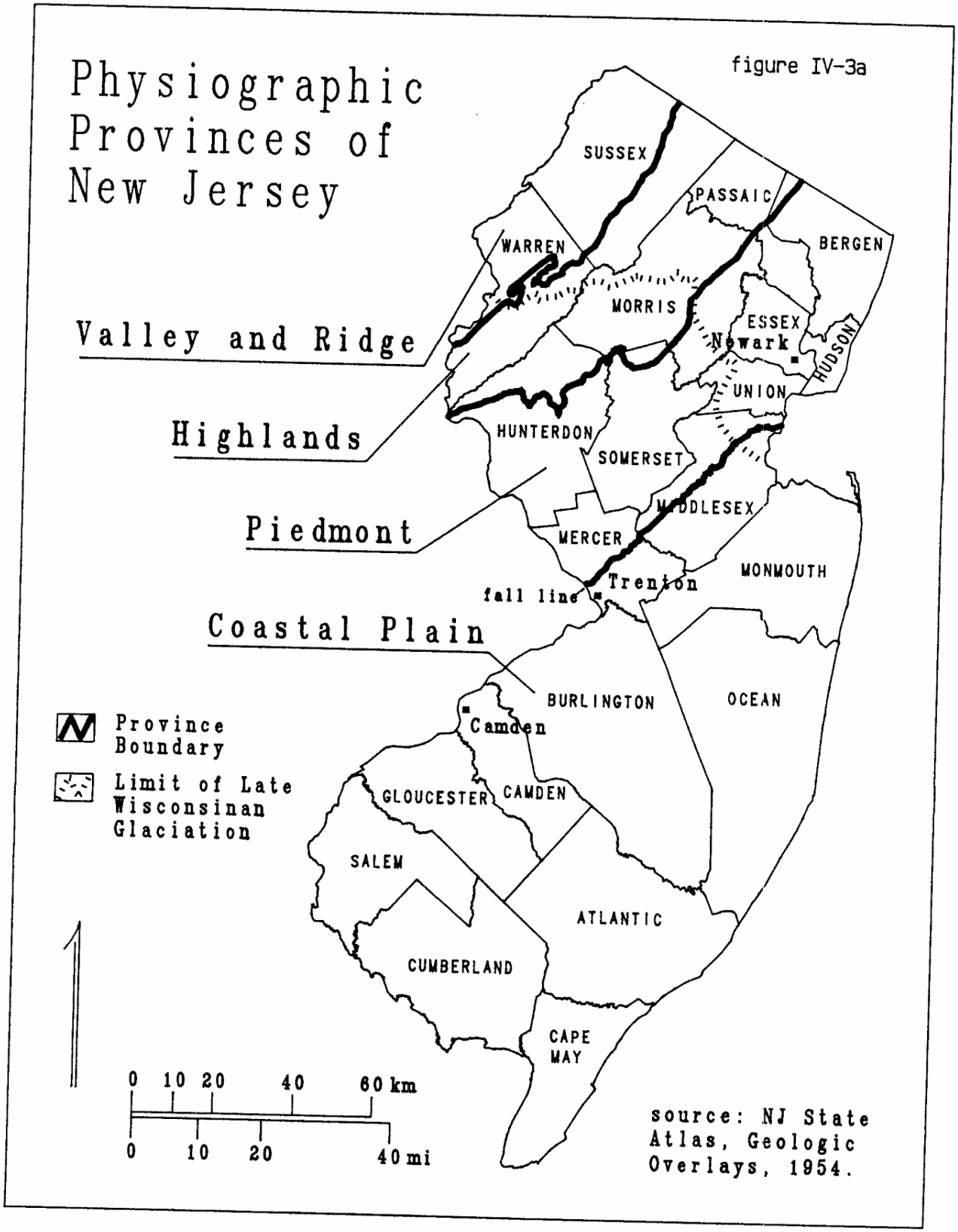
Ground Water In The State's Physiographic Provinces

New Jersey has four geomorphologically distinct physiographic provinces covering the State's approximately 7,500 square miles (Figure IV-3a). They are from south to north: the Coastal Plain, Piedmont, Highlands, and Valley and Ridge. There are general structural and lithologic disparities existing 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.

Coastal Plain

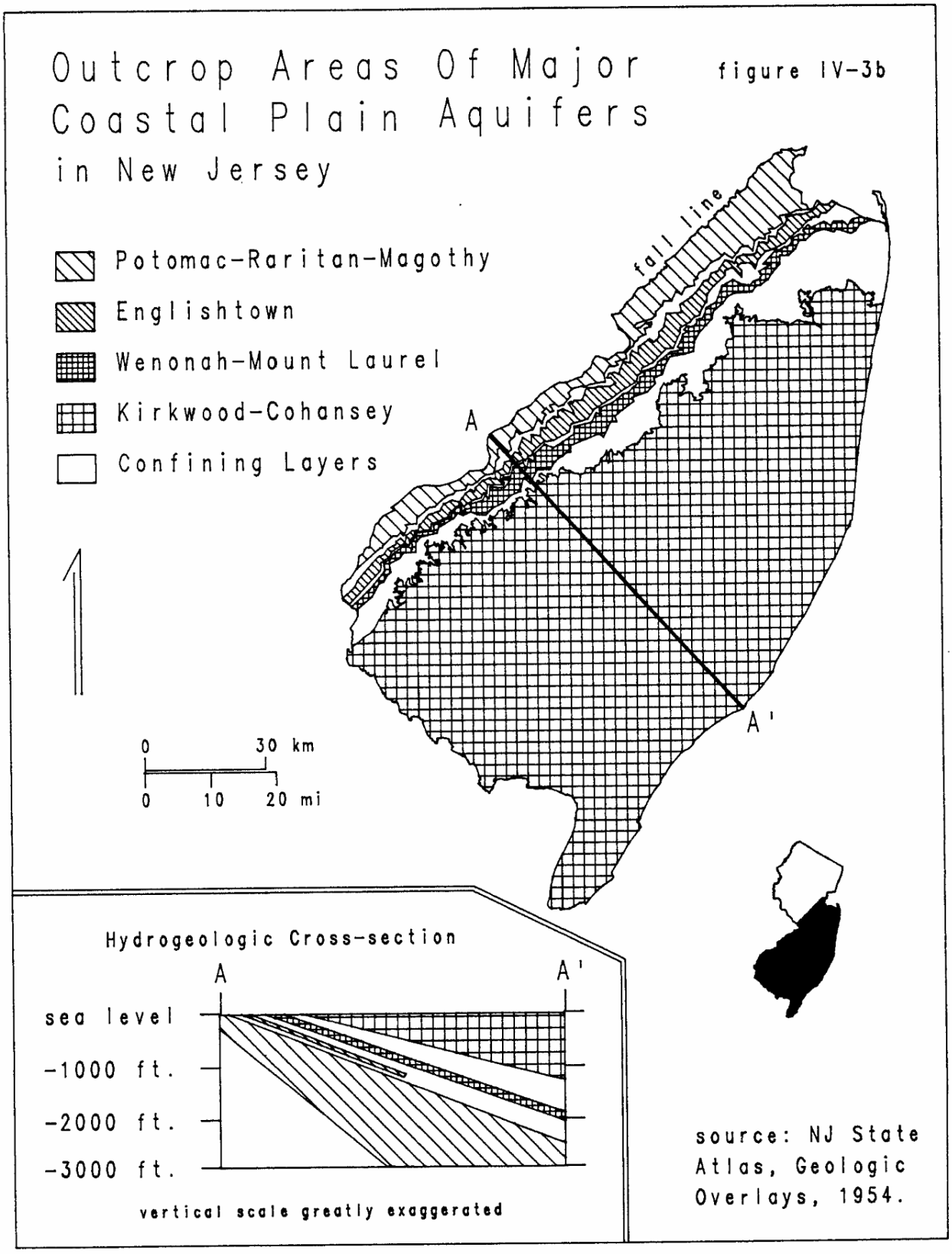
The Coastal Plain is the largest of the physiographic provinces in New Jersey, covering an area of 4,689 square miles (Figure IV-3a, 3b). It is a southeasterly dipping and thickening wedge of stratified unconsolidated sediments that vary in age from Cretaceous, 144-66.4 million years ago (mya), to the end of the Tertiary (1.6 mya). A veneer of more recent alluvial sediments has been locally deposited on the older wedge. This seaward thickening sedimentary wedge of sand, gravel, silt and clay overlies an eroded surface of pre-Cretaceous bedrock. The sediment thickness is known to vary from a feather edge along the Fall Line to at least a documented 6,407 feet in Cape May County (Loyd Mullikin, Supervising Geologist within the N.J.G.S., oral communication, 1990).

The changing depositional environment during the Coastal Plain's formational history produced a multilayered aquifer system consisting of 1 major unconfined aquifer and 4 major confined aquifer systems. These systems from youngest to oldest (and shallowest to deepest) are the


Physiographic Provinces of New Jersey
figure IV-3a
Valley and Ridge
Highlands
Piedmont
Coastal Plain
SUSSEX
PASSAIC
BERGEN
WARREN
MORRIS
ESSEX
Newark
HUDSON
UNION
HUNTERDON
SOMERSET
MIDDLESEX
MERCER
Trenton
MONMOUTH
fall line
BURLINGTON
OCEAN
Camden
GLOUCESTER
CAMDEN
SALEM
ATLANTIC
CUMBERLAND
CAPE MAY
Province Boundary
Limit of Late Wisconsinan Glaciation
0 10 20 40 60 km
0 10 20 40 mi
source: NJ State Atlas, Geologic Overlays, 1954.

Outcrop Areas Of Major Coastal Plain Aquifers in New Jersey

figure IV-3b



source: NJ State Atlas, Geologic Overlays, 1954.

unconfined Kirkwood-Cohansey aquifer system, and the confined, Kirkwood 800-Foot Sand, Wenonah-Mount Laurel aquifer, Englishtown aquifer system, and Potomac-Raritan-Magothy (PRM) aquifer system (Zapecza, 1984). All of these confined aquifers become unconfined in their outcrop areas to the northwest. Additional confined aquifers such as the Vincentown and Piney Point may be found in local areas of Monmouth County and the southernmost counties respectively.

Ground water supplies most of the potable water to the inhabitants of the Coastal Plain. Seventy-one percent of the total purveyor-supplied water in the province consists of ground water and seventy-five percent of its inhabitants rely on municipal or domestic ground water supplies. Population growth in the Coastal Plain to the year 2000 is estimated to average 20 percent, which will undoubtedly put further demands on the ground water in the province (NJDEP, 1985).

The unconfined 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, is directly underlain and 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 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).

Natural flow in the confined aquifers is from the outcropping recharge areas in the northwest, with an area of approximately 1,400 square miles, to suboceanic discharge areas to the southeast. Water may also flow from one confined aquifer to another; such flow is controlled by the hydraulic gradient between aquifers and the conductivities of intervening confining layers. Overpumping in some of these aquifers has resulted in water level declines in four major regional areas (Leahy et al., 1987). These are: 1) the Potomac-Raritan-Magothy aquifer around Camden; 2) the Atlantic City 800-Foot Sand

aquifer around Atlantic City; 3) the Old Bridge and Farrington aquifers of the PRM system at the South River/Raritan Bay area; and 4) 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) within the U.S. Department of the Interior 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. These radiological contaminants are thought to occur naturally and the USGS is presently studying their occurrence in the Coastal Plain. 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.

Piedmont

The Piedmont Physiographic Province is an approximately 1,580 square mile lowland region that coincides with the geologic trend of the Newark Basin in New Jersey. This basin is a down-faulted trough that was filled with non-marine stream and lake deposited sediments during the Triassic (245-208 mya) and the 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. These and younger sedimentary formations of the Jurassic-aged Brunswick Group include, and are intruded by and interlayered with, igneous diabase and basalt (Olsen, 1980). Basically, the sedimentary units 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.

Approximately two-thirds of New Jersey's population resides in this Province. It is estimated that approximately 59 percent of the purveyor-supplied water here is ground water. In addition more than 71,000 domestic wells supply approximately 9 percent of the inhabitants with water (NJDEP,

1985). Most ground water flow in the bedrock is through a complex network of interconnected fractures, bedding-plane partings, and intergranular pores. Preferential fracture alignment throughout much of this basin results in anisotropic ground water flow. The density of hydraulically connected fractures decreases with depth and Kasabach (1966) noted that most ground water storage in the Stockton and Passaic (Brunswick Shale) Formations is restricted to the upper 500 feet in Hunterdon County, New Jersey. The bedrock aquifers are generally unconfined near the surface and semiconfined at depth. Wells chiefly case off the unconsolidated overburden and draw water from bedrock in an open borehole. Based on available data, Houghton and Flynn (1988) determined that the mean yields for residential wells in the Newark Basin aquifers are:

Aquifer	Mean yield (gpm)	no. wells used in mean
Stockton	20.0	309
Passaic	16.3	1,196
basalt	11.8	94
Lockatong	9.5	393
diabase	7.4	141

Ground water quality in the three major formations in the Newark Basin is generally good but locally may require treatment for undesirable contaminants and characteristics. The most common water quality exceedances of criteria are for the State recommended secondary drinking water standards. In Table IV-5A the percent of each characteristic and contaminant exceeding the secondary standard are: manganese (27% of samples exceeded the standard), maximum hardness (20.8%), corrosivity (31.2%), total dissolved solids (13.6%), iron (14.5%), sodium (8.5%), and sulfate (8.2%) (Serfes, M.E., 1992). These high concentrations are characteristic of the deep ground water in this area (Carswell, 1976). Others have noted a decline in water quality with depth in the basin (Kasabach, 1966; Anderson, 1968).

In the urbanized lower Hackensack River Basin and the nearby Newark area, water quality is generally poor due to anthropogenic and natural factors. Saltwater intrusion due to overpumping and the pumping of deep, slowly moving, naturally mineralized water and the dredging of ship canals in Newark Bay and the Passaic River (Nichols, 1968) has resulted in poor water quality here. Localized salt water intrusion has degraded ground water quality with chloride concentrations as high as 1,900 parts per million being recorded (Nichols, 1980).

A study of natural radioactivity in the ground water of the Newark Basin was conducted by Zapecza and Szabo (1987a,b). They showed that uranium enrichment occurs in black mudstones near the Lockatong-Passaic contact and that complex hydrogeochemical relationships account for radionuclide activities. Gross alpha particle activities and radium-226 activities are directly related to uranium decay and locally exceed MCLs of 15 and 5 picocuries per liter (pCi/L), respectively. The MCL of 5 pCi/L for radium is for radium-226 plus radium-228. Radium-228 was outside the scope of the 1987 study. Based on 260 ground water samples, gross alpha particle activities ranged from less than 0.1 to 124 pCi/L; 5 percent exceeded the MCL. Radium-226 concentrations ranged from less than 0.01 to 22.5 pCi/L.

Table IV-5A. Statistcal 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; uS/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 (C)	147	9.5	12.5	13	13.5	17	–	–
Specific Conductance (uS/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 $CaCO_3$ satuation defined as zero using the Langelier Index (American Water Works Association, 1975).

Table IV-5A 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	10p	0
Nitrate, [NO_2+NO_3]-[NO_2], (as N)	55	<0.1	0.33	1.6	3.0	7.4	10p	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	50-200s	0
Arsenic	43	<1	<1	2	3	19	50p	0
Barium	119	<2	34.5	110	200	1200	2000p	0
Beryllium	119	<0.5	<0.5	<0.5	<0.5	1	--	--
Cadmium	145	<1	<1	<1	<1	3	5p	0
Chromium	43	<1	<1	<1	<1	5	100p	0
Cobalt	119	<3	<3	<3	<3	<3	--	--
Copper	147	<10	<10	<10	<10	200	1300p	--
Iron	147	<3	<3	7	24	11000	300s	14.5
Lead	147	<10	<10	<10	<10	16	15p	.7
Lithium	121	<4	9	20	29	100	--	--
Manganese	147	<1	<1	5	55	1600	50s	26.9
Mercury	43	<0.1	<0.1	<0.1	<0.1	.3	2p	0
Molybdenum	119	<10	<10	<10	<10	170	--	--
Strontium	119	50	227.5	430	712.5	11000	--	--
TRACE AND MINOR DISSOLVED CONSTITUENTS (ug/L)								
Vanadium	121	<6	<6	<6	<6	25	--	--
Zinc	148	<3	9	22	54	1100	5000s	0
ORGANIC CONSTITUENTS								
Carbon, Organic, (mg/L, as C)	43	0.3	0.7	0.8	1.4	3.1	--	--
Phenols Total, (ug/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 $CaCO_3$ satuation defined as zero using the Langelier Index (American Water Works Association, 1975).**

Barium levels exceeding the primary drinking water standard or MCL of 1.0 mg/L were reported in Zapecza and Szabo (1987b) and a level of 2.13 mg/L in Hunterdon County is under investigation by the DEP. Barite ($BaSO_4$) mineralization occurs locally throughout the Newark Basin (Dombroski, 1980) and accounts for most of the barium found in ground water here. However, anthropogenic inputs of barium into the ground water environment are also possible.

Highlands

The Highlands Province is 1,016 square miles in area and is characterized as a belt of northeast-southwest trending ridges separated by broad valleys. These upland ridges are generally composed of resistant Precambrian (> 570 mya) crystalline metamorphosed rocks that were originally igneous and sedimentary. Less resistant Paleozoic (245 to 570 mya) sedimentary rock generally make up the valleys and are in fault and unconformable contact with the older crystalline rocks. The rocks are a major source of water for domestic, industrial, and municipal consumers in the Highlands (Figure IV-3c).

Ground water flow in the Highlands is mainly unconfined and is controlled by topography, fracture, and foliation plane geometry. Flow is from upland areas to valleys where ground water either discharges to surface waters, or continues to flow down-valley within the saturated zone. Local flow systems dominate and intervalley regional flow is not known to occur (NJDEP, 1985b). The optimum depth for domestic wells in crystalline rocks is considered by Davis and Turk (1964) to be 150 - 250 feet. This depth agrees closely with the findings of Gill and Vecchioli (1965), Kasabach (1966), and Miller (1974). Well yields vary locally but James (1967) found that yields are generally higher in lowland than upland areas. He also observed that yields in different rock types become progressively less as one progressed from pyroxene granite and gneiss, through hornblende granite, biotite gneiss, amphibolite, to quartz diorite.

Ground water in the Highlands is of a good quality for most purposes, however as illustrated in table IV-5B, localized quality problems do occur (Serfes, in press). Based on sampling in 1989 and 1990, the most common problems are associated with the state-recommended secondary drinking water standards. The acceptable standards and ranges exceeded are: corrosivity (48 percent less than lower limit of -1 pH unit), manganese (16.3 percent exceeded 50 parts per billion), hardness (16.2 percent less than lower limit of 50 and 7 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 10.5 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).

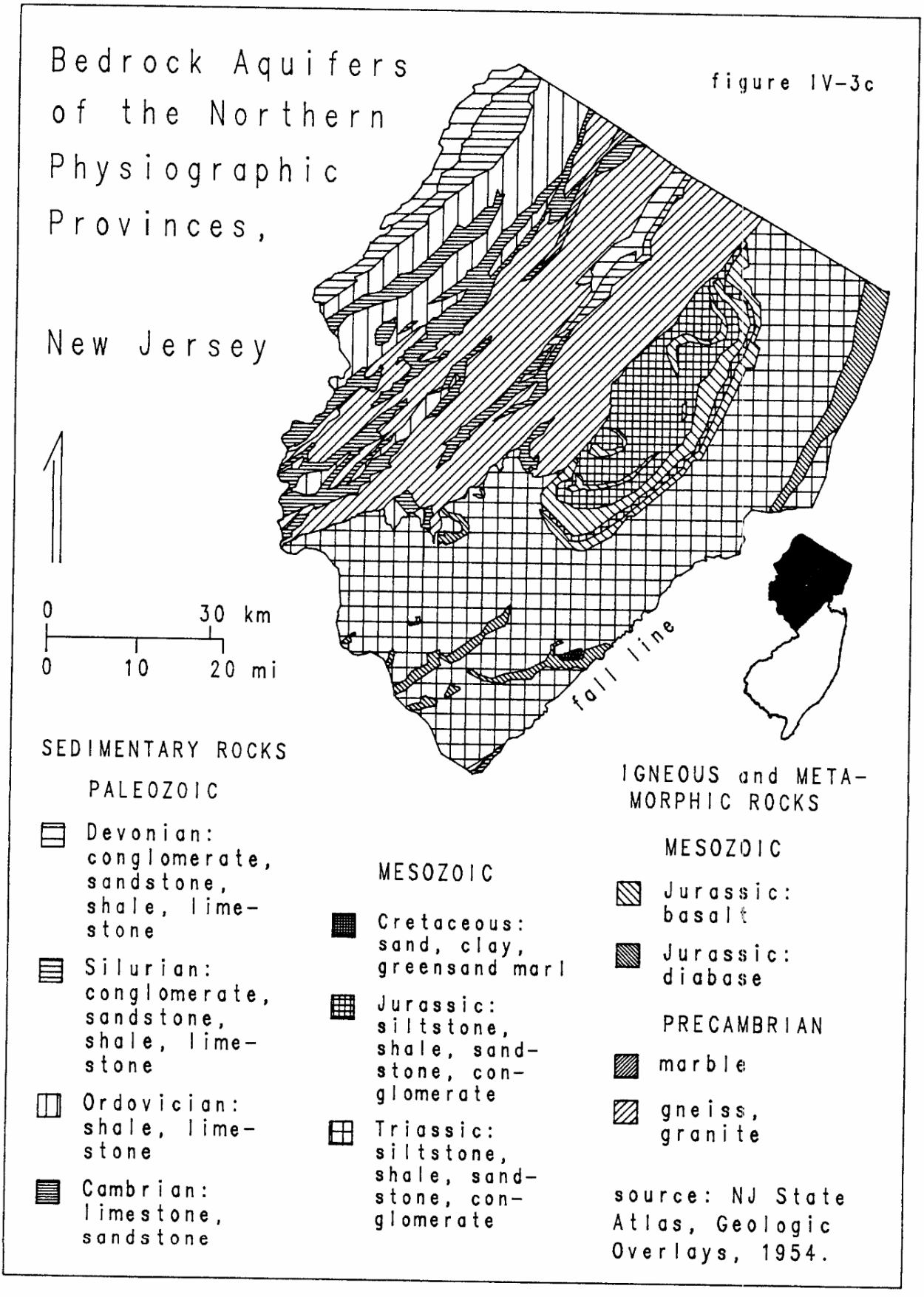

Bedrock Aquifers of the Northern Physiographic Provinces, New Jersey
figure IV-3c
0 30 km
0 10 20 mi
fall line
SEDIMENTARY ROCKS
PALEOZOIC
Devonian: conglomerate, sandstone, shale, limestone
Silurian: conglomerate, sandstone, shale, limestone
Ordovician: shale, limestone
Cambrian: limestone, sandstone
MESOZOIC
Cretaceous: sand, clay, greensand marl
Jurassic: siltstone, shale, sandstone, conglomerate
Triassic: siltstone, shale, sandstone, conglomerate
IGNEOUS and METAMORPHIC ROCKS
MESOZOIC
Jurassic: basalt
Jurassic: diabase
PRECAMBRIAN
marble
gneiss, granite
source: NJ State Atlas, Geologic Overlays, 1954.

Table IV-5B. Statistcal summary of analyses of water from the Precambrian units in the Highland Province 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; us/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
Temperature (C)	43	10	10.5	11	12	18	–	–
Specific Conductance (us/cm)	42	74	167	212	303	599	–	–
Oxygen, dissolved (mg/l)	43	0.05	3.8	5.5	7.05	9.3	–	–
pH (standard units)	42	5.1	6.4	6.75	7.3	8.1	6.5 to 8.5	30.2%<6.5, 0%>8.5
Field Alkalinity (mg/l as $CaCO_3$)	43	10	43.5	63	84.75	281	–	–
Solids[1], dissolved (mg/l)	41	50	108.5	140	185	356	500[s]	0.0
Corrosivity (pH units)[2]	42	-3.66	-1.81	-0.93	-0.36	0.2	-1 to 1[s]	48%<(-1), 0.0%>(1)
Hardness,(mg/L as $CaCO_3$)	43	34	57	79	132	310	50 to 250[s]	16.2% <(50) 7%>(250)
MAJOR AND MINOR DISSOLVED CONSTITUENTS (mg/L)								
Calcium	42	8.4	15	22	35	80	–	–
Magnesium	42	1.1	5.2	6.6	10	36	–	–
Sodium	42	2.8	6.2	7.6	8.8	32	50[s]	0.0
Potassium	42	<0.1	0.7	0.8	1.1	3.3	–	–
Chloride	43	1.1	5.4	13	20.2	91	250[s]	0.0
Sulfate	43	3.2	12	18	25	42	250[s]	0.0
Fluoride[3]	43	<0.1	<0.1	0.1	0.27	2.3	4[p]	0.0
Silica	43	12	19	22	29	37	–	–

1 product of a constant derived using linear regression analysis and specific conductance .

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

3 the drinking water standards for these constituents are action levels.

Table IV-5B 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
NUTRIENTS, DISSOLVED (mg/L)								
Nitrogen, NH_3, (as N)	43	<0.01	<0.01	<0.01	0.01	0.04	--	--
Nitrogen, NO_2, (as N)	43	<0.01	<0.01	<0.01	<0.01	0.02	1p	0.0
Nitrogen, NH_3 + Organic, (as N)	43	<0.2	<0.2	0.2	0.4	1.2	--	--
Nitrogen, NO_2+NO_3, (as N)	43	<0.1	0.22	0.8	1.3	5.7	--	--
Nitrate, [NO_2+NO_3] - [NO_2]	43	<0.1	0.22	0.8	1.3	5.68	10p	0.0
Phosphorous Ortho, (as P)	42	<0.01	<0.01	0.01	0.02	0.08	--	--
Phosphorous, (as P)	41	<0.01	<0.01	0.02	0.03	0.09	--	--
TRACE AND MINOR DISSOLVED CONSTITUENTS (ug/L)								
Aluminum	43	<10	<10	<10	<10	50	50 to 200s	0.0
Arsenic	43	<1.0	<1.0	<1.0	<1.0	<1.0	50p	0.0
Cadmium	43	<1.0	<1.0	<1.0	<1.0	2	5p	0.0
Chromium	43	<1.0	<1.0	<1.0	<1.0	2	100p	0.0
Copper	43	<1.0	1	2	4	76	1300p	0.0
Iron	43	<3	4	7	18.5	1700	300s	6.9
Lead[3]	43	<1.0	<1.0	<5	1	8	15p	0.0
Manganese	43	<1.0	<1.0	2	7.75	320	50s	16.3
Mercury	42	<0.1	<0.1	<0.1	<0.1	0.3	2p	0.0
Zinc	43	<3	4	12	29.5	1800	5000s	0.0
ORGANIC CONSTITUENTS								
Carbon Organic, (mg/L as C)	43	<0.1	0.3	0.4	0.5	5	--	--
Phenols Total, (ug/L)	39	<1.0	<1.0	<1.0	2	12	--	--
RADIOACTIVITY (pci/L)								
Gross Alpha	19	0.48	0.8	1.3	1.8	27.5	15p	10.5

1 product of a constant derived using linear regression analysis and specific conductance

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

3 the drinking water standards for these constituents are action levels.

Valley and Ridge

This province is 515 square miles in area and mainly comprised of thick sequences of Paleozoic (570-245 mya) sedimentary units with subordinate occurrences of unrooted Precambrian crystalline rocks to the southeast near the Highlands province and minor intrusives. Sedimentary rock types include dolomite, limestone, sandstone, shale, and siltstone. The Paleozoic rocks are folded and faulted with the most intense deformation found in the southwest.

This province has a relatively low population and the predominant land uses are recreational in the northwest and agricultural in the southeast. A compilation of hydrologic data by Miller (1974) showed that ground water supplied 60 percent of the daily water consumption and most of the ground water was obtained from bedrock wells.

Ground water flow is through fractures in all rock types, in solution channels through limestone and dolomite, and through pores in the unconsolidated stratified drift. The structural controls on local and regional ground water flow in these rocks are complex as discussed in Herman (1988). Moderate to large supplies of water are obtained from stratified drift, cavernous limestone and dolomite, and shear zones near faults. Lesser yields are obtainable from Precambrian crystallines, noncavernous limestone and dolomite, shale, and quartzite (Miller, 1974). Most of the ground water storage is within 300 feet of the land surface.

The ambient ground water quality in this province 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. Lead levels exceeding the older MCL of 50 parts per billion (the current MCL is 15 ppm) was found in water from some domestic wells in the Lafayette Meadows area in Sussex County. An investigation by NJDEP in the early 1980s indicated that the source of this lead is a nearby lead-zinc mineralized zone occupying secondary fractures within the limestone bedrock. Similar undiscovered problem areas may exist in this province. The New Jersey Geological Survey is currently promoting studies to better understand this problem so that a systematic approach to recognizing similar problem areas can be developed.

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 meltwater 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, 77 percent

and 81 percent respectively of the pumped ground water is from stratified-drift deposits with yields from individual wells ranging from 20 to 2,200 gallons per minute (gpm) (Van Abs, 1986).

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.

C. GROUND WATER MANAGEMENT IN NEW JERSEY

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 seven major components:

1. **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.

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

3. **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.

4. **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.

5. **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.

6. **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.

7. **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 will occur through A Ground Water Strategy for New Jersey. It establishes major new 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 will coordinate case assignments, priorities, and technical standards for pollution cases involving hazardous substances. This system will result 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 will develop 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.

Ground Water Quality Standards establish objectives for controlling the discharge of pollutants to ground water and the correction of pollution from past discharges. The standards contain numerical criteria for many pollutants, and are fundamental to the implementation of the New Jersey Water Pollution Control Act. New standards were promulgated in 1993. The standards contain a new system for classifying ground water of the State, numerical criteria for many pollutants, and a policy which protects good quality ground water from significant degradation due to future discharges.

Well Head Protection will further protect 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 are expected to be proposed in 1994.

Under New Jersey's program, the State will be delineating well head protection areas in unconfined aquifers using an EPA endorsed ground-water model called 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 Land and Water Planning is developing 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 is

in the process of applying this methodology to map aquifer-recharge areas on a county-by-county basis, with the Middlesex County being the first (scheduled for completion in 1994). The methodology has already been applied by municipalities and other organizations on a local scale.

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 which ensures 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 assessment management strategies 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 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. In addition there is a smaller database housed in the USGS branch office in West Trenton, New Jersey. The NJGS is currently developing an ambient ground water quality and aquifer parameter database that will store data from NJGS projects and other programs. Much of that type of data is not entered into WATSTORE. For example, most ambient ground water quality data gathered from the NJPDES permit program and the Bureau of Safe Drinking Water's New Well DataBase are not in WATSTORE.

Research

Basic research on ground water quality issues has been reduced in the Department, due to budgetary restrictions. However, some research is conducted through the 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 shown in Tables IV-1a and 1b, 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: the remedial discharges, and the operational discharges. The remedial discharges include the reinjection of ground water that has been treated under such remediation programs as ISRA, CERCLA, and other Department remediation programs. The 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 consisting 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.

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 the 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 in 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 regulations include 1) ISRA, 2) the NJ Spill 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 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.

Under the Spill Act, Water Pollution Control Act, and the Solid Waste Management Act, responsible parties may enter Administrative Consent Orders or Memoranda of Agreement to conduct investigations, remedial alternative analyses, and/or remedial actions at contaminated sites.

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 required the Department to prepare and adopt the New Jersey Statewide Water Supply Master Plan of 1982 and also to prepare revisions and updates to this plan. The plan is currently undergoing a major revision within the Department and is expected to be completed in 1995. This revised 1995 plan will focus 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 revised 1995 plan will strongly emphasize ground water as a potential water supply. The plan will in turn address ground water vulnerability, and propose management 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 State 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 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 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 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 roles 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 nine major watershed organizations, over one 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.

D. FINDINGS OF CURRENT RESEARCH ON GROUND WATER IN NEW JERSEY

Studies of ground water quality and quantity problems in New Jersey are continuing; recent investigations are examining four such issues (see Figure IV-4):

1. naturally occurring radionuclides in ground water.

2. pesticide and fertilizer pollution of ground water.

3. models that demonstrate the effect that hypothetical ground water withdrawals will have on stressed aquifers in the Passaic River basin.

4. the water levels in Coastal Plain aquifers in order to determine the potential for saltwater intrusion.

Naturally Occurring Radionuclides: Three separate studies focusing on the occurrence of naturally derived radionuclides in ground water in three geologically distinct areas have been, or are being, conducted.

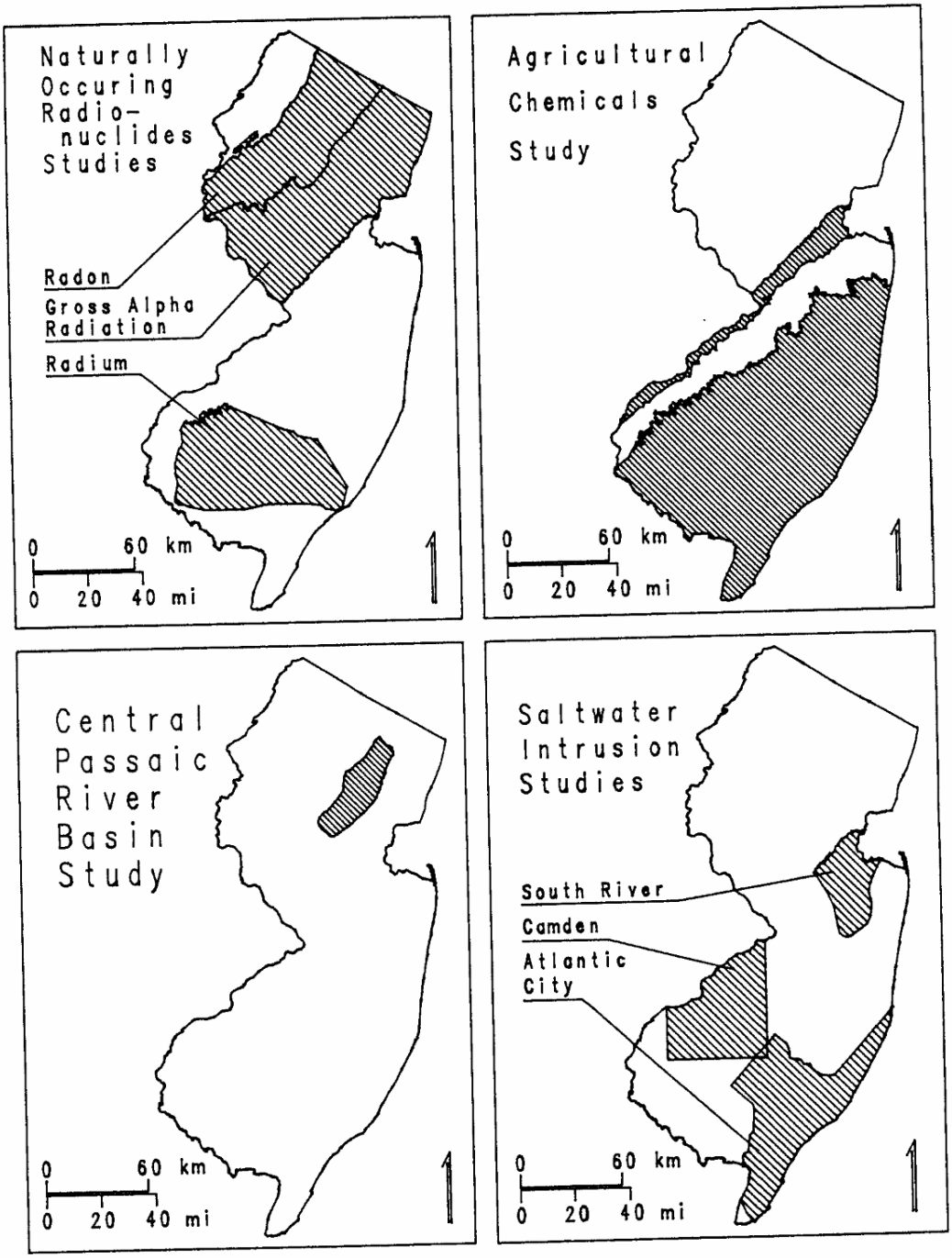
i. In 1987 the NJDEP, in cooperation with Princeton University, sampled 154 wells that draw water from crystalline rocks in the Reading Prong for radon. These radon levels were observed to range from 36 to 24,000 picocuries per liter (pCi/L), and 5.4 percent of the wells sampled were found to have levels exceeding 10,000 pCi/L. A level of 10,000 pCi/L in ground water is believed to correlate with a level of 1 pCi/L in the air of a residence (Cothern, 1987). The USEPA proposed MCL for radon in drinking water of 300 pCi/L was exceeded in 90 percent of the samples collected.

ii. A study in the Newark Basin by the U.S. Geological Survey (USGS), in cooperation with the NJDEP, determined gross alpha-particle activity and geochemical field parameters in 260 wells (Zapecza and Szabo, 1987a,b). Selected samples were analyzed for radium-226, uranium, radon-222 and trace metals. Gross alpha-particle activities ranged from less than 0.1 to 124 pCi/L, 5.7 percent exceeding the MCL of 15 pCi/L. Radium-226 levels ranged from 0.1 to 22.5 pCi/L, 3.9 percent exceeded the MCL of 5 pCi/L. However, this is a minimum percentage exceedence because radium-228 was not considered. Radon-222 ranged from 71 to 15,900 pCi/L and uranium ranged from 0.1 to 40 pCi/L. The major source of the radionuclides is a laterally continuous, vertically narrow, uranium-rich layer that is shallow enough in the far northeast and southwest parts of the basin to be tapped by some wells. The highest radionuclide concentrations in ground water in the basin coincide with the distribution of the two parts of the layer.

iii. A USGS study, in cooperation with the NJDEP, is focusing on high radium levels in the Kirkwood-Cohansey aquifer system in the Coastal Plain of southern New Jersey. Levels of radium-226 plus -228, and gross alpha particle activities exceed their MCLs in many wells. Results of the initial study indicate that out of 82 widely distributed wells tested, 26 percent exceeded the MCL for radium (Kozinski, Szabo, Zapecza and Barringer,

figure IV-4

Major Ground-water Studies in New Jersey
General Study Areas



1992). Radium-226 usually exceeds radium-228, but here radium-228 frequently predominates. This indicates that its parent isotope, thorium-232, occurs in widespread concentrations. Higher radium concentrations correlate with decreasing pH and increasing nitrates, barium, calcium, magnesium and manganese concentrations. A follow-up study used 42 wells to determine the relationship between radium concentration in ground water and agricultural land use. It was found that in agricultural areas the median radium 228 and 226 is 4.8 pCi/L and 2.5 pCi/L respectively as compared to <1 pCi/L and 0.64 pCi/L for non-agricultural land. Sampling also showed decreases in radium and associated constituents with depth and age of ground water (Szabo, Rice, MacLeod, and Barringer.

Agricultural Chemicals: A study by the NJDEP, in cooperation with the USGS, sought to determine if agricultural chemicals such as pesticides and nutrients have adversely affected the quality of ground water in New Jersey (Louis and Vowinkle, 1989; and Louis, written communication, 1989). The project was designed to examine agricultural wells in areas where ground water is most susceptible to contamination. The outcrop areas of Coastal Plain aquifer systems--the Potomac-Raritan-Magothy and the Kirkwood-Cohansey--and the bedrock aquifers in northwestern New Jersey were studied. Water samples were collected from domestic, irrigation, and public-supply wells located within 800 meters of agricultural land. One hundred and twenty wells in ten counties were sampled from 1986 to 1988. The samples were analyzed for nutrients, volatile organic fumigants, herbicides and insecticides. Residues of 22 pesticides and 3 pesticide metabolites were detected in concentrations ranging from 0.01 to 13 parts per billion (ppb). Dissolved nitrate concentrations exceeded the primary drinking water standard of 10 milligrams per liter (mg/L) in 24 percent of the samples. This study clearly indicates that agricultural chemicals are having an adverse affect on ground water quality.

Ground Water Quantity in the Central Passaic River Basin: The buried valley aquifer system in this basin has experienced increasingly heavy ground water withdrawals over time. Ground water levels here have declined as much as 80 feet since the turn of the century. To better manage the limited ground water resources in this area, the NJGS is studying ground-water quantity and quality in the Central Passaic River in conjunction with USGS. The NJGS has issued a series of reports as a result of this effort including a plan of study, a basic data report on pumpages and water levels, and three reports on hydrogeology and bedrock topography. Additional NJGS outputs include a GIS report and a ground-water model designed to predict the aquifer system's response to various ground-water withdrawal schemes. In addition, the USGS also has a report on the ground-water quality of the area. The information has been very useful to the Department in responding to ground-water allocation requests and ground-water pollution cases.

Saltwater Intrusion Studies: Overpumping of ground water and its relationship to saltwater intrusion have been the subject of several recent studies in the New Jersey Coastal Plain. One on-going study showed significant declines in ground water levels in major artesian aquifers of the

Coastal Plain. Overpumpage has caused large regional cones of depression to develop; the most extensive of these are in the Potomac-Raritan-Magothy aquifer system. Here, from 1978 through 1983, heads declined as much as 23 feet. In the Englishtown aquifer system, heads declined as much as 29 feet during the same period; however, the cones were not as extensive (Eckel and Walker, 1983). From 1983 to 1988, declines were as much as 52 feet. It should be noted that recently, water levels within the Englishtown (and Mount Laurel) aquifers have risen dramatically within the past three years due to the availability of Manasquan water and the cut back on the use of public supply wells (H. Kasabach, NJGS, DEP, personal communication).

The lowering of heads indicates not only potential ground water quantity problems, but also potential quality problems. Saltwater from adjacent surface water bodies may recharge the aquifers in response to the lowered heads. Recent USGS and NJGS investigations have found signs of saltwater intrusion in several coastal plain aquifers including those in the South River, Camden, and Atlantic City areas (Leahy and Paulachok, 1987). A study in progress in Cape May County focuses simultaneously on ground water pumpage and saltwater intrusion. The goal is to define optimal withdrawals that will safeguard water quality.

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CHAPTER V
WATER POLLUTION CONTROL PROGRAMS

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WATER POLLUTION CONTROL PROGRAMS

A: POINT SOURCE CONTROL PROGRAMS

Introduction

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, however, reports that approximately $4.75 billion of new investment in wastewater treatment projects is required to meet current needs in the State. Table V-A1 presents the costs for the various categories assessed in the 1992 Needs Survey.

New Jersey's point source-related programs are described in the narrative below. The program discussions 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 Wastewater Assistance Program

The NJDEP, through its Municipal Wastewater Assistance (MWA) program, administers various financial assistance programs which offer low-cost funding for the construction of wastewater treatment facilities 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 MWA 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 moneys 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 114 loans totaling almost $1.0 billion in its first seven years, that are issued as follows:

TABLE V-A1. NEW JERSEY 1992 NEEDS SURVEY RESULTS FOR SEWAGE SYSTEMS

CURRENT 1992 PUBLICLY-OWNED WASTEWATER TREATMENT NEEDS ELIGIBLE FOR FEDERAL FINANCIAL ASSISTANCE

CATEGORY	STATE ESTIMATED CURRENT NEEDS
Secondary Treatment	1,958
Advanced Treatment	269
Infiltration/Inflow	227
Replacement/Rehabilitation	328
New Collector Sewers	402
New Interceptor Sewers	275
Combined Sewer Overflows	1,290
Stormwater Management	7
Nonpoint Source	3
Total	4,759

* All Figures Are In Millions of Dollars (January 1992 - Design Year Needs)

From: USEPA, September 1993.

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

In applying for funding, applicants must meet deadlines for each of the following steps: commitment, planning, design, and formal application.

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 46 landfills with NJPDES permits.

In 1985, a revised fee schedule for NJPDES permits was adopted. It utilized a comprehensive assessment of potential environmental damage resulting from discharges and imposed a fee based on the extent of projected water quality damage. The Department is in the process of proposing changes to the fee methodology to make the fee system fair, equitable and predictable. In fiscal year 1993, the NJDEP collected $10.5 million in NJPDES permit fees.

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 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. Planning for the first pilot watershed (the Whippany River) is underway and monitoring will commence in late 1994. A detailed discussion of the Department's plans for watershed based management is presented later within this chapter.

The NJPDES regulations are being revised to provide provisions for smaller scale, numerous, but primarily innocuous discharges (i.e. 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 Department issues Treatment Works Approval (TWA) permits which authorize the construction and operation of domestic and industrial treatment works, which include sewage treatment plants, collection and conveyance systems, pumping stations, outfalls sewers, 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. 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.

New 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. This was accomplished by

1) raising the flow threshold requirement from 2,000 gallons per day to 8,000 gallons per day, and

2) by not requiring a permit for industrial pre-treatment systems which discharge into publicly owned treatment works which have been delegated the industrial pre-treatment program pursuant to 40 CFR 403 and N.J.A.C. 7:14A-13.1(a).

The above rules also continue the sewer connection ban program, although it is 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 three consecutive month period. 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 wet-weather 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, approximately 63 municipalities were affected by a sewer connection ban.

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 or be incompatible;

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

-to 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 operated 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. are considered "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 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 POTW's and the subsequent heavy metal loadings to the POTWs receiving waters.

Enforcement-Related Activities

The Water and Hazardous Waste Enforcement Element monitors compliance with, and enforces as necessary, all permits issued under the NJPDES permit program for surface water, ground water, and indirect discharges to publicly owned treatment works (POTWs) unless the department has delegated that authority to an approved local agency for controlling indirect discharges. 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 facilities 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. 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 expiration. 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. Penalties assessed and collected pursuant to the Clean Water Enforcement Act are deposited into the "Clean Water Enforcement Fund" and are used by the Department to implement and enforce the State's Water Pollution Control Act programs.

The Clean Water 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.

Table V-A2 summarizes the numbers of inspections conducted by the Water & Hazardous Waste Enforcement Element within Enforcement, the percentage of dischargers found to be out of compliance (i.e., not meeting permit limitations), and the penalties assessed.

TABLE V-A2 SUMMARY OF NJPDES PERMIT COMPLIANCE INSPECTIONS AND PENALTY ASSESSMENTS

FISCAL YEAR 1992:

	MUNICIPAL	INDUSTRIAL
Surface Water Inspections:	In compliance 125 Non-compliance 72 **Total = 197** % Non-compliance=37%	In compliance 731 Non-compliance 385 **Total = 1,116** % Non-compliance=35%
Ground Water Inspections:	In compliance 28 Non-compliance 6 **Total = 34** % Non-compliance=18%	In compliance 294 Non-compliance 191 **Total = 485** % Non-compliance=39%
Penalties Assessed:	SW $2,864,506 GW $22,882 **Total = $3,087,388**	SW $10,204,053 GW $1,722,915 **Total = $11,926,968**

FISCAL YEAR 1993:

	MUNICIPAL	INDUSTRIAL
Surface Water Inspections:	In compliance 271 Non-compliance 132 **Total = 403** % Non-compliance=33%	In compliance 911 Non-compliance 259 **Total = 1,170** % Non-compliance=22%
Ground Water Inspections:	In compliance 70 Non-compliance 43 **Total = 113** % Non-compliance=38%	In compliance 212 Non-compliance 92 **Total = 304** % Non-compliance=30%
Penalties Assessed:	SW $2,942,167 GW $45,845 **Total = $2,988,012**	SW $18,104,546 GW $752,850 **Total = $18,857,396**

B: NONPOINT SOURCE POLLUTION PROGRAMS

Introduction

Nonpoint source (NPS) pollution is a major cause of 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, suggest 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 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 within the designated coastal zone boundary of New Jersey. State mandates for nonpoint source control are currently directed under the New Jersey Sewage Infrastructure Improvement Act which is discussed below.

The following is a summary of all major NPS control activities that either have begun, or have been completed and not reported, since the 1992 305(b) reporting cycle.

1. <u>Activities Funded under Section 319(h) of the CWA</u>

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.

To address this modification and specify needed actions, the Department is currently developing a detailed NPS Strategy. In general, the focus of the Department's 319(h) grant is on regional initiatives based on integration and coordination. This is evidenced by the new and continuing initiatives in the 319(h) workplan. The Department's primary concern is activities which focus on a watershed or other regional (county or municipality groups) geographic area which integrate ground and surface water concerns wherever possible. These initiatives consist of identification of pollution sources and implementation of best management practices for the protection of surface and ground water resources within the defined geographic region. 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 to provide a strong participation component for long term commitment to the projects.

Current watershed project initiatives include the Musconetcong, the Barnegat Bay, and the Whippany. The first two initiatives are discussed in detail below; the Whippany project is discussed within Watershed-Based Planning/Management later in this chapter. Future watersheds chosen 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 in the workplan will support regional and local activities that exist, in particular the 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.

Nonpoint Source Pollution Control Strategy

The Department is preparing a detailed Nonpoint Source Pollution Control Strategy that identifies specific tasks necessary for nonpoint source pollution control. The first step of the strategy will be to formulate a consistent, comprehensive, and coordinated approach to NPS policy implementation within the Department. The policy approach identifies all NPS management offices within the Department and assigns roles to be coordinated in an intra-Departmental effort. As part of this Strategy, the Department will place an emphasis on integrating water resources management planning on a watershed basis. The Department will provide opportunities for public review and comment on the draft NPS Strategy 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.

This manual will expand eventually to include retrofitting solutions for existing development as new techniques for controlling stormwater and NPS pollution are discovered. Also included in the manual are BMP guidelines for road construction and maintenance. Completion of this section of the manual is expected to occur within 1994.

Watershed Prioritization For NPS Management

The NJDEP plans to identify priority watersheds in order to provide a basis for the implementation of nonpoint source control programs. The Department has drafted a watershed-based priority system which has currently been used in selecting NPS demonstration projects. The system analyzes major watersheds based on both their resource value and the level of current pollution. Using this system, the Department worked with the Interagency NPS Committee (the DEP, along with The NJ Department of Agriculture, the State Soil Conservation Committee, the Soil Conservation Service, the Cooperative Extension of Rutgers University, and the U.S. Geological Survey) to identify a priority watershed that would be a good demonstration project area. There is at the same time a separate ground water NPS priority system. The Department will coordinate these lists to ensure that there is a comprehensive priority system that avoids conflicts between the surface and ground water management programs.

Stormwater Management Program

Since the inception in 1989 of New Jersey's Nonpoint Source Assessment and Management Program, the stormwater management program has been an evolving process. In the initial stages, the focus was on (1) the creation and adoption of local municipal ordinances for stormwater and (2) a generic stormwater management plan that can serve as a model for municipalities to use in the design their own stormwater management plans. These stormwater management tools are currently being refined through avenues such as the Department of Community Affairs Site Improvement Act and Phase III of the Sewage Infrastructure Improvement Act Program. Both Acts deal with stormwater management on a local level. The control measures they mandate are closely tied to the NPS-BMP Manual and will serve as guidance in the development of local NPS management plans.

The Stormwater Management Program is designed to develop a regional focus for stormwater management. The program will seek to incorporate the control techniques developed on a local scale and coordinate and adapt them for utilization on a regional scale. The long term goals of the program will place an emphasis on regional stormwater management plans incorporating a watershed approach. Management activities will include setting priorities, water quality modeling, and BMP development and implementation. Also

involved in this scheme will be an extensive public outreach and education component as well as public input components for counties and local agencies.

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 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). That report, among other things, discloses the following information:

- A total of 7,351 stormwater outfalls are distributed between 88 municipalities. One hundred and seventy-eight of these discharges are to the ocean.
- Ocean discharges in Cape May County account for 58 percent of all stormwater discharges to the ocean. Monmouth County's ocean discharges account for 23.6 percent of all ocean stormwater discharges.
- Many waterbodies in the four coastal counties receive discharges from a large number of stormwater outfalls. For example, Barnegat Bay, Manahawkin Bay, Matawan River, Navesink River, Raritan Bay, Sandy Hook Bay, Shark River, and the Shrewsbury River; each receive discharges from over 200 stormwater outfalls.
- Between 1987 and 1991, there were 62 ocean recreational beach closures and 697 bay beach closures.
- The New Jersey Cooperative Coastal Monitoring Program (CCMP) has concluded that the majority of beach closures are the result of elevated levels of bacteria occurring after rainfall events. The identification and management of stormwater discharges is necessary to prevent future beach closings. Indeed, the CCMP currently estimates that up to 70

percent of ocean beach closures could be prevented through the implementation of the SIIA.

Phase II - Final Mapping and Monitoring

Under Phase II of the program, 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 currently developing NPS abatement regulations under Phase III. The regulations, if adopted, would require 94 coastal communities to develop municipal nonpoint source abatement plans and begin implementing abatement measures. These measures will provide control of nonpoint source pollution from new development, as well as remediation from existing urbanized areas. These measures will 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. The 1989 stormwater and CSO Bond Fund was identified as a source of funding for continued work, but may not be applicable to nonstructural NPS controls.

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

Upon completion of the final maps, any of the 94 communities in the four southern coastal counties - Atlantic, Cape May, Monmouth, and Ocean - 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 problems with such sewer systems. 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) 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, the appropriation from the 1989 Stormwater and CSO Bond Fund would be required for implementation.

Barnegat Bay Management Plan (BBMP)

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. As of March 1994 the following activities will be underway by the Department, with more projects being planned for in the future.

- The siting of marine pumpout stations in strategic locations in Barnegat Bay.
- The development a waterfront public access guide for the watershed.
- An assessment of water quality in the Toms River watershed as it relates to land use and nonpoint source pollution.
- Analyzing the hydrologic linkages between ground water and surface water within the Metedeconk and Toms River basins.
- The placement of advisory signs on some State lands alerting the public to the presence of sensitive animal or plant species.
- Contracting with The Trust for Public Land for the purpose of purchasing lands for environmental protection and public access. In addition, the project will set up a grant fund for nonprofit groups involved in environmental planning, education, research, monitoring and/or stewardship.

In addition to projects being conducted by the NJDEP, the USEPA, and the USGS, other governmental agencies as well as private citizen groups are conducting various efforts, including -

- The organizing of a Barnegat Bay Watch Monitoring Program by the New Jersey Marine Science Consortium which will allow local citizens to participate in monitoring the water quality of the Bay.
- The formation of a Barnegat Bay Watershed Association by private citizens to function as an advocate for the Bay.
- The design of educational information regarding nonpoint source pollution and water quality within Barnegat Bay by the Ocean County Agricultural Extension Service and Ocean County Soil Conservation

District. The educational information will be printed on grocery bags and posters, as well as fliers that will be included in cable television bills.

- The formation of a committee to draft a detailed education plan for Barnegat Bay by the New Jersey Marine Sciences Consortium which will be based on the recommendations included in the overall Barnegat Bay management plan.

Musconetcong Watershed Project

As mentioned earlier, the Department along with an Interagency NPS Committee (the DEP in concert with the NJ Department of Agriculture, the State Soil Conservation Committee, the Soil Conservation Service, the Cooperative Extension of Rutgers University, and the U.S. Geological Survey), had developed a ranking system for the selection of a priority watershed within which to conduct NPS demonstration projects. This effort followed two years of attempting to address Section 319(h) demonstration project guidance through a relatively uncoordinated process of independent proposals affecting a variety of land uses and regions of the State. The Department and the Interagency NPS Committee decided that the former approach was not accomplishing its intent because too little money was available for any one project to achieve measurable success.

In response to this, the Department and the Interagency NPS Committee decided to focus the entire competitive grant process on one watershed at a time, in order to allow for a more comprehensive analysis, planning, implementation and monitoring of NPS control impacts. Late in 1992, Department NPS managers and the Interagency NPS Committee, using a draft priority system developed by the Department, selected the Musconetcong River watershed as a demonstration project area.

The focus of the 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.

This project is proposed to take five years in order to allow for appropriate implementation plan development, NPS control implementation, and effective monitoring and assessment. The Department will use funds from the competitive grant for State FY 1994 to provide for oversight, planning, and other activities conducted by the Department during the first year. In later years of the demonstration, the Department intends to use Section 319(h) base grant funds as well as other funding sources.

The Department has received indications of significant interest from a wide variety of state and federal agencies regarding this project. The NJ Department of Agriculture, the State Soil Conservation Committee, the Soil Conservation Service, the Cooperative Extension of Rutgers University, the U.S. Geological Survey, the North Jersey Resource Conservation and Development Council and local soil conservation districts are among the agencies that will be involved in the project. Expressions of interest have also been received from the Regional Planning Boards for Lake Musconetcong and Lake Hopatcong, both of which are within the project area, the National Park Service and the Musconetcong Watershed Association. All interested agencies will be invited to participate in the project.

Middlesex County Aquifer Protection Demonstration Project

This project is designed to develop a case study document and guidance manual that demonstrates the planning and implementation of NPS pollution controls for aquifer recharge protection. The major component of the project involves a case study, performed with the cooperation of the Middlesex County Planning Board, to identify and protect recharge and well head protection areas in several cooperating townships. The project will include a delineation of the geographic areas involved, a survey of pollutant sources (point and nonpoint), an identification of appropriate management techniques (including BMPs developed by NJDEP and its consultants), and an implementation of the management techniques through local and county ordinances.

Ground Water BMP Development

The Department has developed guidance for implementing Best Management Practices for ground water protection. This guidance is in the form of a series of public information brochures designed for distribution to targeted municipalities throughout the State. They will also be incorporated into the Department's BMP manual discussed above. The brochures cover topics such as:

- Road Salting
- Septic Management
- Motor Vehicle Services

- Small Unregulated Storage Tanks
- Urban/Suburban Landscaping

2. Planning Activities Funded Under Sections 205(j) and 604(b) of the CWA

Pass Through Grants

- Delaware River Basin: The DRBC has been conducting a multi-phased project designed to determine the distribution of toxic substances within the Delaware estuary, both within the sediments as well as the water column. The overall goal of the project is to develop management schemes to protect water quality from toxic pollutants.

- Mercer County Soil Conservation District: This study compared the maintenance of stormwater detention basins lined with wildflower cover to that of basins lined with turfgrass. Several basins located in Mercer County were seeded with commercially available wildflower seed mixes and evaluated. A practical guidance has resulted from the study that serves to identify suitable wildflower mixtures and procedures necessary for the successful seeding of stormwater detention basin cover.

- Somerset County Department of Public Works: This study, currently underway, is designed to assess possible changes in water quality in Mac's Brook due to the development of the Bridgewater Commons Mall, which has a stormwater discharge to the Brook. Baseline water quality information characterizing Mac's Brook before the mall was built is based upon sampling data routinely collected at a USGS monitoring station located immediately downstream from the Mall.

- Cape May County Well Head Protection Project: This project is designed to locate and delineate private domestic well cluster areas within Cape May County for the well head protection program. Well Head Protection Areas have been delineated for well clusters, and management for these areas has been developed and implemented. All research and analysis developed under this program will be formulated for Geographical Information System (GIS) compatibility.

- Ocean County Well Head Protection Program: This program has delineated well head protection areas for public water supply wells. Potentially hazardous land uses within the well head protection areas have been mapped. Land use controls and land use options designed to protect water supply wells have been explored in this project.

- Hopatcong Borough: A grant was awarded to Hopatcong Borough to develop a municipal nonpoint source abatement program for Lake Hopatcong. The development of the abatement plan is similar to the approach that is being followed by municipalities in the coast under the Sewage Infrastructure Improvement Act. The Borough is conducting a stormwater facility inventory and is mapping all outfall structures and existing controls. In addition, the Borough is organizing stream walks designed to promote citizen involvement and to identify obvious major

NPS problems. The Borough is collecting water quality samples at selected locations. All of the information gathered during these activities will be analyzed and used to develop a NPS Abatement Program for the Borough.

- Upper Millstone River Storm Runoff Impact Study: This study quantified pollutant loadings contributed by nonpoint sources in relation to existing land uses. The Study also evaluated the potential impact of prospective nonpoint source pollution generated by the future development that is anticipated within the lower reach of the Upper Millstone River watershed. The Study employed a comprehensive mathematical storm runoff model (SWWM-4). The study area borders Mercer and Middlesex Counties and includes the subbasins of Rocky Brook and Upper Millstone River, above the confluence with Cranbury Brook, with about 41 square miles of drainage area. Based on model projections, the pollutant loading trend increases with the degree of urbanization. As 80% of farm and forested lands located in the study area are converted to urban land use, the loading for the following pollutants will increase as follows: TSS - 20 times, BOD - 10 times, total phosphorus - 10 times, total nitrogen - 4 times, and ammonia - 3 times.

3. Programs Funded from a Variety of Funding Sources

Section 6217 of the Coastal Zone Act Reauthorization Amendments

Traditionally, the National Oceanic and Atmospheric Administration's (NOAA) Coastal Zone Management program has served as the foundation for watershed protection in state-defined "coastal zones." Recently, Congress enacted the Coastal Zone Act Reauthorization Amendments of 1990 (CZARA) to give special protection to coastal waters in the light of increasing beach closures, shellfish harvesting prohibitions, and the loss of biological productivity. CZARA is jointly managed by NOAA and USEPA and requires the water quality management agencies of coastal states to develop coastal nonpoint source pollution control programs.

Section 6217(a) of the CZARA requires each coastal state with a federally approved coastal zone management program under section 306 of the Coastal Zone Management Act (CZMA) to develop and submit to NOAA and EPA a coastal nonpoint program for approval. The central purpose of section 6217 is to strengthen the links between federal and state coastal zone management and water quality programs in order to enhance state and local efforts to manage land use activities that degrade coastal waters and coastal habitat. To accomplish this purpose, the statute seeks to improve state and local government's capability to control and manage land use activities that affect coastal waters, primarily through the implementation of -

1. management measures in conformity with guidance published by USEPA under section 6217(g), and

2. additional state-developed management measures implemented as necessary to achieve and maintain applicable water quality standards.

NOAA and USEPA do not expect states to develop stand-alone coastal nonpoint programs, but rather expect that implementation of the coastal nonpoint program will be accomplished through changes to the approved state nonpoint source management program such as activities funded under section 319 of the Clean Water Act, as well as changes to the state coastal zone management program developed under section 306 of the CZMA.

Industrial Stormwater Permitting

This program issues permits for stormwater discharges associated with certain industrial activities. One of the major implementation objectives of the Permit Program is to maximize the use of pollution prevention strategies and source controls designed to minimize or eliminate contact between rainfall and pollution sources.

NJDEP will accomplish this objective through a progressive system of general and industry-specific permits. Two basic or general permits have been proposed by the Department that will apply to most regulated industries, construction activities, as well as certain mining activities. These permits will 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 are exposed to rainwater. These general permits will be followed by a separate series of industry-specific permits developed in coordination with the industrial community, which will 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; thereby, preventing the pollutants from actually getting into the stormwater.

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 is 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.

C: Watershed-Based Planning/Management

Introduction

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 up to this point in time, to address the heightened expectations of current environmental concerns requires a renewed emphasis on more detailed and site-specific problem assessment and more comprehensive pollution management. This will not only address point source discharges to ground and surface waters, but also stress pollution prevention and source reduction, while also focusing on more difficult to regulate non point sources of pollution.

Also at issue are instances where the combination of Federal and State legislative mandates and directives originating from divergent policy perspectives designed to address dissimilar concerns have led to overlapping and contradictory regulations. In addition, water resource management programs such as water supply, water quality, wellhead protection, stormwater, 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, rather, a resurrection and expansion of a planning process instituted within the Department back in the mid 1970's and then termed the "continuous planning process". What has changed is a shift away from politically defined planning regions to regions defined on a basis of a river basin.

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 Will New Jersey Institute a Watershed-Based Planning/Management Approach ?

A Watershed-Based Planning/Management approach begins with a characterization of the watershed. 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 cost-effective implementation measures will be developed as means to meeting those goals. Those measures will be organized into a workplan that will coordinate and concentrate existing programs 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 overall management effort.

In summary, New Jersey perceives the benefits of the Watershed-Based 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. In addition, policy debates are more likely to remain as part of the planning process, allowing permitting to be a more routine process and thereby reducing permitting backlogs.

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 has been on going since the fall of 1993 when, in October, 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 on-going and will continue throughout the development and implementation of a watershed management plan for the Whippany River. Existing data from many sources are being collected and evaluated to establish a baseline of information to assess the health of the existing water resources. Additional data will be collected as needed, including water quality monitoring of the Whippany River that will begin in the fall of 1994.

The pilot project will culminate in a **Whippany River Watershed Management Plan** which will contain management strategies for the watershed. These strategies might include changes in zoning, increased water conservation, improvement of riparian buffers, discharge controls, or implementation of nonpoint source pollution best management practices. 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 as well as by regional and local entities.

The Department is presently discussing where the next watershed based management effort will be. At the heart of the debate is a ranking list of watersheds; more specifically, just how such a list should be developed and what criteria should be used to rank candidate watersheds. It is hoped that a ranking system will be finalized by the end of 1994 and a ranking of watersheds will soon follow.

D: NEW JERSEY'S SHELLFISH MONITORING AND REGULATION PROGRAM.

Introduction

New Jersey's shellfish resources support an important commercial and recreational fishery. The 1984 commercial landings of shellfish (hard clams, soft clams, surf clams, ocean quahogs, oysters, mussels and sea scallops) in New Jersey had a dockside value in excess of $46.1 million. The recreational fishery in New Jersey concentrates primarily on the harvest of hard clams. Although annual data on recreational landings is not available, a survey conducted by the Division of Fish, Game & Wildlife in 1980 indicates that the recreational landings of hard clams comprise approximately one-third of the total hard clam harvest.

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. 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. These are determined through actual measurements of coliform concentrations in the water column, hydrographic (tracing), and shoreline surveys.

The Bureau of Shellfisheries (Division of Fish, Game & Wildlife) is responsible for issuance of licenses for the various shellfish harvested. In 1990 12,313 clamming licenses (hard and soft clams) were issued of which 1,958 were commercial. Also, the Bureau issued 92 oyster tonger licenses during 1990, up from only 39 in 1988.

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 State 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 State 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 administrated 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.

Relay Program

The ability of shellfish to purify themselves of bacterial contamination when relayed to clean water was discovered early in the 1900's. New Jersey's Department of Environmental Protection presently 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 Relay Program was initially begun during the early 1970's in the vicinity of Atlantic City. This area included Lakes Bay, Absecon Bay and Scull Bay plus the vast complex of interwinding waterways. The program was subsequently expanded to include portions of Raritan and Sandy Hook Bays, the Navesink, Shrewsbury, Manasquan and Shark Rivers and certain areas

in Atlantic and Cape May Counties. The waters in these localities are classified as Special Restricted or Condemned. Hard clams taken from these waters are relayed to specially designated beds in Barnegat Bay, Little Egg Harbor, and occasionally to Great Bay.

An individual must comply with two requirements in order to participate in the relay program: (1) A harvester must possess a valid commercial clamming license and, (2) a valid Relay Permit.

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 it is known that lower water temperatures (minimum 50 degrees F) inhibits 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 also used and, to a less frequent extent, the Manasquan and Shark Rivers also. 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 is monitored by video camera.

The depuration program in New Jersey was first began in the 1940's for the purpose of cleansing oysters. It was revised in the early 1970's to treat soft clams; hard clams were then added in the early 1980's. Currently the State of New Jersey has one plant certified for the depuration of hard clams, located in Highlands. In 1988, because of numerous violations at the plant, the State suspended the depuration program; moreover, both the DEP and DOH imposed a moratorium on the establishment of any further clam depuration operations until new regulations governing the program could be revised and additional enforcement personnel made available.

New revised DEP and DOH regulations, which encompass both hard and soft clam depuration, became effective in November 1991. In mid-1993 a State Steering Committee, composed of staff from DEP and DOH, received a set of proposed plans for a second depuration plant to be located in Highlands. The plant is expected to be in operation by 1995.

E: 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 V-E1 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-1900's. 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 and is presently the responsibility of the U.S. Army Corps of Engineers. Section 303 provides protection through the antidegradation provisions of the

TABLE V-E1: 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

Surface Water Quality Standards. The State includes wetlands in the definition of "surface waters" and in the near future will proceed to establish water quality standards for wetlands thereby expanding the role of section 303 in the protection of these waters.

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 the Pinelands Commission and therefore, activities in these areas do not require a freshwater wetlands permit nor are they subject to transition area requirements.

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 hydrophytic 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 2922 Statewide general permits and 127 individual permits resulting in the filling of 507.9 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 2,551.1 acres of wetlands. Further, the U.S.F.W.S. observed that this is probably an underestimate 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.

As stated previously, section 404 of the federal Clean Water Act addresses the regulation of wetlands and waters of the State and is presently the responsibility of the U.S. Army Corps of Engineers. The FWPA requires that the State take appropriate action to assume the Federal 404 Permit program from the Army Corps. On March 4, 1993, the State of New Jersey submitted its application to USEPA for assumption of the section 404 permitting authority under the Clean Water Act. The State's application was declared complete on June 13, 1993. On December 22, 1993, EPA approved New Jersey's application.

With respect to other wetlands-related activities, the State is presently involved in a comprehensive mapping project to identify and classify all wetlands statewide. Approximately 95 percent of the State has been completed to date. 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.

Additional Issues Relevant to Wetlands Protection In New Jersey.

The following are issues specifically requested by USEPA to be used in their assessment of New Jerseys wetlands protection program.

Federal permits/licenses to which the State applies section 401 certification authority: The State applies 401 Certification to all 404 permits, permits based on Section 10 of the Rivers and Harbors Act, as well as requests for Federal licenses such as Federal Energy Regulatory Commission licenses. The State of New Jersey has denied Water Quality Certification for all Nationwide permits (NP) except NP numbers 1 (Aids to navigation), 4 (Fish and Wildlife Harvesting Enhancement and Attraction Devices and Activities), 24 (State Administered Section 404 Program) and 37 (Emergency Watershed Protection and Rehabilitation). In addition, the State conditioned NP number 34 (Cranberry Production Activities) by stating that applicants must meet the State's policy on expansion of cranberry facilities into wetlands.

Summary of 401 certification activity from 1992 to 1994. The State cannot tabulate the number and types of activities for which 401 certification has been reviewed and approved because in most cases this review occurs simultaneously with the State's permit process. Thus, statistics are only kept

on the type of state permit being requested and the type of impacts associated with the state permit.

Integration of New Jersey's wetlands protection activities with stormwater management. At this time, the State 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. However, these requirements deal mainly with mechanical methods for removal of solids from the stormwater and do not measure, on a site by site basis, the success of the method once it has been implemented. As the stormwater program completes its best management practices (BMP) manual for stormwater, the wetlands program will be better able to integrate these BMPS.

State activities funded through the 104(b)(3) wetland grant program. The Department has received 104(b)(3) grants for the following projects:

(a) Formulation of a State Wetland Conservation Plan designed to look at non-regulatory mechanisms for wetland protection in New Jersey;

(b) Wetlands mitigation habitat evaluation study to evaluate the success of mitigation sites required through the regulatory program;

(c) Permit Delegation Study designed to investigate the practicality and efficiency of allowing some local entity to implement various state environmental laws;

(d) Study of the Great Swamp Watershed. The Great Swamp Watershed is under development pressure while at the same time it is one of the most significant wetland complexes in the State. It contains both State and Federal wetland reserves which appear to be changing over time as a result, some say, of development pressures in the watershed;

(e) Completion of wetland maps for Sussex County. The State has completed wetlands maps for the entire State with the exception of Sussex County and the Pinelands Reserve Area. State funding is tenuous for completion of these areas; and

(f) Purchase computer equipment to electronically link the Pinelands area with the Department to facilitate the State's assumed authority under Section 404 of the Clean Water Act (Assumption). On December 22, 1993, the EPA approved the State of New Jersey's assumption application. As a result, when assumption becomes effective, the State will have regulatory authority in the Pinelands Area for the first time (previously, the Pinelands Area was exempt from State regulation). The Department of Environmental Protection entered into an agreement with the Pinelands Commission to better allocate resources in this area. A computer link will assure that coordination with the commission will be effective.

Effective mechanisms used in protecting wetlands in New Jersey. It has been determined that the most efficient way for the State to protect its wetlands is through assumption of the 404 Program. Assumption of this Program allows the State to apply one law, the Freshwater Wetlands Protection Act, to all wetlands in New Jersey. In addition, it eliminates the conflicts that have occurred between the State's program and that of the Army Corps of Engineers. To date, aside from the wetlands grant which assists in the purchase of computer equipment, the State has not received any funding to assist with Assumption.

F: SURFACE WATER QUALITY STANDARDS PROGRAM

Modifications were proposed in November 1992 to the New Jersey Surface Water Quality Standards (SWQS) that were formally adopted in October 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. Below are listed the highlights of the changes to the SWQS.

- Recodification of the SWQS (formerly 7:9-4) to place them in their own chapter of New Jersey Administrative Code (N.J.A.C. 7:9B);

- Inclusion of wetlands under surface waters to protect the structure and function of wetlands;

- Aquatic and human health criteria were adopted for most of the toxic substances which includes priority pollutants (e.g. pesticides, volatiles, acid compounds etc.) and non priority pollutants (bacterial quality, temperature, solids, chlorides, detergents, etc.);

- Human health criteria were adopted for several carcinogens with a risk level of one-in-one-million and possible 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 were adopted for several streams based on trout fisheries data available in order to show if the waters are suitable for the propagation of trout or the maintenance of trout and their associated species;

- 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;

- Category One (C1) antidegradation designation was adopted for the stretch of Rockaway River, from Washington Pond outlet downstream to the Route 46 bridge;

- Reclassification of less restrictive uses to portions of Assunpink Creek and Posts Brook based on updated information from Trout Maintenance (TM) to Non Trout (NT);

- Reclassification of the stretch of the Wallkill River from the outlet of Franklin Pond to the State line from FW2-Trout Maintenance to FW2-Non Trout;

- Prohibition of mixing zones for bacterial indicators. Criteria for bacteria 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 A

SHELLFISH RESOURCES AND HARVEST AREA CLASSIFICATIONS FOR 1994

Introduction

The State's shellfish resources are spread throughout its coastal and estuarine waters. The distribution of the shellfish resources can best be described by dividing the State into three basic regions consisting of the Atlantic Coast estuaries, Delaware Bay, and the Atlantic Ocean.

Atlantic Coast Estuaries

The hard clam, *Mercenaria mercenaria*, is the most widely distributed species being present in abundant quantities in virtually every estuary from Raritan Bay to Cape May. The expansive distribution and high consumptive appeal of this species provides excellent commercial and recreational opportunities. Aquaculture programs are currently enhancing the numbers of this species being marketed.

The soft clam, *Mya arenaria*, is also found throughout the Atlantic Coast estuaries but the distribution of commercially important beds is limited. Although commercial populations of soft clams may occur occasionally in any estuary, areas supporting a regular fishery are confined to the Navesink and Shrewsbury Rivers and sections of Sandy Hook Bay.

Oyster beds within the Atlantic Coast estuaries have been significantly reduced from historic levels and are now only present in commercial densities in the Mullica and Great Egg Harbor River systems. Commercial harvest from these areas represent at most, five percent of the total oyster landings for New Jersey.

The mussel, *Mytilus edulis*, is found in the estuaries as well as offshore. Although they may be extremely abundant at certain times they represent a relatively low percentage of the shellfish landed in New Jersey.

Delaware Bay

Today the oyster, *Crassotrea virginica*, is most abundant in Delaware Bay which accounts for at least 95 percent of New Jersey's annual oyster landings. The oyster fishery in Delaware Bay is almost exclusively a commercial operation. Although hard and soft clams occur in Delaware Bay there is only a limited commercial fishery for hard clams.

Atlantic Ocean

The surf clam, *Spisula solidissima*; blue mussel, *Mytilus edulis;* ocean quahog, *Arctica islandica;* and the sea scallop, *Placopecten magellanicus*; are all oceanic species and are harvested off New Jersey's coast. Harvesting of all

species is predominantly a commercial enterprise although some bait and recreational harvesting of surf clams along the beaches does occur.

Ocean quahogs and sea scallops do not occur within New Jersey's territorial sea (within three miles of the beach) but considerable quantities are landed by both New Jersey and other vessels at New Jersey ports. Surf clams are found both in New Jersey and federal waters and support a significant fishery. Currently the bulk of the New Jersey inshore (within three miles) resource is located between the Shark River Inlet and the Great Egg Harbor Inlet.

The Department's Bureau of Marine Water Classification and Analysis (BMWC&A) annually assigns harvest classifications to the State's shellfish growing waters. The BMWC&A has classified coastal waters into five categories of shellfish harvesting areas: Approved, Seasonal, Seasonal Special Restricted, Special Restricted Area, Prohibited, and Condemned. See Chapter IV, section D
for a detailed discussion of these categories.

From January 1971 through January 1979, 18,660 acres of New Jersey's estuarine waters were reclassified from approved to a more restrictive classification. Approximately 25 percent of these areas were reclassified Condemned. The general decline in classification was attributed to increased recreational and development pressure in coastal areas and the declining effectiveness of older municipal wastewater treatment plants. In 1980 a net gain resulting from of an over 5,000 acre upgrade was recorded. During 1981 an additional net gain of approximately 2,500 acres was established. The 1982 reclassifications resulted in a net loss of slightly over 200 acres. The net gain for 1983 was approximately 6,700. A net loss of approximately 8,484 acres in 1984 was a direct result of the seasonal disinfection policy in the Raritan Bay complex and its effect on water quality during the winter. A net increase of 255 acres was shown for 1985. The 1986 regulations were changed to expand the availability of 13,000 acres in Raritan Bay for depuration for an additional two months. The most notable changes for 1987 were the downgrading of 3,740 acres of the Atlantic Ocean in the North Coastal Basin from approved to prohibited, and the upgrading of roughly the same acreage in the South Coastal Basin Ocean area from prohibited to approved. In 1989 approximately 14,946 acres were upgraded, resulting in a net gain. Most of this (13,000 acres) was the result of an upgrade of portions of Raritan Bay from Seasonal Special Restricted to Special Restricted. Of the remaining estuarine and ocean areas, only 240 acres received down graded classifications.

Classification totals for the ocean waters have fluctuated in recent years. Large numbers of acres are initially closed when each regional ocean discharge goes on line. After an assessment of observed water quality, operational efficiency and reporting reliability, some refinement (reduction) of the Condemned classifications may occur.

Status of New Jersey's Shellfish Growing Waters

For the purpose of this Report, New Jersey has been divided into five major basins which are subject to shellfish growing water classification regulations. These include the Raritan River Basin, the New Jersey North Coastal Basin,

the New Jersey South Coastal Basin, the Delaware River Basin Commission Zones 5 and 6, and the Atlantic Ocean.

Raritan River Basin

Only a small portion of the Raritan River itself need be examined, as most of the upper basin consists of freshwater habitats. Prime consideration here is given to Raritan Bay, Lower New York Bay, Sandy Hook Bay, Navesink River, Shrewsbury River and their tributaries. There are no waters in this basin classified Approved. Seventy-five percent of the available acreage is classified Special Restricted. Based on earlier data collected during the period of disinfection and non-disinfection a new classification (Seasonal Special Restricted) was developed that allowed the harvest of shellfish for depuration during certain periods of the year. Now that wastewater treatment plant effluent discharge to this basin is disinfected on a year round basis, those areas previously classified as Seasonal Special Restricted have been upgraded effective July 1989 to Special Restricted.

Reclassifications in the Raritan River Basin since 1988 include:

July 1989
Raritan Bay: 13,000 acres, Seasonal Special Restricted to Special Restricted. Expanded dates available for relay and depuration.

Designated Use Assessment

Seventy-five percent of that portion of the Raritan River Basin under the jurisdiction of the Department's Bureau of Marine Water Classification and Analysis partially support the shellfish harvesting designated use based upon criteria established by the National Shellfish Sanitation Program (NSSP). The remaining twenty-five percent do not support the use.

New Jersey North Coastal Basin

This basin consists of a large portion of the Atlantic Ocean coastal environment in New Jersey. Most of the acreage classified in this basin is in Barnegat Bay. Barnegat Bay comprises the largest percentage of the total acreage available for shellfish harvesting in this basin. The remainder of the basin is made of a number of somewhat smaller bays, rivers, creeks and their tributaries. These include Shark River, Manasquan River, Metedeconk River, Toms River, Forked River, Oyster Creek, Manahawkin Bay, Little Egg Harbor, Cedar Run, Westecunk Creek, Tuckerton Creek, Big Thorofare, and Big Creek.

Fully open shellfish harvesting acreage constitutes 70-75 percent, as of 1989, of the total available acreage in this basin. These areas are generally located in Barnegat Bay and Little Egg Harbor. This leaves 10-15 percent (1989) of the total available acreage Condemned, and 10-15 percent (1989) classified as Seasonally Approved. Under the Shellfish Relay Program, clams are removed from certain Condemned and Special Restricted waters of the Raritan River Basin as well as Manasquan and Shark Rivers and deposited in specified

Approved waters in Barnegat Bay, Little Egg Harbor Bay in Tuckerton Cove, or Great Bay for purification.

Reclassification on the North Coastal Basin since 1988 include:

May 1988	
Little Egg Harbor:	15 acres Approved to Special Restricted
July 1988	
Little Egg Harbor (Tuckerton Cove):	112 acres, Seasonal to Approved
August 1990	
Manasquan River:	424 acres, Special Restricted to Prohibited
January 1992	
Cedar Run Cove:	175 acres, Seasonal to Special Restricted
April 1994	
Barnegat Bay:	178 acres, Seasonal to Approved

Designated Use Assessment

Based upon criteria established by the National Shellfish Sanitation Program (NSSP); 63 percent of the shellfish waters in the North Coastal Basin fully support the designated use for shellfish harvesting, 13 percent partially support the use, and 24 percent do not support the use.

New Jersey South Coastal Basin

The New Jersey South Coastal Basin, combined with the New Jersey North Coastal Basin, make up more than 90 percent of the Atlantic Ocean coastal zone drainage basin in New Jersey. In comparison with the three other basins (Raritan River, New Jersey North Coastal Basin and Delaware River Zones 5 and 6)) which support shellfish harvesting, this basin is the most productive as far as hard clams are concerned.

The New Jersey South Coastal Basin includes Great Bay, Mullica River, Reed Bay, Absecon Bay, Lakes Bay, Great Egg Harbor, Great Egg Harbor River, Ludlam Bay, Great Sound, Jenkins Sound, Grassey Sound, Richardson Sound, and Cape May Harbor. Reclassifications which have taken place in this basin since 1988 include:

July 1989	
Reed Bay:	10 acres, Seasonal to Special Restricted
Shelter Island Bay:	57 acres Special Restricted to Seasonal
Great Egg Harbor Bay:	706 acres Seasonal to Approved
Ludlam Bay:	285 acres Special Restricted to Approved
Townsend Sound and Mill Thorofare:	243 acres Seasonal to Approved

Great Channel:	248 acres Special Restricted to Seasonal
August 1990	
Absecon Bay:	140 acres Seasonal to Approved
Ship Channel:	107 acres Approved to Seasonal
Ludlam Bay:	74 acres Approved to Special Restricted
Ludlam Thorofare:	38 acres Prohibited to Approved
Ware Thoro-Mill Creek:	51 acres Prohibited to Approved
Great Sound Area:	281 acres Seasonal to Approved
Great Channel:	437 acres Prohibited to Seasonal
Jenkins Sound Area:	1034 acres Prohibited to Seasonal
Grassy Sound/Richardson Sound:	1724 acres Prohibited to Seasonal
Maurice River Cove:	389 acres Approved to Seasonal
January 1992	
Broad Creek (Brigantine area):	27 acres Approved to Seasonal
Great Egg Inlet:	72 acres Approved to Special Restricted
Ship Channel:	36 Seasonal to Special Restricted 9 acres Seasonal to Approved 15 acres Approved to Special Restricted 153 acres Approved to Seasonal
Great Egg Harbor Bay:	8 acres Approved to Seasonal
Grassy Sound Channel:	45 acres Seasonal Special Restricted
Grassy Sound - Richardson Sound:	246 acres Prohibited to Seasonal 1126 acres Seasonal to Approved
Richardson Sound:	22 acres Seasonal to Prohibited
Old Turtle Thorofare:	45 acres Prohibited to Seasonal
January 1993	
Strathmere - Ludlum Bay area:	283 acres Approved to Seasonal
Avalon area:	68 acres Approved to Special Restricted 95 acres Special Restricted to Approved
April 1994	
Atlantic City Lakes Bay area:	87 acres Special Restricted to Prohibited

Designated Use Assessment

Based upon criteria established by the Department's BMWC&A; 61 percent of the shellfish waters in the South Coastal Basin fully support the designated use for shellfish harvesting, 12 percent meet partial use, and 27 percent fail to support this designated use.

Delaware River Basin - Zones 5 and 6

Delaware Bay contains 97 percent of the total classified acreage in the basin and is the only area in the basin that contains waters classified as Approved for shellfish harvesting. The remaining areas are classified either Special Restricted, Prohibited, or Seasonally Approved. In the past, problem areas have included the Maurice River and Cove area, the Cohansey River area, the Back Creek area, the Cedar Creek area and the Nantuxent Creek area. Of the total acreage available for shellfish harvesting, 86 percent are currently classified Approved, roughly 13 percent are either Special Restricted or Seasonally Approved. A little over one percent of the waters are currently classified as Prohibited.

Delaware Bay is the major oyster producing area of the State. Although the bay and its tributaries still produce approximately 98 percent of the oysters harvested, their numbers have been severely reduced due to MSX (*Minchinia nelsoni* disease and the presence of the oyster drill *Urosalpinx cinerea* and *Euplaura candata*). Most oysters which are harvested in New Jersey originate in Delaware Bay seed beds and are transplanted to the leased grounds for growing and harvesting. Roughly 28,000 acres in the Bay are leased for planting seed oysters.

Reclassifications which have taken place in the Delaware River Basin since 1990 include:

1990
Maurice River Cove: 389 acres Approved to Seasonal

1992
Cape Shore Area: 5615 acres Prohibited to Approved

Designated Use Assessment

Based upon criteria established by the NSSP; 86 percent of the shellfish waters in the Delaware River Basin fully support the shellfish harvesting designated use, 13 percent partially support the use, while about 1 percent fail to support this use.

Atlantic Ocean

None of the basins previously discussed included figures on the Atlantic Ocean. There are 280,708 acres of marine waters which are regulated by the BMWC&A. Of this total area 72 percent of the waters are classified as

Approved while the remainder is classified as Condemned (1986 data). The reclassifications in the Atlantic Ocean since 1988 are as follows:

May 1988	
Atlantic Ocean (Ocean County - Dover Township Area):	Prohibited to Approved 1045 acres
Atlantic Ocean (Absecon Inlet Area):	Prohibited to Approved 590 acres
Atlantic Ocean (Wildwood Area):	Approved to Prohibited 2795 acres
July 1989	
Atlantic Ocean (Cape May Area):	Prohibited to Approved 295 acres Approved to Prohibited 230 acres
August 1990	
Atlantic Ocean (Hereford Inlet area):	Prohibited to Approved 2,760 acres
January 1993	
Atlantic Ocean:	Prohibited to Approved 1585 acres
April 1994	
Atlantic Ocean:	Prohibited to Approved 140 acres

APPENDIX B

RESULTS OF THE 1992 LAKES WATER QUALITY ASSESSMENT

Presented here are the results of the Department's Lake Water Quality Monitoring Program for 1992. The objective of this Program was to acquire limited limnological data from specific public lakes so that a baseline trophic status could be determined for each lake in the study. This information will also be used to monitor future lake water quality trends. This project represents an on going lake assessment process that has existed for several years. The study is described in detail in Chapter III, section D of this report.

Harrisville Lake, Burlington County, 40 acres.
Harrisville Lake is on the Wading River, which in turn drains into the Mullica River. Heavy growth of macrophytes impedes boating and fishing activities in some areas of the lake. The shallow depth (5 ft. max.) helps support the heavy plant growth. During the spring and summer, total phosphorus levels in the water column were low (0.02 mg/L), which is fairly common for New Jersey Pinelands lakes. During the fall, total phosphorus levels were 0.05 mg/L, possibly due to decaying macrophytes. The watershed is mostly forested area with some agriculture, mainly cranberry bogs.

Lake Oswego, Burlington County, 90 acres.
Lake Oswego is on the Oswego River which drains into the Mullica River. Much of the lake, because of its shallow depth (6 ft. max.), is choked with *Nuphar advena* (spatterdock) and *Xyris caroliniana* (yellow-eyed grass). Total phosphorus levels were relatively low (0.03 mg/L or less). The watershed is mostly forested with some agriculture, mainly cranberry bogs.

Tuckahoe Lake, Cape May County, 11 acres.
Tuckahoe Lake is located within the Lester G. Macnamara Wildlife Management Area. *Utricularia spp.* (bladderwort) covers the majority of the lake bottom and collects in floating masses along portions of the shoreline. Fishing and boating are only minimally impacted. Since total phosphorus levels (0.02mg/L) in the water column were relatively low, macrophyte growth is most likely influenced by the lake's shallow depth (4 ft. max.).

Grenloch Lake, Camden County, 9 acres.
Grenloch Lake is located on the Big Timber Creek which in turn drains into the Delaware River. Turbidity was evident during each monitoring run and impairs the lake aesthetically. Algal blooms contributed to the turbidity with chlorophyll a levels as high as 23.45 mg/L, but erosion from exposed shoreline areas may also have been contributing to the problem. Total phosphorus was high in the water column (0.25 mg/L) and therefore supported excessive algal production.

Menantico Ponds, Cumberland County, 62 acres.
The Menantico Ponds are a series of interlocking lakes located within an old sand quarry. They are part of the Menantico Creek and are located within a NJ Wildlife Management Area. Algal blooms and excessive macrophyte growth were not evident during any of the monitoring runs, however high

total phosphorus levels (up to 0.10 mg/L during the summer) could lead to increased plant productivity. Blue-green algae, which are normally an indicator of nutrient-rich water, were present during the summer.

Harrisonville Lake, Gloucester and Salem Counties, 30 acres.
Harrisonville Lake is a impoundment on Oldman's Creek that in turn drains into the Delaware River. The lake is part of a NJ Wildlife Management Area. Excessive growth of *Ceratophyllum demersum* (coontail) and some *Utricularia spp.* (bladderwort) has impaired the recreational use of the lake. The watershed is mostly agriculture and therefore it is possible that runoff from the surrounding area contributes to the elevated nutrient levels.

Malaga Lake, Gloucester County, 45 acres.
Malaga Lake is a impoundment on Scotland Run and Indian Branch Creek, all part of the Maurice River watershed. About 50% of the lake is not accessible to boats because of heavy macrophyte growth. The dominant species present are *Nymphoides cordata* (floating heart) and *Utricularia spp.* (bladderwort). The plant growth is confined to those areas of the lake with a depth of about 4 feet or less. Total phosphorus levels in Malaga Lake's water column were relatively low (0.02 mg/L or less). Shallow depth and possibly nutrients contained in the sediments influence the macrophyte growth.

Amwell Lake, Hunterdon County, 12 acres.
Amwell Lake is part of a NJ Wildlife Management Area. During each monitoring run, the water's appearance was very turbid (Secchi disk readings of 1 foot or less). The clarity problems are in part attributable to heavy algal blooms (chlorophyll a as high as 163 mg/L). Extremely high levels of total phosphorus in the water column (up to 0.46 mg/L) contribute to the excessive macrophyte growth. Agriculture, which makes up much of the watershed, is the probable major contributor of nutrients to the lake.

Hooks Creek Lake, Middlesex County, 40 acres.
Hooks Creek Lake is part of the Cheesequake State Park. Nutrient levels in the water column are low but the lake experiences a problem with excessive macrophyte growth each summer and fall. The dominant species present is *Najas flexilis* (bushy pondweed). The macrophyte growth is heavy enough to warrant treatment of the lake with herbicides each year.

Stone Tavern Lake, Monmouth County, 52 acres.
Stone Tavern Lake was built in the early 1970's to provide flood protection for the Assunpink Creek and to provide habitat for fish and wildlife. The lake is located within the Assunpink Wildlife Management Area. Certain areas of the lake have macrophyte growth heavy enough to restrict boating and fishing opportunities. The dominant species present is *Anacharis canandensis* (waterweed). Total phosphorus (0.04 mg/L) and chlorophyll a (11.5 mg/L) were moderate during the summer monitoring run but increased to 0.29 mg/L and 53.63 mg/L, respectively during the fall monitoring. The watershed for the Assunpink Creek within this region is mainly agricultural, however, there is also a sewage treatment plant which discharges into the creek upstream of the wildlife management area.

Lake Shenandoah, Ocean County, 101 acres.
Lake Shenandoah is on the South Branch of the Metedeconk River which in turn drains into the Atlantic Ocean. Heavy growth of the macrophyte

Cabomba caroliniana (fanwort) restricts much of the boating and fishing during the summer months. Algal blooms are also present during the spring, summer, and fall (chlorophyll a as high as 37.27 mg/L). Moderately high levels of total phosphorus (0.04 mg/L) may be due to runoff from urban and agricultural areas.

Lake Success, Ocean County, 91 acres.
Lake Success is in the Colliers Mills Fish and Wildlife Management Area that drains to the Ridgeway Branch and eventually to the Toms River. Because of a low pH; (4.0 - 4.4) pickerel, catfish, and sunfish are the only fish available for fishermen. Much of the lake's shoreline and upper end has heavy growth of *Nymphaea odorata* (whitewater lily). Shallow depth (5 foot max.) contributes to the heavy plant growth. Total phosphorus levels in the water column were moderately high (up to 0.04 mg/L) especially for a lake in this remote, pine forested area.

Sawmill Pond, Sussex County, 20 acre.
Sawmill Pond, located in High Point State Park, is part of the headwaters to Big Flat Brook, which drains into the Delaware River. Approximately 40% of the lake surface is covered by macrophyte growth and this in turn limits recreational usage. The dominant species present is *Myriophyllum spicatum* (water milfoil). Total phosphorus levels in the water column were relatively low; ranging from 0.02 to 0.03 mg/L. Because of its location, the lake has a small watershed made up mostly of forested area. Shallow depths combined with possible elevated nutrient levels in sediments contribute to the heavy growth of macrophytes.

Steenykill Lake, Sussex County, 37 acres.
Steenykill Lake, located in High Point State Park, drains to Mill Brook and then the Delaware River. Heavy macrophyte growth impedes some boating and fishing usage. The upper third of the lake along with the shoreline areas and coves have dense stands of *Myriophyllum spicatum* (water milfoil) and to a lesser extent *Potamogeton spp*. (Pondweed). Total phosphorus levels were low except during the spring, when turnover may have resulted in a higher level (.14 mg/L). Because of its location, there is only a small watershed, which is mainly forested. Shallow depths combined with possible elevated nutrient levels in sediments contribute to the heavy growth of macrophytes.

Stony Lake, Sussex County, 15 acres.
Stony Lake, located in Stokes State Forest, is fed by a natural trout stream. As much as 80% of the lake is supporting varying degrees of macrophyte growth, with the perimeter of the swimming area having some of the heaviest growth. The dominant species present are *Myriophyllum humile* (water milfoil) and *Utricularia spp*.(bladderwort). Total phosphorus levels in the water column were low except during the summer monitoring run (0.14 mg/L). During the summer, this lake becomes stratified which leads to anoxic conditions (dissolved oxygen levels of 0.18 mg/L) near the lake bottom. These conditions are favorable for the release of nutrients such as phosphorus from the bottom sediments. The build-up of dead and decaying plant material on the lake bottom is the source of high nutrient levels.

Ghost Lake, Warren County, 7 acres.
Ghost Lake is considered to be part of the Jenny Jump State Forest. Boating and fishing opportunities are impeded because of the heavy growth of

macrophytes. The dominant species present was *Myriophyllum spp.* (water milfoil) with some *Ceratophyllum demersum* (coontail) and *Potamogeton spp.* (pondweed) interspersed. Total phosphorus levels were low except during the fall (0.06 mg/L), when decaying plants may have been releasing nutrients into the water column. The macrophyte growth is enhanced because of the lake's shallow depth and possible nutrient rich sediments.

APPENDIX C

AQUATIC LIFE USE SUPPORT TABLES

Beginning in 1992, the Department began a program of performing watershed-specific intensive macroinvertebrate surveys on a broad geographic scale. The results of these studies are used in this report to assess the aquatic life support designated use. Macroinvertebrate communities are examined using USEPA's Rapid Bioassessment Protocols that provide evidence regarding the overall health of instream biota. At the time of this report's preparation, only nine watersheds (or portions their of) had been studied and their results available for use. It is hoped that these assessments will continue and that they will supplement the older fin-fish surveys as determinants of the aquatic life use. The watersheds presented here are the Hammonton Creek, Assunpink Creek, Green Brook (Raritan River system), Great Egg Harbor River, Musconetcong River, Pennsauken Creek, Rahway River, Upper Passaic River, and the Whippany River.

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Hammonton Creek

Date of assessment: Jan. 1992

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Hammonton Cr.	Hammonton, Rt. 542	mod. impaired	
Hammonton Cr.	Hammonton, Boyer Rd.	severely impaired	possible toxicity
Hammonton Cr.	Mullica Twp., Columbia Rd.	healthy	

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Assunpink Creek

Date of assessment: March 1992

River Mainstem

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Assunpink Creek	Roosevelt, Assunpink wildlife management area	mod. impaired	possible toxicity
Assunpink Creek	Edinburg, Edinburg Rd.	healthy	
Assunpink Creek	Trenton, Mulberry St.	mod. impaired *	possible toxicity
Assunpink Creek	Trenton, Willow St.	mod. impaired *	possible toxicity

Tributaries

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Shipetauken Ck.	Lawrence Twp., Van Kirk Rd.	severely impaired	
Shipetauken Ck.	Lawrence Twp., Princeton Pk.	severely impaired	
Lt'le Shabakunk Cr.	Lawrence Twp., Rt. 206	severely impaired *	possible toxicity
Shabakunk Cr.	Ewing Twp., Bull Run Rd.	severely impaired	
Shabakunk Cr.	Lawrence Twp., Rt. 206	mod. impaired	possible toxicity
Miry Run	Mercerville, Quakerbridge Rd.	mod. impaired	possible toxicity
Pond Run	Hamilton Twp. Whitehorse-Mercerville Rd.	severely impaired	possible toxicity

*** Assessment tentative, due to insufficient sample size.**

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Green Brook

Date of assessment: Feb. 1992

River Mainstem

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Green Brook	Watchung Twp., Apple Tree Rd.	severely impaired	
Green Brook	Seeleys Mill, New Providence Rd.	mod. impaired	possible toxicity
Green Brook	Watchung Twp., Raymond Ave.	severely impaired	possible toxicity
Green Brook	Green Brook Park, Park Dr.	mod. impaired	possible toxicity
Green Brook	Sebrings Mill, off Mill Rd.	mod. impaired	
Green Brook	Bound Brook Boro., Main St.	mod. impaired	

Tributaries

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Cedar Brook	So. Plainfield, Cedarbook Ave.	mod. impaired	possible toxicity
Bound Brook	Middlesex Boro., Bound Brook Rd.	mod. impaired	possible toxicity
Stony Brook	Watchung Boro., Sunlit Dr.	mod. impaired	
Stony Brook	No. Plainfield, West End Ave.	mod. impaired	possible toxicity
Ambrose Brook	No. Stelton, School St.	mod. impaired	possible toxicity
Ambrose Brook	Piscataway Twp., Behmer Rd	severely impaired	
Ambrose Brook	Middlesex Boro., Raritan Ave	mod. impaired	
Blue Brook	in Watchung Reservation	healthy	

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Gt. Egg Harbor River

Date of assessment: March 1992

River Mainstem

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Gt. Egg Harbor R.	Berlin, Camden Co. Park	severely impaired *	
Gt. Egg Harbor R.	nr. Sicklerville, Williamstown-New Freedom Rd.	healthy	
Gt. Egg Harbor R.	Winslow Twp., Williamstown-Winslow Rd.	healthy	
Gt. Egg Harbor R.	nr. Folsom, Rte. 54	healthy	
Gt. Egg Harbor R.	Weymouth, Weymouth Rd.	healthy	

Tributaries

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Four Mile Branch	Monroe Twp, Malaga Rd.	healthy	sig. organic pollution indicated
Squankum Branch	Monroe Twp, Malaga Rd.	mod. impaired *	possible toxicity
Hospitality Branch	nr. Folsom, Rt. 54	healthy *	possible toxicity
Penny Pot Stream	Folsom Twp, Eighth St.	healthy *	possible toxicity
Deep Run	Buena, Rt 54	severely impaired	
Deep Run	Weymouth, Rt 559	healthy	

*** Assessment tentative, due to insufficient sample size.**

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Musconetcong River Basin

Date of assessment: July 1993

River Mainstem

WATERWAY	LOCATION	ASSESSMENT
Musconetcong R	outlet of Lk. Hopatcong	mod. impaired
Musconetcong R	below outlet of Lake Musconetcong	healthy
Musconetcong R	Lockwood, nr. Rt 604,	healthy
Musconetcong R	Beattystown, Kings Highway	healthy
Musconetcong R	New Hampton, New Hampton Rd.	healthy
Musconetcong R	Bloomsbury, Rt 579	healthy
Musconetcong R	Reigelsville, nr. River Rd.	healthy

Tributaries

WATERWAY	LOCATION	ASSESSMENT
Lubbers Run	Hopatcong Twp., Rt 607	slightly impaired
Lubbers Run	Lockwood, Rt 206	healthy
Mine Brook	Mansfield Twp., Rt. 517	healthy
Trout Bk.	Hackettstown, Rt. 57	slightly impaired
Hances Bk.	So. of Beattystown, Rt.57	mod. impaired
Unnamed Trib.	Penwall, Rt. 57	healthy

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Pennsauken Creek

Date of assessment: March 1992

River Mainstem: North Branch

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Pennsauken Ck	Mt. Laurel Twp., Church Rd.	mod. impaired *	possible toxicity
Pennsauken Ck	Cherry Hill Twp., Fellowship Rd.	mod. impaired *	possible toxicity
Pennsauken Ck	Maple Shade, Rt. 537	mod. impaired	
Pennsauken Ck	Cinnaminson, Fork Landing Rd.	severely impaired	

River Mainstem: South Branch

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Pennsauken Ck	Evesham Twp., Greentree Rd.	severely impaired	possible toxicity
Pennsauken Ck	Maple Shade, Rt. 41	severely impaired	possible toxicity
Pennsauken Ck	Maple Shade, Rt. 537	severely impaired	
Pennsauken Ck	Pennsauken, Fork Landing Rd.	severely impaired	

*** Assessment tentative, due to insufficient sample size.**

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Rahway River

Date of assessment: Feb. 1992

River Mainstem

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Rahway River	W. Orange, Northfield Ave, above reservoir	severely impaired *	possible toxicity
Rahway River	Springfield Twp., Washington Ave.	severely impaired *	possible toxicity, diesel fuel noted on water
Rahway River	Springfield Twp., Kenilworth Blvd.	mod. impaired *	possible toxicity
Rahway River	Rahway, River Rd. & Church St.	mod. impaired	

Tributaries

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Robinson's Br.	Scotch Plains, Raritan Rd.	mod. impaired	Possible toxicity. Golf course located upstream
Robinson's Br.	Scotch Plains, Goodman's Crossing	mod. impaired	possible toxicity
Robinson's Br.	Westfield Twp., Lamberts Mill Rd.	mod. impaired	possible toxicity
Robinson's Br.	Rahway, Rt. 27 below Middlesex Reservoir	mod. impaired *	possible toxicity
So. Br. Rahway R.	Menlo Park, Parsonnage Rd.	severely impaired	Area highly commercial. Possible toxicity
So. Br. Rahway R.	Colonia, Maplewood Ave.	severely impaired *	possible toxicity

***Assessment tentative, due to insufficient sample size.**

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Upper Passaic River

Date of assessment: Feb. 1992

River Mainstem

WATERWAY	LOCATION	ASSESSMENT	COMMENTS & OBSERVATIONS
Passaic R.	Mendham Twp., Tempewick Rd.	mod. impaired	
Passaic R	nr. Millington, off Valley Rd.	healthy	reference station

Tributaries

WATERWAY	LOCATION	ASSESSMENT
Primrose Bk.	Jockey Hollow Nat. Park	healthy
Primrose Bk.	Lees Mill Rd.	mod. impaired
Indian Grave Bk.	near Bernardsville, Hardscrabble Rd.	mod. impaired
Great Bk.	Harding Twp., Blackwells Place	mod. impaired
Great Bk.	Morris Twp., Blackberry La.	mod. impaired
Loantaka Br.	Morris Twp., Gt Swamp WMA, nr Bluestone Terr.	severely impaired
Loantaka Br.	Nr. Green Village, Green Village Rd.	mod. impaired
Great Bk.	Gt. Swamp WMA, near Woodland Rd.	mod. impaired
Black Bk.	near Hickory Tree, Southern Blvd.	severely impaired
Black Bk.	near Meyersville, New Vernon Rd.	severely impaired
Trib. to the Dead R.	near Liberty Corner, off Somerville Rd.	healthy
Dead R.	near Liberty Corner, off Somerville Rd.	healthy
Dead R.	nr. Mt. Bethel & Exit 36 of I# 78 King George Rd.	mod. impaired

AQUATIC LIFE SUPPORT ASSESSMENT

WATERSHED: Whippany River

Date of assessment: July 1993

River Mainstem

WATERWAY	LOCATION	ASSESSMENT
Whippany R	Mendham Twp., Mt. Pleasant Rd	mod. to non-impaired
Whippany R	Whitehead Rd.	mod. impaired
Whippany R	Morristown, Ridgedale Ave.	mod. impaired
Whippany R	Morris Twp., Jefferson Rd.	mod. impaired
Whippany R	Parsippany Troy Hills, Edwards Rd.	mod. impaired

Tributaries

WATERWAY	LOCATION	ASSESSMENT
Watnong R.	Morristown, Lake Rd.	mod. impaired
Troy Brook	Mountain Lakes, Lake Rd.	mod. to severely impaired
Troy Brook	Troy Hills, Beaverwyck Rd.	mod. impaired

Earlier biomonitoring assessments of the Whippany Mainstem:

Date of assessment: 1990

WATERWAY	LOCATION	ASSESSMENT
Whippany R	Morristown, Whitehead Rd.	mod. impaired

Date of assessment: 1985

WATERWAY	LOCATION	ASSESSMENT
Whippany R	Below Speedwell Lk. outlet	mod. impaired
Whippany R	0.1 mi. below Morristown STP Discharge	severely impaired
Whippany R	Hanover Twp., Parsippany Rd.	severely impaired
Whippany R	Rt. 10, nr. M.V. inspection station	severely impaired
Whippany R	Hanover Twp. Rt., 10	severely impaired
Whippany R	E. Hanover Twp. Troy Rd.	mod. impaired

APPENDIX D

LIST OF USE IMPAIRED WATERS

The following table is a list of watersheds/rivers that have been found to be use impaired. Included in the table are the locations within the waterways where the use impairment applies, which correspond in turn to the locations where the waters were monitored.

Assessments presented here are based upon numerous data sources. Judgments regarding primary contact use are based upon fecal coliform levels from samples collected from the DEP/USGS Fixed-Station Cooperative Ambient Monitoring Network. Aquatic life support at some locations is based upon fishery assessments performed by the Department's Division of Fish, Game and Wildlife. More recent assessments are based upon macroinvertebrate population studies performed by the Office of Monitoring Management. Shellfish harvesting use is based upon the shellfish harvesting classifications. These classifications denote the sanitary fitness of coastal waters for shellfish harvesting. Finfish consumption use is assessed based on the presence of toxic contaminants such as PCB's and Dioxin within fin-fish tissue.

Assessments based upon the Ambient Network (primary contact recreation) are applied to limited portions of rivers that represent the locations of specific monitoring stations. Conclusions regarding other uses such as the support of aquatic life, fish consumption, etc. can be applied to entire river reaches because of the extensive nature of the monitoring performed by the Department to assess these specific uses.

In addition, as is noted in the body of this Report; because of the intensity of land use within New Jersey, the dense population, economic pressures for development, and the ubiquitous nature of nonpoint source pollution throughout the State; all waters assessed as fully supporting designated uses in this report are classified as **threatened**. This applies to both the primary contact recreation use and the aquatic life use statewide.

WATERSHED	WATERWAY	STATION	USE IMPAIRED
WALLKILL R.	WALLKILL R.	Franklin	PRIMARY CONTACT
	WALLKILL R.	Sussex	PRIMARY CONTACT
	WALLKILL R.	Unionville	PRIMARY CONTACT
	total Wallkill	TOTAL WATERSHED	SOME AQUATIC LIFE IMPAIRMENT
	PAPAKATING CR.	Sussex	PRIMARY CONTACT
	BLACK CR.	Vernon	PRIMARY CONTACT
PAULINS KILL	PAULINS KILL	Balesville	PRIMARY CONTACT
	PAULINS KILL	Blairstown	PRIMARY CONTACT
PEQUEST R.	PEQUEST R.	Pequest	PRIMARY CONTACT
POHATCONG CR.	POHATCONG CR.	New Village	PRIMARY CONTACT
MUSCONETCONG R.	MUSCONETCONG R.	Lockwood	PRIMARY CONTACT
	MUSCONETCONG R.	Beattystown	PRIMARY CONTACT
	MUSCONETCONG R.	Bloomsbury	PRIMARY CONTACT
	MUSCONETCONG R.	Riegelsville	PRIMARY CONTACT
WICKECHEOKE CR.	WICKECHEOKE CR.	Stockton	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
ASSUNPINK CR.	ASSUNPINK CR.	Upper Watershed	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
ASSUNPINK CR.	ASSUNPINK CR.	Trenton	PRIMARY CONTACT AQUATIC LIFE SUPPORT
ASSUNPINK CR.	Tributaries	overall	AQUATIC LIFE SUPPORT
CROSSWICKS CR.	CROSSWICKS CR.	Extonville	PRIMARY CONTACT
	TRIBS TO CROSSWICKS CR		SOME AQUATIC LIFE SUPPORT IMPAIRMENT
RANCOCAS CR	RANCOCAS CR OVERALL		SOME AQUATIC LIFE SUPPORT IMPAIRMENT
	SB RANCOCAS CR.	Vincentown	PRIMARY CONTACT

WATERSHED	WATERWAY	STATION	USE IMPAIRED
	SB RANCOCAS CR.	Hainesport	PRIMARY CONTACT
PENNSAUKEN CR	SB PENNSAUKEN CR.	Cherry Hill	PRIMARY CONTACT, AQUATIC LIFE SUPPORT Fin-fish consumption use
	NB PENNSAUKEN CR.	Moorestown	PRIMARY CONTACT
	MAINSTEM PENNSAUKEN CR.		AQUATIC LIFE SUPPORT Fin-fish consumption use
COOPER R	COOPER R	Lawnside	PRIMARY CONTACT AQUATIC LIFE SUPPORT
	COOPER R	Haddonfield	PRIMARY CONTACT AQUATIC LIFE SUPPORT
	COOPER R	lower end	AQUATIC LIFE SUPPORT Fin-fish consumption use
BIG TIMBER CR.	SB BIG TIMBER CR.	Blackwood Terrace	PRIMARY CONTACT
	WOODBURY CR	Strawbridge Lk.	PRIMARY CONTACT SOME IMPAIRMENT TO AQUATIC LIFE SUPPORT
	MANTUA CR	Alcyon Lk	PRIMARY CONTACT SOME IMPAIRMENT TO AQUATIC LIFE SUPPORT
RACCOON CR	RACCOON CR.	Swedesboro	PRIMARY CONTACT SOME IMPAIRMENT TO AQUATIC LIFE SUPPORT
OLDMANS CR.	OLDMANS CR.	Porches Mill	PRIMARY CONTACT
SALEM R	SALEM R	Woodstown	PRIMARY CONTACT
	SALEM R	Courses Landing	PRIMARY CONTACT AQUATIC LIFE SUPPORT

WATERSHED	WATERWAY	STATION	USE IMPAIRED
COHANSEY R	COHANSEY R	Seeley	PRIMARY CONTACT
GR EGG HARBOR R.	GR EGG HARBOR R.	Berlin	AQUATIC LIFE SUPPORT
GR EGG HARBOR R.	GR EGG HARBOR R.	Sicklersville	PRIMARY CONTACT AQUATIC LIFE SUPPORT
	GR EGG HARBOR R.	Blue Anchor	PRIMARY CONTACT
	GR EGG HARBOR R.	Weymouth	PRIMARY CONTACT
HAMMONTON CR.	HAMMONTON CR.	Hammonton	AQUATIC LIFE SUPPORT
HAMMONTON CR.	HAMMONTON CR.	Westcoatville	PRIMARY CONTACT SOME AQUATIC LIFE SUPPORT IMPAIRMENT
MANASQUAN R	MANASQUAN R	Squankum	PRIMARY CONTACT SOME AQUATIC LIFE SUPPORT IMPAIRMENT
MARSH BOG BK	MARSH BOG BK	Squankum	PRIMARY CONTACT
SHREWSBURY	SHREWSBURY		SOME AQUATIC LIFE SUPPORT IMPAIRMENT
	SHARK R	Neptune	PRIMARY CONTACT
SB RARITAN R	SB RARITAN R	Middle Valley	PRIMARY CONTACT
	SB RARITAN R	High Bridge	PRIMARY CONTACT
	SB RARITAN R	Stanton Station	PRIMARY CONTACT
	SB RARITAN R	Three Bridges	PRIMARY CONTACT
N BR RARITAN R.	MULHOCKAWAY CR.	Van Syckel	PRIMARY CONTACT
	SPRUCE RUN	Glen Gardner	PRIMARY CONTACT
	NESHANIC R	Reaville	PRIMARY CONTACT
	LAMINGTON R	Ironia	PRIMARY CONTACT
	LAMINGTON R	Pottersville	PRIMARY CONTACT
	LAMINGTON R	Burnt Mills	PRIMARY CONTACT
	ROCKAWAY CK	Whitehorse	PRIMARY CONTACT
	N BR RARITAN R.	Chester	PRIMARY CONTACT

WATERSHED	WATERWAY	STATION	USE IMPAIRED
	N BR RARITAN R.	Burnt Mills	PRIMARY CONTACT
	N BR RARITAN R.	North Branch	PRIMARY CONTACT
MILLSTONE R	MILLSTONE R	Manalapan	PRIMARY CONTACT
	MILLSTONE R	Grovers Mill	PRIMARY CONTACT
	MILLSTONE R	Kingston	PRIMARY CONTACT
	MILLSTONE R	Blackwells Mills	PRIMARY CONTACT
	MILLSTONE R	Weston	PRIMARY CONTACT
	MILLSTONE R	watershed	AQUATIC LIFE SUPPORT
	STONY BK	Princeton	PRIMARY CONTACT AQUATIC LIFE SUPPORT
	BEDENS BROOK	Rocky Hill	PRIMARY CONTACT SOME AQUATIC LIFE IMPAIRMENT
	CRANBURY BK		AQUATIC LIFE SUPPORT
	BEAR BK		SOME AQUATIC LIFE IMPAIRMENT
	MANALAPAN BK	Manalapan	PRIMARY CONTACT
	MATCHAPONIX BK	Spotswood	PRIMARY CONTACT
RARITAN R	RARITAN R	Raritan	PRIMARY CONTACT
	RARITAN R	Manville	PRIMARY CONTACT
	RARITAN R	Queens Bridge	PRIMARY CONTACT
	TIDAL RARITAN R		AQUATIC LIFE SUPPORT Fin-fish consumption use
	RARITAN R WATERSHED	Lower/Upper	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
RAHWAY R	W BR. RAHWAY R.	West Orange	PRIMARY CONTACT
	RAHWAY R	Springfield	PRIMARY CONTACT

WATERSHED	WATERWAY	STATION	USE IMPAIRED
	RAHWAY R	Rahway	PRIMARY CONTACT
	RAHWAY R WATERSHED	in general	AQUATIC LIFE SUPPORT
	ELIZABETH R	Ursino Lake	PRIMARY CONTACT
	ELIZABETH R	in general	AQUATIC LIFE SUPPORT
U. PASSAIC R	U. PASSAIC R	Millington	PRIMARY CONTACT
	U. PASSAIC R	Chatham	PRIMARY CONTACT
	U. PASSAIC R	Two Bridges	PRIMARY CONTACT
	U. PASSAIC R	Foulertons Brook	AQUATIC LIFE SUPPORT
	U. PASSAIC R	Chatham-Livingston	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
	U. PASSAIC R	Livingston-Little Falls	AQUATIC LIFE SUPPORT
	U. PASSAIC R	Foulers Bk.	AQUATIC LIFE SUPPORT
	TRIBUTARIES TO U.PASSAIC R		SOME AQUATIC LIFE SUPPORT IMPAIRMENT
WHIPPANY R	WHIPPANY R	Morristown	PRIMARY CONTACT
	WHIPPANY R	Pine Brook	PRIMARY CONTACT
	WHIPPANY R	Lower watershed	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
	TRIBS TO WHIPPANY R		SOME AQUATIC LIFE SUPPORT IMPAIRMENT
ROCKAWAY R	ROCKAWAY R	Boonton	PRIMARY CONTACT
	ROCKAWAY R	Pine Brook	PRIMARY CONTACT
	ROCKAWAY R	Dover-Reservoir	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
	ROCKAWAY R	below Reservoir	AQUATIC LIFE SUPPORT
PEQUANNOCK R	PEQUANNOCK R	Macopin Intake	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
WANAQUE R	WANAQUE R	Wanaque	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
RAMAPO R	RAMAPO R	Mahwah	PRIMARY CONTACT
POMPTON R	POMPTON R	Packanack Lake	PRIMARY CONTACT SOME AQUATIC LIFE SUPPORT IMPAIRMENT
L.PASSAIC R	L.PASSAIC R	Singac	PRIMARY CONTACT
	L.PASSAIC R	Little Falls	PRIMARY CONTACT

WATERSHED	WATERWAY	STATION	USE IMPAIRED
L.PASSAIC R	L.PASSAIC R	Elmwood Park	PRIMARY CONTACT
	L.PASSAIC R	Pompton R-Little Falls	AQUATIC LIFE SUPPORT
	L.PASSAIC R	Little Falls-Garfield	SOME AQUATIC LIFE SUPPORT IMPAIRMENT
	L.PASSAIC R	Below Garfield	AQUATIC LIFE SUPPORT
	TIDAL PASSAIC R		AQUATIC LIFE SUPPORT Fin-fish consumption use
SADDLE R	SADDLE R	Fair Lawn	PRIMARY CONTACT
	SADDLE R	Lodi	PRIMARY CONTACT
	SADDLE R	in general	AQUATIC LIFE SUPPORT IMPAIRMENT
		Hohokus R.	AQUATIC LIFE SUPPORT
		Ramsey Bk.	AQUATIC LIFE SUPPORT
		Valentine Bk.	AQUATIC LIFE SUPPORT
HACKENSACK R	HACKENSACK R	River Vale	PRIMARY CONTACT
	HACKENSACK R	New Milford	PRIMARY CONTACT AQUATIC LIFE SUPPORT
	TIDAL HACKENSACK R		AQUATIC LIFE SUPPORT Fin-fish consumption use

COASTAL WATERS

WATERSHED	WATERWAY	STATION	USE IMPAIRED
ATLANTIC COAST	BARANEGAT BAY INLET NORTHWARD		Finfish consumption use partially supported
NEW JERSEY/NEW YORK INTERSTATE WATERS			Impairment of multiple uses
	UPPER MONMOUTH CO. COASTAL AREA		No support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	RARITAN BAY		75% partially support shellfish harvesting, 25% does not support shellfish harvesting
ATLANTIC COASTAL ESTUARIES	NAVESINK R		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	SHEWSBURY R		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	SHARK R		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	MANASQUAN R		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	METEDECONK R		No support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	TIDAL TOMS R		No support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	UPPER BARNEGAT BAY	ADJACENT TO TOMS R	Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	TIDAL MULLICA R		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	ABSECON BAY		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	LAKES BAY		Partial support of shellfish harvesting
ATLANTIC COASTAL ESTUARIES	LOWER GT. EGG HARBOR R		Partial to no support of shellfish harvesting
	LOWER CAPE MAY		No support of shellfish harvesting

APPENDIX E

RECENT WASTEWATER TREATMENT PLANT UPGRADES/EXPANSIONS

APPENDIX E

RECENT WASTEWATER TREATMENT PLANT UPGRADES/EXPANSIONS

The following is a list of wastewater treatment plants that have been upgraded and/or expanded and have renewed operation between January 1992 and December 1993. This list includes wastewater discharges within the Whippany Watershed that were reported to be in noncompliance with their discharge permits in the 1992 Water Quality Inventory Report. This information is an outgrowth of an extensive information gathering effort initiated by the Whippany Watershed Pilot Project.

The following wastewater treatment plants have been upgraded and/or expanded and have renewed operation between January 1992 and December 1993:

FACILITY	UPGRADE TO:	DESIGN CAPACITY	RECEIVING STREAM	WATERSHED	COMMENTS
Morris twp, Woodland	level 4	2.0 MGD	Loantaka Brook	Passaic	
Bernardsville Boro	adv. sec.	0.8 MGD	Mine Brook	No. Br. Raritan	
Cedar Grove Twp.	level 4	2.0 MGD	Peckman River	Passaic	
Hanover SA	level 4	3.75 MGD	Whippany River	Passaic	
Hackettstown MUA	adv. sec.	3.30 MGD	Musconetcong R.	Upper Delaware	
Manville Boro	sec.	0.80 MGD	NA	NA	Eliminated discharge
Morris Twp.-Butterworth	level 4	3.30 MGD	Whippany River	Passaic	
Morristown Town	level 4	3.35 MGD	Whippany River	Passaic	
Musconetcong SA	sec.	2.27 MGD	Musconetcong R.	Upper Delaware	
Phillipsburg Town	sec.	3.5 MGD	Lopatcong Creek	Upper Delaware	
Pompton Lakes	level 4	1.15 MGD	Pompton River	Passaic	
Somerset- Raritan Valley	adv. sec.	16.3 MGD	Cuckels Brook	No. Br. Raritan	
Wanaque Valley RSA	level 4	1.05 MGD	Wanaque River	Passaic	
Warren Twp., Stage 4	level 4	0.80 MGD	Dead River	Passaic	
East Windsor MUA	adv. treatment upgrade/expansion	3.35 MGD	Millstone River	Millstone River	Upgrade includes addition of ammonia and phosphorus removal
Burlington City	adv. treatment	3.2 MGD	Delaware R., zone 2	Lower Delaware	