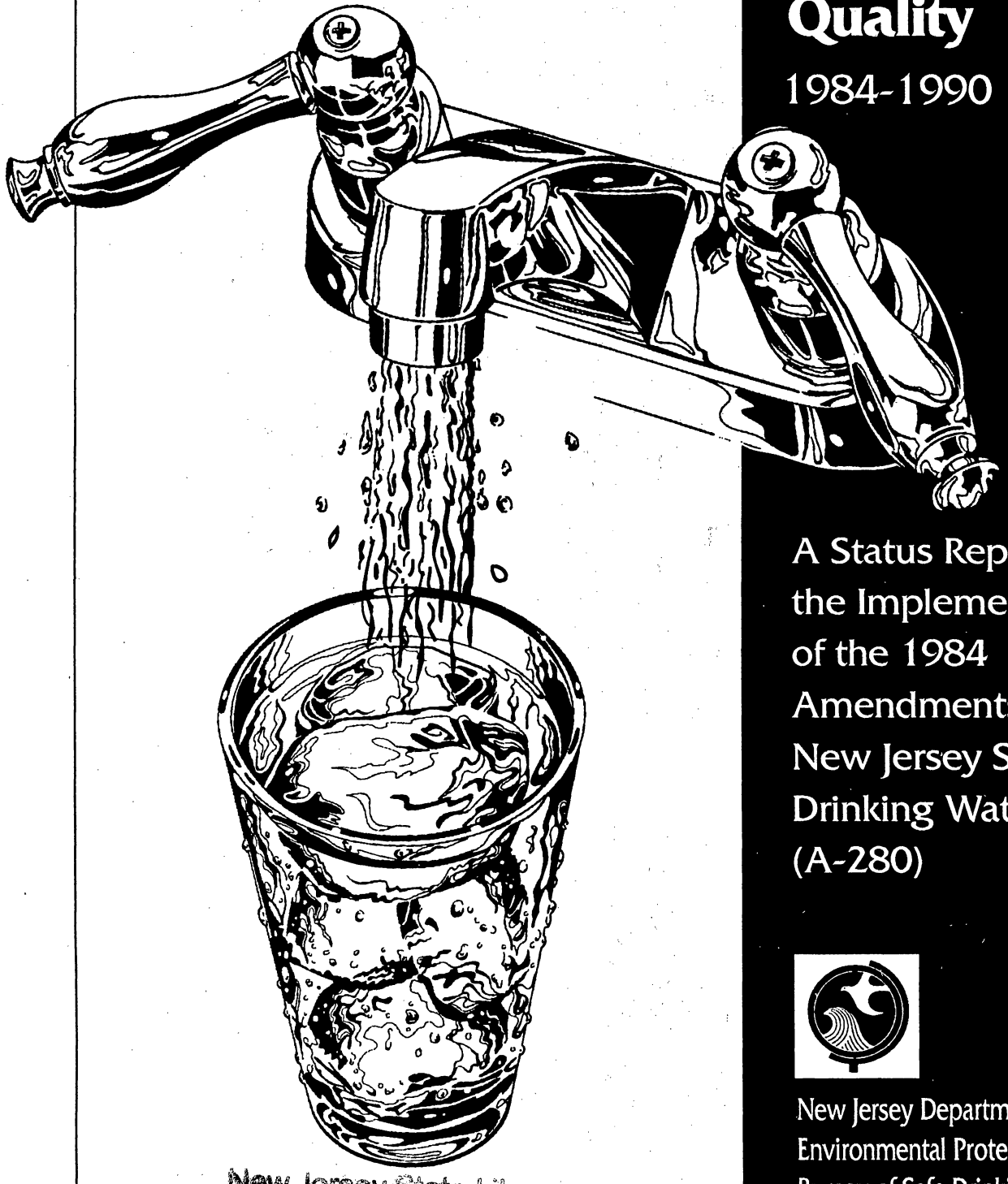
Assessing New Jersey's Drinking Water Quality

1984-1990



A Status Report on the Implementation of the 1984 Amendments to the New Jersey Safe Drinking Water Act (A-280)

New Jersey Department of Environmental Protection and Energy
Bureau of Safe Drinking Water and
Division of Science and Research

Assessing New Jersey's Drinking Water Quality

A Status Report

on the

Implementation of the 1984 Amendments to the

New Jersey Safe Drinking Water Act (A-280)

(1984 - 1990)

by
Pat Bono
Principal Environmental Specialist
Bureau of Safe Drinking Water

Sandra Krietzman, M.S.
Environmental Scientist
Bureau of Safe Drinking Water

Leslie McGeorge, M.S.P.H.
Deputy Director
Division of Science and Research

New Jersey Department of Environmental
Protection and Energy

August, 1992

Jim Florio
Governor
State of New Jersey

Scott Weiner
Commissioner
Dept. of Environmental
Protection and Energy

State of New Jersey
Department of Environmental Protection and Energy
Office of the Commissioner
CN 402
Trenton, NJ 08625-0402
Tel. # 609-292-2885
Fax. # 609-984-3962

Scott A. Weiner
Commissioner

Dear Reader:

I am pleased to issue "Assessing New Jersey's Drinking Water Quality - A Status Report on the Implementation of the 1984 Amendments to the New Jersey Safe Drinking Water Act (A-280)." This comprehensive document provides an historical overview and a progress report of the hazardous contaminant testing program activities in New Jersey. This report shows that since the program first began, standards have been set for certain hazardous contaminants of concern in drinking water, and that less contamination above the standards is now being detected in public community water systems in New Jersey. The Department of Environmental Protection and Energy has approved construction projects totalling $34.7 million (1984-1991) to remedy drinking water contamination problems.

New Jersey has been a national leader in both monitoring and standard setting for hazardous contaminants in drinking water. The risk assessment and analytical procedures used to set standards were reviewed in conjunction with the New Jersey Drinking Water Quality Institute and provide a basis for determining current and future drinking water standards in New Jersey. In fact, these procedures are being applied to other environmental media standard setting activities as well.

It is my hope that this report leads to a better understanding of New Jersey's drinking water quality.

Sincerely,

Scott A. Weiner
Commissioner

SAW/SK:lb

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)... **Page**

List of Tables and Figures

List of Tables and Figures (Continued)...

Acknowledgements:

This report is the cumulative effort of management and staff within two programs of the New Jersey Department of Environmental Protection and Energy (department) - the Bureau of Safe Drinking Water (BSDW) and the Division of Science and Research (DSR):

Data preparation and evaluation: Pat Bono, Principal Environmental Specialist (BSDW); Leo Korn, M.S., Research Scientist (DSR); Sandra Krietzman, M.S., Environmental Scientist (BSDW); Joan Kryak, Principal Environmental Specialist (BSDW); Leslie McGeorge, M.S.P.H., Deputy Director (DSR); Leslie Sherratt, Data Processing Administrative Analyst (BSDW) and Terri Tucker, Data Processing Administrative Analyst (DSR).

Technical Review: Perry Cohn, Ph.D., M.P.H., Drinking Water Project Manager and Steve Jenniss, M.S., Director, Environmental and Chemical Laboratory Services (NJ Department of Health); Barker Hamill, Bureau Chief, (BSDW); Lee Lippincott, M.S., Research Scientist, (DSR); Vince Monaco, P.E., Section Chief (BSDW); Eileen Murphy, Ph.D., Research Scientist, (DSR); Steven Nieswand, P.E., Administrator (Water Supply Program) and Gloria Post, Ph.D., Research Scientist (DSR).

Word Processing: Joanne Harris and Patricia Smith of the BSDW and Barbara Ungarini of the Bureau of Water Allocation, Water Supply Program. Cover Design: Denise Beck, Communications Office.

The department gratefully acknowledges Richard Sullivan, Chairman of the New Jersey Drinking Water Quality Institute, for his assistance with the development of the scope and content of this report.

EXECUTIVE SUMMARY

The State of New Jersey has always maintained a strong interest in the safety of its drinking water supplies. Modeled after the federal act, the state passed the New Jersey Safe Drinking Water Act in 1976 and subsequently was delegated primacy by the United States Environmental Protection Agency (USEPA). Prior to 1984, the water quality program consisted of regulating and monitoring microbiology, inorganic chemistry, trihalomethanes, limited pesticides and herbicides, and radiochemistry parameters. These state monitoring requirements were identical to those required by the federal government.

On January 9, 1984, landmark legislation was signed into law that established New Jersey's hazardous contaminant testing program in drinking water. These amendments to the New Jersey Safe Drinking Water Act (P.L. 1983 c.443) mandated that public community water supplies begin monitoring the water delivered to their consumers for a list of 22 synthetic organic contaminants commonly referred to as the "2a" list. This legislation also charged the N.J. Department of Environmental Protection and Energy (department) with the responsibility of setting maximum contaminant levels (MCLs) for these 22 contaminants, targeting other candidate compounds to add to the list, and establishing a drinking water quality research program. In addition the legislation created a tax on public community water supplies to cover the costs associated with the administration of the bill and established the New Jersey Drinking Water Quality Institute (Institute), a 15 member advisory group to the department on matters relating to drinking water. The department and the Institute felt a review of the monitoring results and an evaluation of that program's effectiveness would be highly useful for planning future aspects of the state's drinking water program. This report is a summary of the hazardous contaminant testing program as requested by the Institute.

The Institute recommended MCLs for 16 of the 22 hazardous contaminants to the department in 1987 and MCLs for these 16 contaminants were adopted by the Commissioner in January 1989. The lack of USEPA approved analytical methodologies precluded the Institute from recommending MCLs for all 22 of the hazardous contaminants listed in the law. Prior to the adoption of these enforceable standards, the department developed interim guidelines for assessing drinking water test results based on the best available published federal information available at the time. These interim guidelines were used by the department from 1985 through 1988. Although the guidelines enabled the department to strongly recommend actions needed at the water supplies with the highest levels of synthetic organic contaminants, many water utilities were willing to take contaminated wells out of service but deferred making large capital expenditures for treatment for removal of the hazardous contaminants until the MCLs were adopted into regulation and were enforceable.

The first hazardous contaminant test results were due January 9, 1985, one year after the legislation was signed. Each subsequent year, all of the approximately 635 public community water supplies must submit test results semi-annually. The exceptions to this rule are water utilities that bulk purchase their source water. These utilities have a slightly modified schedule. Consequently, over 9000 sets of test results have been received by the department between 1984-1990. An analysis of the drinking water quality trends over this time period has been conducted.

Purveyor compliance with the hazardous contaminant testing requirements is considered good. Between 86% and 93% of the public community water systems

conducted the required hazardous contaminant testing during each of the two semi-annual sampling periods which run January 1 through June 30 and July 1 through December 31 of each year. If a water system did not sample for a full year, the department sampled the water delivered to the consumer for the hazardous contaminants and referred the water system for enforcement action.

Each A-280 sample result reported to the Bureau of Safe Drinking Water (bureau) contains analytical results for approximately 17 different synthetic organic chemicals. Approximately 98% of all analytical results reported annually to the bureau are less than the detectable level. In 1989, the first year the MCLs were in effect, only 16 of the 630 systems had MCL violations as defined by A-280 regulations. In the following year, the number of systems with violations dropped to three. The designation of a system in violation is intended to apply to only those systems which have a demonstrated water quality problem.

An evaluation of the hazardous contaminant test results submitted annually (initial round {1984} through 1990) on a per system basis showed between 71% and 81% of the systems reported no detectable contamination. Although there were no MCLs prior to 1989, the data collected between 1984 and 1990 were analyzed to determine how the reported values compared to the MCLs that were eventually adopted in 1989. The percentage of purveyors reporting any detectable contamination at concentrations greater than the MCL decreased from 21% to 8% between 1985 (the first full year of testing) and 1990. These values represent an overestimation of contamination since they are grouped such that only one detection reported during one semi-annual sampling period places the water system in the detected category for the entire year. When the percentage of purveyors reporting detectable contamination was evaluated utilizing the federal MCLs now available for all the A-280 contaminants except meta-dichlorobenzene, the percentage of public water systems above the federal MCLs (versus the State standards) also decreased over time from 11% in 1985 to 2% in 1990. Despite the difficulties in evaluating the data over time primarily due to changes in detection limits, these trends indicate modest improvements in water quality since the beginning of the A-280 program. However, the percentage of purveyors reporting contamination below the MCLs increased from 4% to 21% between 1985 and 1990. This increase in percentage of trace levels of contamination does not necessarily represent a decrease in drinking water quality but, is presumed to reflect a refinement in the laboratories' ability to detect low level contamination.

For a number of reasons, one analytical result above the A-280 MCL does not necessarily indicate a public health concern. First, very conservative assumptions were used to develop the MCLs, primarily the fact that the MCLs are based on a lifetime exposure to the contaminant at that level. Second, one sample does not necessarily reflect water quality over a significant period of time. Third, most of the reported analytical results which exceed the MCL are still considered to be relatively low; the vast majority of all detectable results are less than 50 ppb.

In general, laboratories are now calculating lower method detection limits (MDL) for these hazardous contaminants and reporting lower levels of contamination than earlier in the program, partially due to aggressive efforts on the part of the department to insure the laboratories certified by the State of New Jersey are following the USEPA approved methods. The allowable test methods also changed from the USEPA 600 series methods, commonly used for wastewater analysis, to USEPA 500 series methods developed for analyzing drinking water samples. The 500 series

methods coupled with improved instrumentation provide more sensitive analytical results. Therefore, more water purveyors with low concentrations of contaminants are now reporting test results that would have been reported as non-detectable in earlier rounds of testing. The decrease in the percentage of purveyors reporting contamination above the MCL may reflect the effect of the adoption of the MCLs and the accompanying regulations in 1989. The MCL regulations as well as the law mandated that water utilities correct exceedances of the MCL within a year of confirmation of the contamination. Through 1991, an estimated 34.7 million dollars of construction projects have been approved by the department for water utilities to provide treatment or alternative water supplies; over half of this money was approved in 1990-1991.

Because of the volatile nature of most of the regulated compounds almost all of the organic contamination reported is associated with groundwater sources. The most commonly detected contaminants in New Jersey public community drinking water systems are 1,1,1-trichloroethane, trichloroethylene and tetrachloroethylene; between 4 and 10% of the samples collected throughout the 1984 to 1990 monitoring period contained one or more of these three contaminants. The following four contaminants have never been detected at concentrations above the MCL: dichlorobenzenes, chlordane, polychlorinated biphenyls and xylenes.

When water systems were evaluated according to size, the medium sized systems showed the greatest decrease in the number of systems reporting contamination when pre-MCL (1984-1988) and post-MCL (1989-1990) intervals were compared. Four counties have had no systems with persistent contamination - Cape May, Hudson, Mercer and Salem. A persistent contamination problem is defined in this report as a water system that reported contamination in more than half of the sampling intervals since the hazardous contaminant testing program began. Morris County, the county with the largest number of public community water systems along with Sussex County, had the greatest absolute number of water supplies with pre- and post-MCL persistent contamination.

The Institute is currently evaluating recent toxicological data to determine if the MCLs adopted by the department in 1989 are based on the most current information available on the health effects associated with ingesting these chemicals in drinking water. Analytical method validation and treatment data have been evaluated for the remaining contaminants on the 2a list so that MCL recommendations may be issued for some of these contaminants in the near future. The Institute has also developed a "2b" list, a list of additional contaminants found in New Jersey drinking waters for which concern exists regarding potential human health effects, and for which analytical methods are available. Specific recommendations for MCLs for most of these contaminants are currently being developed. The Institute will also continue its work in identifying new contaminants for regulation in drinking water. The department currently has a number of standard setting-related research projects underway, to support the work of the Institute, such as developing methods for the determination of disinfection by-products and investigating methods for determining practical quantitation levels without performing extensive interlaboratory studies. Currently, the processes used to develop MCLs for the hazardous contaminant testing program are being applied to additional water quality programs throughout the department.

Since its inception, the hazardous contaminant testing program or "A-280" program (named after the legislation amending the N.J. Safe Drinking Water Act) has provided protective guidelines for New Jersey regulators to evaluate the quality of drinking water throughout the state. The ultimate goal of the program

is to promote the delivery of safe drinking water and to reduce public exposure to health risks associated with drinking water. The following status report provides a more detailed analysis of how New Jersey's drinking water program has developed and how the department and the regulated community has responded to the detection of hazardous contaminants in drinking water systems.

LIST OF ABBREVIATIONS

A-280	Refers to the 1984 Amendments to the NJ Safe Drinking Water Act, proposed as Assembly Bill 280
AS	Air Stripping-Packed Tower Aeration
Bureau	Bureau of Safe Drinking Water (BSDW)
Department	New Jersey Department of Environmental Protection and Energy (NJDEPE)
DSR	Division of Science and Research
GAC	Granular Activated Carbon
Institute	N.J. Drinking Water Quality Institute
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
NJDOH	New Jersey Department of Health
OQA	Office of Quality Assurance
PCWS	Public Community Water Systems
PWSID	Public Water System Identification
QC	Quality Control
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Chemical
2a List	The list of 22 hazardous contaminants in Section 2a of the 1984 amendments to the NJ Safe Drinking Water Act, A-280
2b List	A list of hazardous contaminants developed in accordance with Section 2b of the 1984 amendments to the NJ Safe Drinking Water Act, A-280

LIST OF ABBREVIATIONS

A-280	Refers to the 1984 Amendments to the NJ Safe Drinking Water Act, proposed as Assembly Bill 280
AS	Air Stripping-Packed Tower Aeration
Bureau	Bureau of Safe Drinking Water (BSDW)
Department	New Jersey Department of Environmental Protection and Energy (NJDEPE)
DSR	Division of Science and Research
GAC	Granular Activated Carbon
Institute	N.J. Drinking Water Quality Institute
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
NJDOH	New Jersey Department of Health
OQA	Office of Quality Assurance
PCWS	Public Community Water Systems
PWSID	Public Water System Identification
QC	Quality Control
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Chemical
2a List	The list of 22 hazardous contaminants in Section 2a of the 1984 amendments to the NJ Safe Drinking Water Act, A-280
2b List	A list of hazardous contaminants developed in accordance with Section 2b of the 1984 amendments to the NJ Safe Drinking Water Act, A-280

LIST OF ABBREVIATIONS

A-280	Refers to the 1984 Amendments to the NJ Safe Drinking Water Act, proposed as Assembly Bill 280
AS	Air Stripping-Packed Tower Aeration
Bureau	Bureau of Safe Drinking Water (BSDW)
Department	New Jersey Department of Environmental Protection and Energy (NJDEPE)
DSR	Division of Science and Research
GAC	Granular Activated Carbon
Institute	N.J. Drinking Water Quality Institute
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
NJDOH	New Jersey Department of Health
OQA	Office of Quality Assurance
PCWS	Public Community Water Systems
PWSID	Public Water System Identification
QC	Quality Control
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Chemical
2a List	The list of 22 hazardous contaminants in Section 2a of the 1984 amendments to the NJ Safe Drinking Water Act, A-280
2b List	A list of hazardous contaminants developed in accordance with Section 2b of the 1984 amendments to the NJ Safe Drinking Water Act, A-280

A-280 STATUS REPORT
(1984 - 1990)

Introduction

When the U.S. Environmental Protection Agency (USEPA) announced in 1982 that it would be several years before the agency would promulgate regulations to control volatile organic chemicals (VOC) in drinking water, New Jersey was already aware that VOC contamination was present in some of its water supplies. State authorities recognized that a long history of high population densities coupled with intense industrial activities made certain State water supplies vulnerable to contamination. Several studies conducted by the USEPA and by the New Jersey Department of Environmental Protection and Energy's (department) Division of Science and Research (DSR) documented the occurrence of organic pollutants nationwide (Westrick et al., 1984) and specifically in New Jersey's groundwaters (Tucker, 1981). The New Jersey research study revealed the presence of generally low levels of contaminants, primarily VOCs (Tucker, 1981). Concern over the length of time it would take USEPA to regulate VOCs in drinking water prompted the New Jersey Legislature to pass amendments to the State Safe Drinking Water Act. Designated Assembly Bill Number 280, the amendments provided for development of a comprehensive statewide program to regulate potential pollutants in drinking water supplies. In 1984, the New Jersey State Legislature adopted this bill which the Governor signed into law.

The amendments, still commonly referred to as "A-280" (P.L. 1983, c.443), provided that:

A. All public community water systems (PCWS) periodically be tested for specific hazardous contaminants;

B. The Commissioner of the department establish standards, called maximum contaminant levels (MCLs), for organic compounds listed in the statute and for other contaminants likely to be present in drinking water;

C. Corrections be made when contamination in excess of the MCLs is found; and

D. The department conduct research activities pertaining to drinking water quality issues.

The new law also established the Drinking Water Quality Institute (Institute) and directed it to make recommendations to the Commissioner. The Institute, formed in 1985, has the responsibility of developing a list of additional contaminants for which testing should be required; developing MCLs; recommending appropriate testing techniques and testing frequencies and reviewing the department's safe drinking water program.

Required testing for a specific list of 22 hazardous contaminants was set forth in Section 2a of the bill and is still commonly called the "2a" list (Table 1). The second group of contaminants, referred to as the "2b" list, was to be developed and was to include substances likely to be found in New Jersey's waters. This list is comprised of unspecified pesticides, synthetic organics and metals, for which MCLs should also be developed.

TABLE 1

A-280 CONTAMINANTS LIST

(Commonly known as the "2a" list")

COMPOUNDS FOR WHICH MONITORING IS PRESENTLY REQUIRED

1. Benzene
2. Carbon Tetrachloride
3. Chlordane
4. Chlorobenzene
5. Dichlorobenzene(s)
   - o-Dichlorobenzene
   - m-Dichlorobenzene
   - p-Dichlorobenzene
6. 1,2-Dichloroethane
7. 1,1-Dichloroethylene
8. trans-1,2-Dichloroethylene
9. cis-1,2-Dichloroethylene[1]
10. Methylene Chloride
11. Polychlorinated Biphenyls
12. Tetrachloroethylene
13. Trichlorobenzene(s)
14. 1,1,1-Trichloroethane
15. Trichloroethylene
16. Vinyl Chloride
17. Xylene(s)
    - o-Xylene
    - m-Xylene
    - p-Xylene

COMPOUNDS FOR WHICH MONITORING IS NOT PRESENTLY REQUIRED

1. Ethylene Glycol
2. Formaldehyde
3. n-Hexane
4. Kerosene
5. Methyl Ethyl Ketone

[1] Monitoring for cis-1,2-dichloroethylene was not possible until the USEPA 500 series methods became available in 1988.

From 1985-1988, the program operated with interim guidelines for the contaminants that were developed based upon information available from the federal government. On January 3, 1989, MCLs for sixteen of the twenty-two 2a list contaminants went into effect.

This report assesses the effectiveness of the A-280 program by evaluating the water quality data collected since the program began in 1984. Several questions will be addressed by this report. What do the data reveal about the safety of New Jersey's public water supplies? What has the program discovered about the occurrence of specific toxic organic pollutants in these supplies? How well do the purveyors of public water supplies comply with the monitoring program? How do the adopted MCLs compare to federal standards or recommendations? Can commercial laboratories adequately test for these compounds? Is the drinking water quality improving based on these data? What more can be done to ensure safe drinking water for the public in New Jersey?

SECTION I: HISTORY AND DEVELOPMENT OF THE A-280 PROGRAM

1. LEGISLATIVE DIRECTIVES

A. Establishment of the Drinking Water Quality Institute

In order to provide external recommendations to the Commissioner of the department on various aspects of the A-280 program, the amendments established an advisory group to the department called the Drinking Water Quality Institute. The Institute was charged with providing recommendations for the following: development of MCLs, development of the 2b contaminants list, evaluation of appropriate analytical testing methodologies and review of general department activities related to the safe drinking water program. The amendments provided the Institute with the technical services of the state agencies (including the department and the N.J. Department of Health (NJDOH)) and other commissions or agencies.

As provided by the statute, the Institute is comprised of 15 members, six of whom are ex officio representatives of the department, NJDOH, and the Water Supply Advisory Council, and nine of whom are appointed representatives of the water purveyors, the academic scientific community and the general public. These members are appointed, three each by the Governor, President of the Senate and Speaker of the General Assembly. Initial appointments to the Institute were made by January, 1985. A listing of the current members of the Institute appears in Appendix A.

The first meeting of the Institute was held in March of 1985. Meetings have generally followed a monthly or bimonthly schedule. Three subcommittees were established. The work of the subcommittees arose from the need to develop information in three critical areas for MCL derivation: health effects, analytical quantitation limits and the capabilities of current treatment technologies to remove contaminants from drinking water.

The three subcommittees and their assignments are:

1) **Lists and Levels** - development of health-based MCLs for 2a list contaminants and identification of additional hazardous contaminants for inclusion on the 2b list.

2) **Testing** - development and assessment of appropriate analytical techniques with reliable quantitation limits and determination of testing frequencies.

3) **Program** - review of department activities undertaken in accordance with the Safe Drinking Water Act and consideration of water treatment issues.

The current focus of the Institute is to continue evaluating appropriate testing methodologies for the remaining 2a list compounds for which it was not previously possible to develop MCLs, to develop MCLs for the 2b list compounds, to review the MCLs previously promulgated, to evaluate recent standard setting activities at the federal level and to review and incorporate research findings into the water quality program.

B. Development of MCLs

The Institute based the development of MCLs on three basic factors: 1) health effects considerations, 2) the availability and capability of testing methodologies and 3) the capability of water treatment techniques. An extensive discussion on the application of these considerations to each of the 2a list contaminants can be found in the Institute's document entitled "Maximum Contaminant Level Recommendations for Hazardous Contaminants in Drinking Water" dated March 26, 1987 (N.J. Drinking Water Quality Institute, 1987). A specific discussion on the determination of testing methodology capabilities has also been previously described (Oxenford et al., 1989). The same approaches described in the Institute document continue to be used by each subcommittee.

The Institute developed MCLs for 16 of the contaminants on the 2a list in 1987. Because no adequate standardized analytical methods were available for the remaining six compounds, it was not possible to derive an MCL for these contaminants. The MCLs recommended by the Institute are presented in Table 2. The department adopted the recommended MCLs with two modifications. The Institute proposed an MCL of 5 ug/l for vinyl chloride based on analytical limitations for reliable quantitation and 6 ug/l for para-dichlorobenzene. Shortly thereafter, USEPA established an MCL of 2 ug/l for vinyl chloride and the department adopted this stricter standard in accordance with the Federal and State Safe Drinking Water Acts which require that state standards be at least as stringent as federal standards. USEPA also released additional information based on the health effects of para-dichlorobenzene, and the USEPA's evaluation of the weight-of-evidence of the carcinogenicity of this contaminant. The department concurred with the USEPA evaluation and adopted by reference the USEPA standard of 75 ug/l for the contaminant (refer to Table 2).

As required by the A-280 legislation, the human health-based levels which were developed are concentrations which are not anticipated to result in adverse health effects after a lifetime of exposure for non-carcinogens and concentrations anticipated to result in no greater than one in one million additional lifetime cancer risk for carcinogens. It should be recognized that, in order to be protective of public health, conservative approaches and assumptions were used to develop these levels and that an assumption of lifetime exposure to these levels was utilized. For these reasons, exposure to concentrations above the MCLs which may be detected in water supplies does not necessarily represent an actual concern for potential human health effects. Individual health-based support documents for each of the A-280 contaminants are included in Appendix B of the Institute recommendation document (N.J. Drinking Water Quality Institute, 1987). These documents include information on potential adverse health effects associated with exposure to various levels of the A-280 contaminants.

The MCLs adopted by the department for fourteen of the 2a list contaminants are currently more stringent than the MCLs established by the USEPA. Diligent efforts to meet the mandate within the A-280 amendments, which set the MCL goal for a contaminant classified as a carcinogen at an excess cancer risk level no greater than one in one million (10^{-6}) over a lifetime exposure, were a primary reason for many of the standards to be lower than those of the USEPA, whose stated target risk range for carcinogens is 10^{-4} to 10^{-6}. Analytical method limitations prevented the department from setting the MCLs for a number of the contaminants at the 10^{-6} level. For most of these contaminants, the MCL was instead set at an approximate 10^{-5} risk level. These stricter New Jersey standards are achievable by the vast majority of New Jersey water purveyors as

TABLE 2

INSTITUTE RECOMMENDED MCLs FOR THE 2a LIST CONTAMINANTS

Contaminants	Institute Recommended MCLs (ug/l)	N.J. Adopted MCLs (ug/l)	USEPA Final MCLs[1] (ug/l)
1. Benzene	1	1	5
2. Carbon Tetrachloride	2	2	5
3. Chlordane	0.5	0.5	2
4. Chlorobenzene	4	4	100
5. o-Dichlorobenzene	600	600	600
m-Dichlorobenzene	600	600	-[2]
p-Dichlorobenzene	6	75	75
6. 1,2-Dichloroethane	2	2	5
7. 1,1-Dichloroethylene	2	2	7
8. cis,-1,2-Dichloroethylene	10[3]	10[3]	70
9. trans-1,2-Dichloroethylene	10[3]	10[3]	100
10. Methylene Chloride	2	2	5[4]
11. Polychlorinated Biphenyls	0.5	0.5	0.5
12. Tetrachloroethylene	1	1	5
13. Trichlorobenzenes	8	8	70[4]
14. 1,1,1-Trichloroethane	26	26	200
15. Trichloroethylene	1	1	5
16. Vinyl Chloride	5	2	2
17. Xylenes (total)	44	44	10,000

[1] The final MCLs can be found in 40 CFR 141.61.

[2] No MCL proposed or finalized.

[3] NJ adopted the Institute recommended MCL of 10 ug/l for the total of cis- and trans-1,2-dichloroethylene. Initially these isomers were reported as a combined analytical result. Although this combined MCL is still in effect, the isomers have been reported separately since 1988.

[4] Final MCL signed by USEPA Administrator May 11,1992.

demonstrated by the sample analysis results summarized in Section II of this report.

After completing this phase of its work, the Institute has continued efforts toward the establishment of standards for the remaining compounds through the efforts of its subcommittees. To date, the Lists and Levels Subcommittee has proposed health-based MCLs for four of the remaining five 2a list compounds (refer to Table 3); it was recommended that the remaining contaminant, kerosene, be removed from the 2a list.

The Testing Subcommittee recommended that the department's Division of Science and Research sponsor research studies to develop adequate testing methodologies for the remaining 2a contaminants. An outside consultant to the department conducted the initial development and evaluation of appropriate analytical methods and validation studies have been completed (Warner, et al., 1989).

As mandated by the A-280 amendments, the department is developing a second list of contaminants called the 2b list. Presently, there is a "working list" consisting of six contaminants which is being considered for regulation. Many of the chemicals that the department investigated for inclusion on the 2b list were included in a USEPA proposal for 38 organic and inorganic contaminants published in 1989 and adopted in 1991 (Federal Register, 1989; Federal Register, 1991). Table 4 presents the current status of these contaminants. The Lists and Levels Subcommittee has developed health-based MCLs for all six compounds on their working list. The Testing Subcommittee has also identified testing methods for each of the contaminants. As indicated on Table 4, four of the contaminants may be analyzed using USEPA approved 500 series (drinking water) methods. The Testing Subcommittee has determined that the best methods for analyzing 2,4,6-trichlorophenol are USEPA methods 604, 625 and 1625, originally developed for the analysis of wastewater. The Testing Subcomittee has also determined that the contaminant methyl tertiary butyl ether can be analyzed by using a USEPA 500 series method. However, this contaminant is currently not an USEPA approved analyte for the 500 series methods. The Program Subcommittee is researching the capability of treatment techniques to remove these contaminants to the level of the health-based MCLs.

C. Establishment of Monitoring Requirements

In accordance with the mandates of the A-280 amendments, the department developed periodic testing requirements for the 2a list contaminants. Regulations establishing the Interim Testing Schedule for 16 of the 2a list contaminants were adopted by the Commissioner in August, 1984 (N.J.A.C. 7:10-14.1 et seq.). The regulations required all public community water systems to conduct initial tests by January 9, 1985. Repeat periodic testing is semi-annual. The A-280 amendments provide the department with the discretion to increase or decrease the frequency of testing on a case-by-case basis. The A-280 amendments also require the annual monitoring of the substances identified as the 2b list when that list is established by regulation.

2. REGULATIONS

The MCL regulations for the A-280 program are contained in N.J.A.C. 7:10-16. These regulations, which became effective January 3, 1989, also contain procedures for determining MCL violations and required actions to be taken by public water

TABLE 3

PROPOSED HEALTH-BASED MCLs FOR THE REMAINING 2a LIST CONTAMINANTS

Compound	Proposed health-based MCL
Ethylene Glycol	290 ppb
Formaldehyde	0.65 ppb
n-Hexane	33 ppb
Methyl Ethyl Ketone	270 ppb
Kerosene	Due to its complex composition, no specific health-based MCL could be developed. The Institute recommended deletion of this mixture from the 2a list.[1]

[1] Monitoring for kerosene will be addressed through the regulation of two of its key components: benzene and naphthalene. Benzene, a 2a list contaminant, is currently regulated. The Institute is developing an MCL recommendation for naphthalene, a 2b working list contaminant (see Table 4).

TABLE 4

2B LIST CONTAMINANTS

Contaminants	Health-Based MCL(ug/l)	USEPA Approved Testing Method	Preferred Treatment Technique
1,1,2,2-Tetrachloroethane	1	502.1 502.2 524.1 524.2	AS[1]
2,4,6-Trichlorophenol	1	604[2] 625[2] 1625[2]	undetermined
1,1,2-Trichloroethane	3	502.1 502.2 524.1 524.2	GAC[3], AS
1,1-Dichloroethane	46	502.1 502.2 524.1 524.2	AS
Naphthalene	2900	502.2 503.1 524.1	GAC
Methyl Tertiary Butyl Ether (MTBE)	700	none approved	AS

[1] AS = Air Stripping (Packed Tower Aeration)

[2] These methods are not approved by USEPA for drinking water analysis. USEPA 600 series analytical methods and method 1625 are approved for wastewater analysis.

[3] GAC = Granular Activated Carbon

purveyors in the event of a violation. The regulations also provide for penalties and civil court actions for violations.

A. Laboratory Certification Regulations

In order to promote accuracy in the monitoring data, the Bureau of Safe Drinking Water (bureau) accepts only those analyses performed by laboratories certified by the State of New Jersey. The certified laboratory may only submit drinking water test results analyzed by using the analytical method(s) for which it is certified. The Regulations Governing Laboratory Certification and Standards of Performance, N.J.A.C. 7:18 et seq., specify which USEPA methods are to be used when analyzing drinking water samples. Any analyses conducted and reported to the state by non-certified laboratories or by certified laboratories using non-certified methods are rejected.

Although the actual number of laboratories certified by the Office of Quality Assurance (OQA) to perform A-280 analyses has varied on a yearly basis, the number of available certified laboratories has been considered sufficient to meet the needs of the A-280 program. During the initial round of testing in 1984, eight laboratories were certified to perform A-280 analyses. For the sample analyses conducted in 1990, 28 laboratories performed analytical work, with nine laboratories conducting analyses on about 75 percent of the total number of samples analyzed. Currently, 80 certified laboratories are available.

Audits conducted early in the program identified some deficiencies in the analytical methodologies, documentation practices and quality control procedures used by the certified laboratories. The department undertook a variety of measures to address the deficiencies. Laboratories were instructed to consistently use specified methodologies. Unannounced on-site audits of the laboratories were conducted. A data form requesting that laboratories report quality control (QC) parameters was developed in order to evaluate ongoing laboratory performance. Prior to January 1989, the submission of QC documentation by the laboratories was voluntary since regulations did not require that this information be reported. When the final New Jersey MCL standards went into effect and the drinking water program switched from using USEPA 600 series analytical methods to USEPA 500 series methods for VOCs, QC reporting became mandatory for all analyses. The QC form was redesigned to provide a greater amount of detailed information on laboratory performance.

Prior to required QC reporting, laboratories were using many different techniques for developing and reporting MDLs rather than using the recommended statistical determination found in 40 CFR 136, Appendix B. The range of reported method detection limits (MDLs) for the volatile organics during the two rounds of 1985 testing was generally 0.2-2 ppb (Krietzman et al., 1987). Subsequently, laboratories have been directed to calculate and report their MDLs using the statistical procedure in 40 CFR 136. Review of the required QC documentation submitted with the first and second rounds of sampling collected in 1989 indicates that the certified laboratories are able to meet the USEPA 500 series MDLs of 0.5 ppb required for VOC parameters. Some laboratories are currently reporting MDLs for VOCs as low as 0.01 ppb.

Two other factors are also believed to influence the MDLs. First the new 500 series methods, although comparable to the 600 series methods, contain analytical modifications in order to detect low level contamination in drinking water which has resulted in lower MDLs. Second, the laboratories have become more proficient

in performing these analytical methods over time. As a result, the laboratories are reporting values which reflect a greater sensitivity in detecting the presence of low level contaminants.

B. Testing Frequency Regulations

The A-280 amendments require the collection of samples from public community water systems semi-annually during periods of representative demand. The amendments also provide the department with the discretion to increase or decrease the frequency of testing on a case-by-case basis. Accordingly, the department has established testing regulations based on a number of factors. The periodic testing frequency requirements for the 2a list are based on whether or not a given public water system bulk purchases water or has its own source and the size of the population it serves. All public community water systems with their own source of water report sample analyses twice each year, once during each six-month submittal period. The testing intervals are from January 1 to June 30 and from July 1 to December 31. Small systems which serve less than 5,000 people may apply for reduced sampling frequency if none of the contaminants have been detected in three consecutive rounds of sampling. Systems which have been granted reduced sampling by the bureau submit analytical results once per year within the first six-month submittal period.

Bulk purchasers conduct periodic tests according to the size of the population they serve. Systems serving greater than 50,000 residents are required to report sample analyses twice each year, once during each six-month submittal period. Those systems serving between 5,001 and 50,000 residents submit test results once per year. Smaller systems serving a population of less than 5,000 people report once every three years.

Purveyors submit the results to the bureau for review. The bureau also conducts spot check and verification sampling to verify the levels of contaminants reported by the public water supplies (see Section II. 1. C and D). Analyses of over nine thousand samples have been submitted to the bureau since the A-280 program began.

C. MCL Regulations

As previously described, the Institute submitted to the Commissioner its report "Maximum Contaminant Level Recommendations for Hazardous Contaminants in Drinking Water" in 1987 (N.J. Drinking Water Quality Institute, 1987). Effective January 3, 1989, after publication in the State Register and a public comment period, the regulations establishing final standards called MCLs for 16 of the 22 contaminants on the 2a list were adopted by the Commissioner. A discussion about the development of MCLs can be found in Section I.1.B. For reference, a list of the 83 contaminants now required to be regulated by USEPA according to the 1986 amendments to the Federal Safe Drinking Water Act, the USEPA drinking water priority list, current USEPA standards and proposed USEPA standards appear in Appendix B. The drinking water priority list is a list of contaminants which are known or anticipated to occur in public water systems and which may require regulation under the Federal Safe Drinking Water Act. USEPA is required to publish proposed MCL goals and MCLs for no less than 25 contaminants on the drinking water priority list within 24 months of publication. New Jersey regulated compounds (2a list) and New Jersey compounds to be regulated (2b list) also appear in Appendix B.

3. INTERIM STANDARDS (1984-1988)

A. Interim Action Levels

Prior to the development and adoption of the MCLs in January, 1989, the PCWS with detectable levels of the A-280 contaminants were classified according to "interim action levels" presented in a document entitled "Drinking Water Guidance" developed by DSR (formerly the Office of Science and Research) and the Division of Water Resources (NJDEP, 1986a). The "Drinking Water Guidance" provided an administrative mechanism for the Department to respond to the levels of hazardous contaminants reported in both community and non-community drinking water systems. This document updated a draft version that had been used for most of 1985 to assess the test results from the initial round of A-280 testing and some of the periodic test results. Appendix C contains the action levels that were used to assess contamination in drinking water prior to January, 1989 when the MCLs went into effect.

All test results above detection limits were evaluated and placed into one of four different levels of response. The levels of response were based on health-based numbers developed from Suggested-No-Adverse-Response-Levels and Recommended Maximum Contaminant Levels published by the USEPA. The majority of the supplies with detectable levels reported very low concentrations and were classified as Level I. No additional action other than continued periodic sampling was necessary for Level I water supplies.

Level II results prompted an intermediate action level. In these situations, the Department conducted immediate resampling of the purveyor's sampling points and nearby sources of supply to confirm the presence of the contamination. All confirmed Level II systems were advised that the levels of contaminants found were not desirable in drinking water and that the source(s) responsible for the levels should not be used if other sources of more acceptable quality were readily available. These purveyors were encouraged, but not ordered, to take actions to improve delivered water quality. Monthly purveyor monitoring and reporting were required in each confirmed Level II case.

Level III included those results that the Department determined to warrant mandatory action. After conducting resampling, as in Level II cases, any system with a confirmed Level III result was informed that the level of contamination was not acceptable in drinking water and that corrective actions had to be implemented within one year. In addition, monthly monitoring and reporting, and quarterly reporting of progress for correcting the problem were required.

Level IV results after verification by the Department required immediate action to prohibit use of the water for potable purposes. A typical response would be to take the affected well out of service or to use alternative supplies or interconnected supplies. A description of Level III and IV responses is presented in Appendix C.

B. Purveyors' Response to Contamination

The vast majority of systems reporting A-280 contamination use ground water as their sole or partial source of supply. Early in the program, contamination with the A-280 regulated compounds was detected in ground water sources only, although a few surface water supplies have recently begun finding low levels of the VOCs in their samples. On the rare occasion that Level IV contamination was reported,

purveyors responded by immediately taking the affected wells out of service. The wells were resampled by the purveyor and the bureau to confirm the contaminant's concentration. All but one PCWS reporting Level IV contamination were able to provide an alternate supply either by switching to another well or via an interconnection with another water supply. The remaining water supplier which serves less than 160 people did not show MCL violations in subsequent testing rounds despite Level IV concentration reported in late 1988.

When the presence of Level III contamination was confirmed, the purveyor was given one year to install treatment or switch to an alternative source of water. While operating under the interim guidelines, regulatory procedures were such that the department did not have full enforcement capability. Most purveyors, however, responded to the contamination by first identifying the source and extent of the problem, and then developing long-term solutions.

Initially, systems reporting Level II contamination were slow to take corrective action. Many systems would report Level II contamination in one sampling period and Level I in the next period. Until the Institute published its recommended MCLs, many systems appeared hesitant to invest in costly long-term solutions and preferred to wait until it became evident that corrective actions would be required. Prior to the MCLs taking effect in January 1989, a commonly practiced solution to the problem of reducing the presence of low levels of VOCs was to blend water from different sources. However, in view of the tremendous amount of water needed to dilute even low levels of contamination to acceptable levels, blending is no longer as viable a means of achieving compliance with the MCLs as treatment. Although some blending still occurs, removal of contaminants is attained almost exclusively via air stripping and/or granular activated carbon units. These remedial practices are considered by USEPA to be the best available technology.

Prior to mid-1987 most purveyors reporting Level I contamination did not realize the need to address their problem. For example, under the interim guidelines, Level I contamination did not require actions beyond random spot checks, yet for six of the fourteen contaminants covered by the interim guidelines, the range of concentrations classified as Level I were above the 1989 MCLs. The six contaminants were: trichloroethylene, 1,1-dichloroethylene, trans-1,2-dichloroethylene, methylene chloride, chlordane and xylenes.

SECTION II: COMPLIANCE & WATER QUALITY DATA

1. MONITORING REQUIREMENTS AND COMPLIANCE

A. Evaluation of Sample Submissions

In order to comply with the A-280 regulations, a PCWS must perform the following: 1) collect samples as required, 2) have the samples properly analyzed by a laboratory certified by the State of New Jersey, 3) submit results within the required time frame to the department and 4) have no confirmed levels of contaminants greater than the MCL. The level of a contaminant exceeding the MCL is confirmed by averaging three check samples taken within a month of contaminant detection with the initial sample as defined by Subchapter 16 of N.J.A.C. 7:10.

B. Compliance with Monitoring Requirements

The bureau considered the response of the purveyors to the overall monitoring requirements of the A-280 program from 1984 to 1990 to be very good. Although some systems have failed to report for a given sampling period, compliance monitoring for these new hazardous organics (86% - 93% of PCWS) is better than for some of the more traditional sampling parameters. Table 5 provides a summary of compliance. The high levels of compliance are attributed to a number of factors. Initially, the bureau publicized the program directly to the purveyors and to the local health officers in order to acquaint both groups with monitoring requirements. Subsequently, the program has directly contacted the certified laboratories who often assist smaller systems with meeting reporting requirements. These contacts have established a good rapport with the regulated community and those that serve them.

Almost all sample analyses meet the qualifying criteria and are accepted by the bureau. During 1988 and 1989, seven purveyors used two non-certified laboratories. In each case, the purveyors did not realize the laboratories were not properly certified for A-280 analysis. The Bureau maintains a violation history for late submission and non-submissions for each purveyor. This information is taken into account whenever enforcement actions are prompted.

C. MCL Violations and Follow-up Actions

Each A-280 sample result reported to the bureau contains analytical results for approximately 17 different synthetic organic chemicals. Approximately 98% of all A-280 analytical results reported annually to the bureau are less than the detectable level.

As of January 1989, whenever an A-280 sample exceeds an MCL, three check samples must be taken by the water purveyor to verify a violation. If the average of the four samples exceeds the MCL (for averaging purposes, check samples containing nondetectable levels of the contaminant are assigned the numerical value of one half the MDL), a violation is issued and the purveyor is required to provide public notification in accordance with the most current version of the Federal National Primary Drinking Water Regulations (40 CFR 141.32, as amended). The bureau may require additional monitoring in order to establish the extent of contamination. The purveyor has one year to bring the water quality into compliance with the MCL in accordance with state regulations. If the concentrations of the contaminant are such that the public is exposed to an imminent health threat, the department may require the water purveyor to promptly

TABLE 5

NUMBER AND PERCENTAGE OF REPORTING

PUBLIC COMMUNITY WATER SYSTEMS BY SAMPLING PERIOD

Period	# of PCWS Reporting*1
Initial Sample	576 (91%)
1-85	533 (93%)
2-85	527 (92%)
1-86	567 (87%)
2-86	447 (88%)
1-87	542 (89%)
2-87	462 (88%)
1-88	534 (86%)
2-88	483 (92%)
1-89	535 (88%)
2-89	455 (87%)
1-90	544 (89%)
2-90	426 (86%)

*1 Although the number of public community water systems has remained at approximately 635, the number of systems required to report in each semi-annual interval varies depending on the monitoring regulations. Water systems that total bulk purchase water and serve less than 50,000 people are on a modified sampling schedule as are small systems with no history of MCL violations. In general, more test results are required to be submitted during the first sampling period of each year.

remediate the supply by taking the affected sources out of service, providing temporary treatment, or utilizing alternative water sources. An extension of the one year period of compliance may be granted by the department for new construction after a public hearing has been held and a determination has been made that the extension will not pose an imminent threat to public health. If a purveyor does not act to bring the water system into compliance, the department initiates enforcement action. Figure 1 presents the process for determining an MCL violation. Table 6 includes those water systems whose average values exceeded an MCL in 1989 and 1990. The information provided on each water system includes the follow-up response by the water utility. As required, all of the purveyors provided public notification of the MCL violation. As can be seen, only one of the public community water system is still in violation of an MCL. It should be noted again the MCLs were developed based on a 70 year exposure period and conservative assumptions, and these violations do not necessarily reflect an immediate human health concern.

D. Verification Sampling

When the program was initially instituted, the Department developed a system to confirm the presence and levels of the chemicals being reported. Under the interim action levels, water systems reporting detectable levels of contamination at Level II or above were resampled by the Bureau to verify the presence of contaminants and to assign an interim action level. Additional monitoring was required of all systems reporting Level II contamination or higher. Systems which reported no detectable levels of contamination or Level I contamination were included in the bureau's spot check program.

E. Spot Check Sampling

As part of the quality assurance program of the bureau and the A-280 program in particular, a portion of the public community water systems which reported no or low levels of contamination were selected during various rounds of A-280 testing to be resampled and analyzed by a state laboratory. A comparison of laboratory results from analyses performed by commercial laboratories certified by the State of New Jersey for A-280 contaminants to those obtained by the department or NJDOH laboratories generally supports reproducibility of analytical results.

The process of selecting sites to be spot checked has essentially remained unchanged over the life of the program. Five percent of the systems which report no detectable levels of contaminants are randomly resampled. For those systems which reported Level I contamination under the interim guidelines (1984-1988), 20 percent of the facilities were retested. For the two rounds of spot check data collected in 1985, 59 sites were chosen to be resampled because of no detectable levels of contamination and 14 sites were resampled because of Level I contamination. Of the 59 sites, 41 sites or 70 percent showed no detectable contamination upon resampling. In many cases spot check samples from the remaining 18 systems showed contamination that was below the detection levels of the original sample. At half of the 14 Level I sites that were randomly chosen, the spot check test results were nondetectable; at five sites the contaminant was verified. These data emphasized the need for uniform method detection limits early in the A-280 program (Krietzman et. al., 1987). A detailed discussion of how the spot check samples compared to the commercial laboratory results can be found in the previous data reports (NJDEP, 1986b; Krietzman et al., 1987).

FIGURE 1

MCL Violation Process

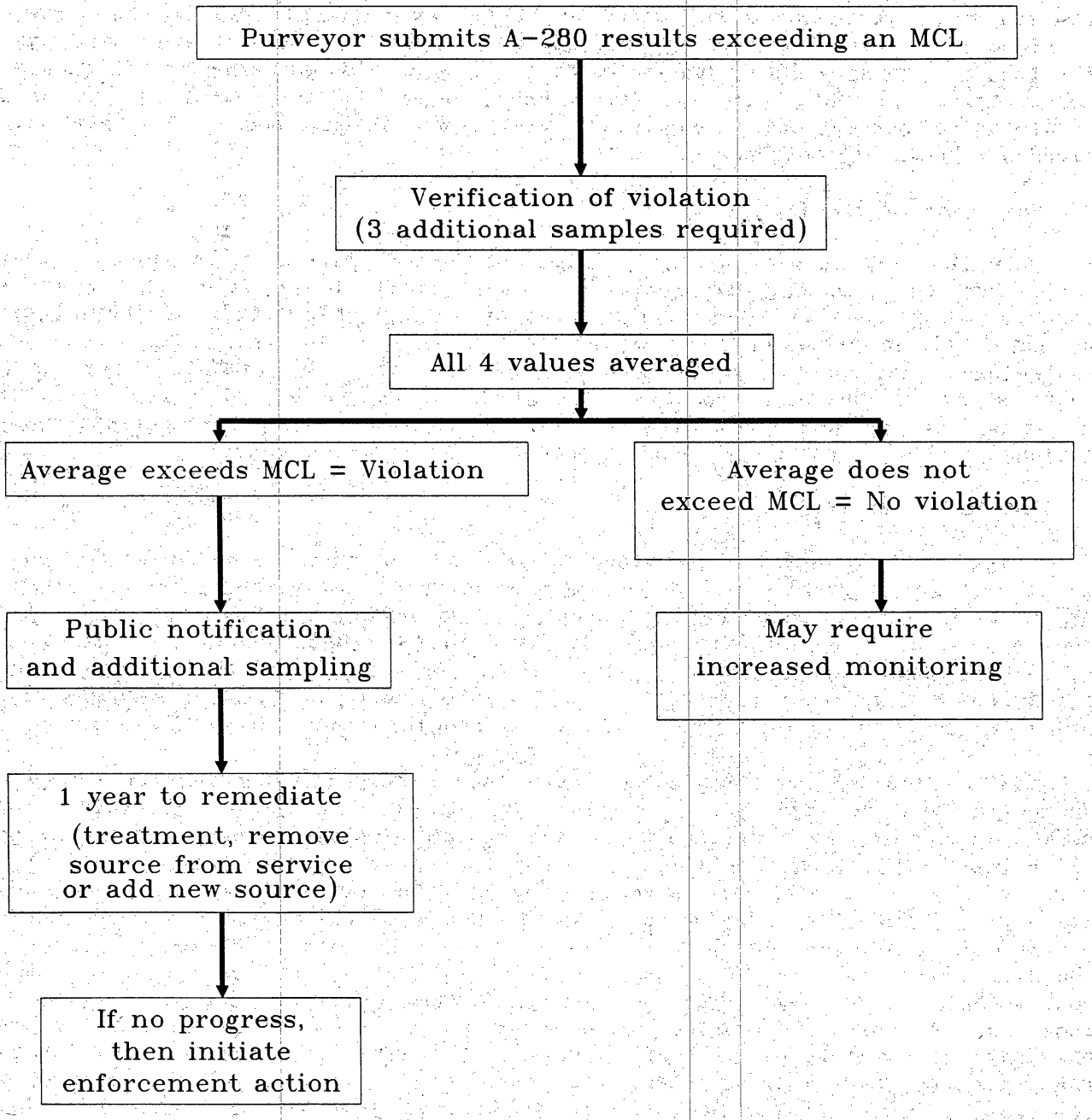


TABLE 6
PUBLIC COMMUNITY WATER SYSTEMS WITH MCL VIOLATIONS in 1989 and 1990 [1]

County	System Name PWSID No.	Contaminant (MCL in ug/l)	Sample Date	Violation level (ug/l)	Date Compliance Achieved	Follow-up Activity
Atlantic	Hamilton Twp. MUA 0112001	Tetrachloroethylene(1)	3/8/89	2.5	7/19/89	Use of Well #6 used only as needed until permanent treatment installed in 7/91.
Bergen	Oakland WD 0242001	Tetrachloroethylene(1)	9/19/90	2.4	10/12/90	Well #5 removed from service. Permit for air stripper issued 8/91. Well #5 returned to service.
Bergen	Park Ridge 0247001	Trichloroethylene(1)	11/3/89	3.5	8/1/90	Water from all affected wells (total of eleven) now receive treatment.
Bergen	Ramsey 0248001	Tetrachloroethylene(1), Trichloroethylene (1)	11/1/89 10/6/89	4.3 1.6	2/6/90	All affected wells receive air stripper treatment.
Bergen	Ridgewood 0251001	Tetrachloroethylene (1), Trichloroethylene (1)	9/27/89 9/27/89	7.0 2.2	2/13/90	Affected wells either removed from service or receive treatment. Treatment installed at 3 stations. Permit issued for additional 7 stations.
Bergen	Waldwick 0264001	Trichloroethylene(1)	10/11/90	20.6	11/16/90	Well #8 removed from service. Balance of affected wells receive air stripper treatment.
Camden	Merchantville-Pennsauken WC 0424001	Tetrachloroethylene (1), Trichloroethylene (1)	8/20/89 8/20/89	1.9 1.7	8/90	Air stripper treatment unit installed at Woodbine plant. System has a total of 4 air strippers at 6 plants.
Essex	Caldwell WD 0703001	Trichloroethylene (1)	8/02/89	2.4	6/14/90	System bulk purchases water from Essex Fells W.D. Essex Fells WD closed Well #13 (West Caldwell).
Essex	Essex Fells WD 0706001	Trichloroethylene (1)	5/26/89	2.9	4/12/90	Affected well removed from service. Air stripper unit installed 4/90.
Essex	Livingston Twp. Div.of Water 0710001	Trichloroethylene (1)	4/25/89	4.3[2] 12.4	1/24/90	Affected wells removed from service. Permit issued for aeration units at 5 wells on 4/92.
Hunterdon	Bloomsbury WD 1003001	Trichloroethylene (1)	6/11/89	9.6	4/1/90	Air stripper treatment unit installed 4/90.

TABLE 6 (Continued)

County	System Name PWSID No.	Contaminant (MCL in ug/l)	Sample Date	Violation level (ug/l)	Date Compliance Achieved	Follow-up Activity
Morris	Roxbury WC 1436002	Tetrachloroethylene (1)	5/10/89	4.5	7/13/89	Affected well removed from service 7/13/89. Subsequent sampling results reported contaminant levels below the MDL. Well returned to service 12/7/89
Morris	Wharton WD 1439001	Trichloroethylene (1)	7/28/89	3.0	8/28/89	Removed affected well from service. Projected installatiion date for air stripping treatment unit currently under construction is 1/93.
Ocean	Toms River 1507005	Trichloroethylene (1)	6/27/89	3.4	7/89	Repair to air stripper treatment unit corrected problem.
Ocean	Beckerville Pines 1518010	Tetrachloroethylene (1)	5/16/89 7/13/89 3/16/90	2.1 2.7[2] 3.1	--	No action taken by purveyor. Affected wells still in service. NJDEPE sampled system in 1990. Compliance order issued 7/92.
Sussex	North Shore Water Assoc. 1904004	1,1,1-Trichloroethane (26)	5/4/89	34	11/2/89	Additional monitoring required. Subsequent sampling results reported contaminant levels below the MCL. No treatment required.
Sussex	Willor Manor WC 1904008	1,1,1-Trichloroethane (26)	7/13/89	31	10/11/89	Home treatment units installed by residents. Subsequent sampling results reported contaminant levels below the MCL.
Union	Rahway WD 2013001	Trichloroethylene (1), Tetrachlorethylene(1)	6/8/89 10/16/89	1.9 2.5	8/16/91	Compliance order sent by NJDEPE to system on 7/17/91. Preliminary design report submitted, final design expected by end of 1992. This surface water source has fluctuating values and had returned to compliance during 1991. However, plans for treatment are proceeding.

[1] An MCL violation (as defined in N.J.A.C. 7:10-16) occurs when the averaged value of the original sample plus 3 check samples exceeds the MCL.

[2] MCL violations were observed at two wells.

A slight modification to the spot check program took place after the MCLs went into effect in 1989. Five percent of the facilities which report no detectable levels of contaminants are resampled as in past years. However, low level contamination sites are now defined as those reporting detectable levels less than the MCL. One in five or 20% of these sites were resampled in 1990.

F. Noncompliance

At the close of each round of testing, the bureau sends letters of noncompliance to each system failing to submit results. If a public water purveyor fails to submit test results after these contacts, the bureau samples the system. The samples are analyzed by either the department's or NJDOH's laboratories. The department's regional enforcement offices are also notified.

In 1986, the bureau collected samples from the eighteen public water systems which had failed to submit any test results from the first three testing periods. Twenty-six such facilities were sampled in 1986, 17 in 1988 and 45 in 1989 and 26 in 1990. No samples were collected in 1987 due to curtailed activities at the state laboratories and other drinking water program priorities. Appendix D provides a listing of the non-reporting systems which the bureau has sampled due to noncompliance. Most of the systems listed are small; many of them are mobile home parks or apartment complexes. A number of these systems have been abandoned by the owner. For those cases, the department has instituted a variety of enforcement and civil actions against the owner. These actions include invoking the Small Water Company Takeover Act in order to have the court appoint a receiver to oversee the water system until a new owner is found.

2. EVALUATION OF WATER QUALITY DATA

A. Limitations in Evaluating Test Results

Although a general assessment of the water quality data collected from the beginning of the program in late 1984 through 1990 is possible, several limitations restrict a more extensive temporal trend analysis. Three important factors are discussed below.

1. **Most analytical results are reported as below detectable levels**. When analyzing detected levels of contamination, only very limited segments of the test results received are being evaluated. In addition, attempts to analyze average concentrations of contaminants including those less than the detection limit, are not meaningful due to the overwhelming number of nondetectable levels reported. Proportions of concentrations greater than the MDL were evaluated, as well as the distributions of concentrations above the MDL for the three most frequently found contaminants. The reported occurrence of individual contaminants is discussed later in this section.

2. **Detection limits vary among certified laboratories**. Detection limits will vary over time within and among laboratories depending on methodologies, analytical instrumentation and analysts. Since the A-280 program began, numerous laboratories certified by the State of New Jersey have conducted analyses for the A-280 contaminants. Each laboratory has been required to report the presence or absence of a contaminant based on its own detection limit calculated according to the 40 CFR 136, Appendix B and the certification procedures established by the OQA (Section I.2.A). Laboratories report the MDLs as calculated values rather than published values. Therefore, values reported as nondetectable are not necessarily

numerically consistent among laboratories certified by the State of New Jersey. This is a limitation in evaluating the data collected because a reported value from one laboratory may fall below the calculated MDL of another laboratory.

3. **A change in analytical methods and general reduction in MDLs** - When the Department instituted the A-280 program, no other state in the country was regulating these 16 compounds in drinking water, nor were there any federal requirements for monitoring these compounds. Consequently, USEPA had not approved specific analytical methods. In the absence of more appropriate analytical methods, New Jersey, through the OQA, initially adopted the laboratory criteria, procedures and methods already approved by USEPA under the Clean Water Act for wastewater analysis. These methods are found in 40 CFR 136 and are referred to as the USEPA 600 series analytical methods.

Under the 600 series methods, the laboratory had considerable latitude in selecting the low-level standard concentrations to establish its calibration curve; the laboratory would extrapolate readings found below the standards used to set the curve. It is important to note that these methodologies were designed to detect the presence of contaminants in wastewater discharges. The concentrations of contaminants regulated under wastewater discharge programs are generally higher than those anticipated in finished drinking water supplies. Only about half of the analyses submitted to the bureau between 1985 and 1988 were accompanied by the voluntary QC form and the forms as originally designed did not provide enough detail to satisfy all the department's analytical concerns.

Effective January 2, 1989 the USEPA adopted the 500 series methods for drinking water testing. These methods, where applicable, were also required for analyzing the A-280 parameters. In contrast with the 600 series methods, the newer USEPA approved 500 series methods are specifically designed to detect low level contamination in drinking water. OQA's requirements that MDLs be calculated using 40 CFR 136, Appendix B are yielding more uniform information over time and among certified laboratories. The OQA noted that the MDLs being reported with the 500 series methods are lower than with the 600 series. As of 1989, submission of the QC form became mandatory.

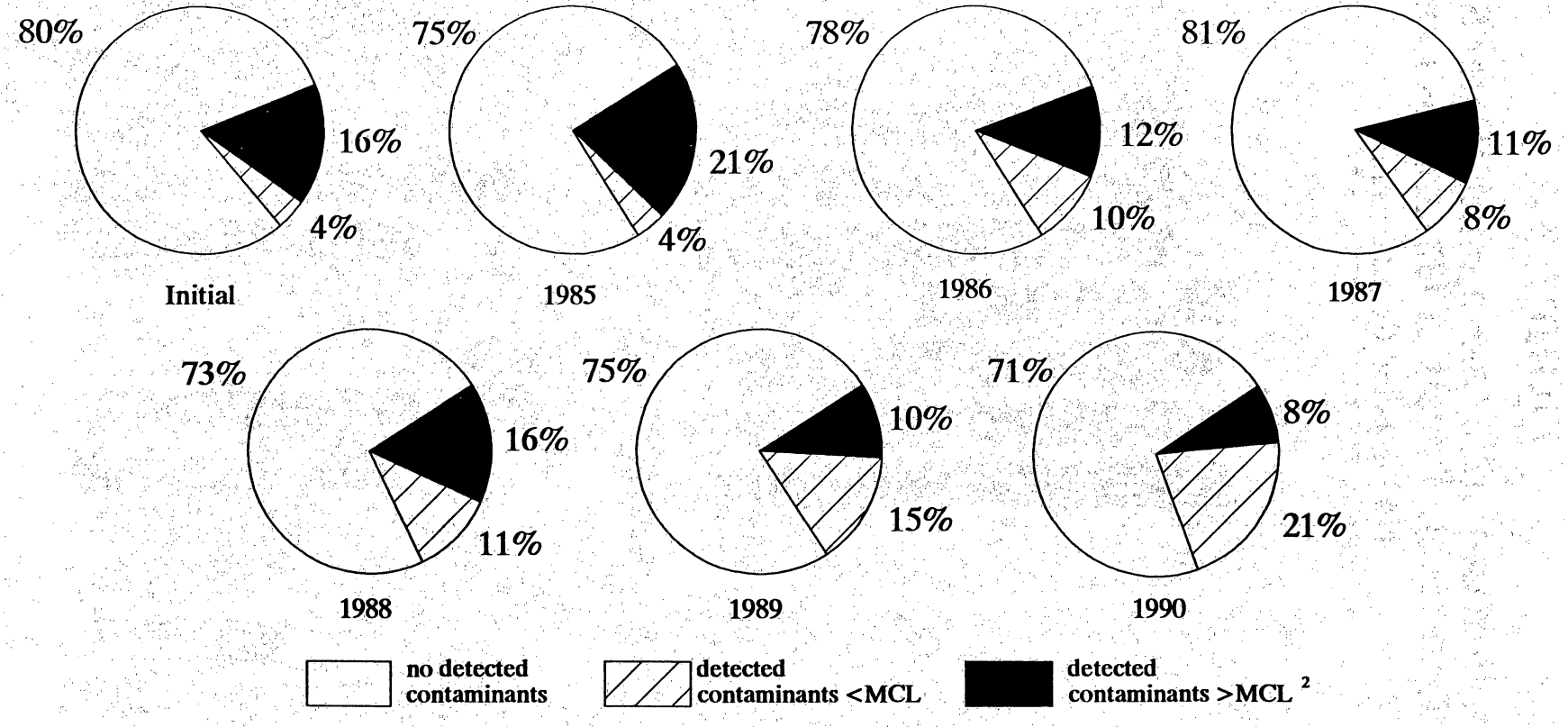
There was a shift by the certified laboratories from the 600 series methods to the 500 series methods between 1988 and 1989. By 1989, all the certified laboratories were using the 500 series methods. The increased use of 500 series methods over time has resulted in significantly lower MDLs. Therefore, in the later years covered by this report, it is probable that any increased detections of low levels of contaminants below the MCLs are the result of the more sensitive test procedures and do not necessarily indicate a water quality trend of increasing contamination. As more information is collected under the 500 series methods, the trends in drinking water quality will be more easily determined.

B. Occurrence of Contaminants

The occurrence of contamination was evaluated and is presented here in two different ways, on both a purveyor and sample specific basis. Figure 2 presents the distribution of purveyors falling into one of three categories: those purveyors which did not detect any of the sixteen contaminants in either round of sampling in a given year, those purveyors which detected one or more contaminants above the MCLs promulgated in 1989, and those purveyors which detected one or more contaminants below the MCLs but no contaminants above the MCLs. The same data are presented as bar charts in Figure 3. Percentages presented for the years 1985

FIGURE 2

Distribution of Public Community Water Systems Reporting Detectable Levels of Hazardous Contaminants [1]



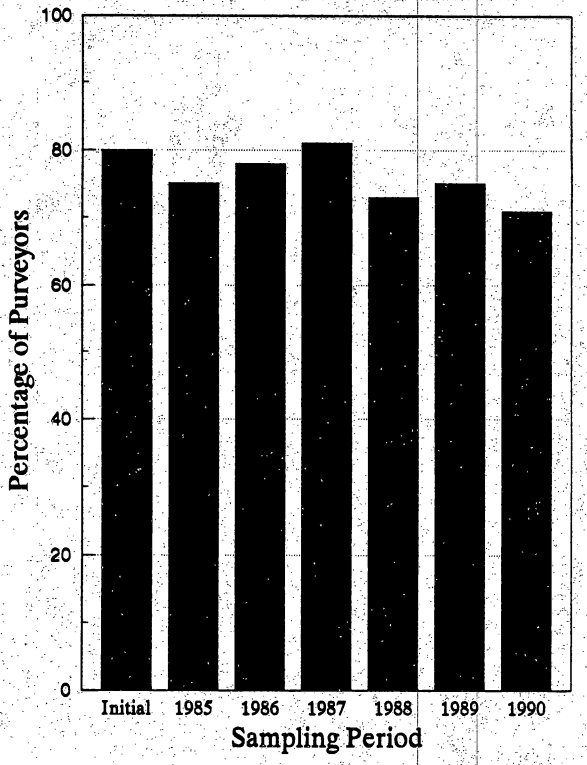
[1] These pie charts present the percentage of public community water systems reporting the presence of at least one of the 16 hazardous contaminants. If contaminants were detected above and below the MCL the purveyor was placed in the > MCL category.

[2] The percentage of public community water systems with detected contaminants exceeding the Federal MCLs are as follows: 1985-11%; 1986-6%; 1987-5%; 1988-11%; 1989-5%; 1990-2%.

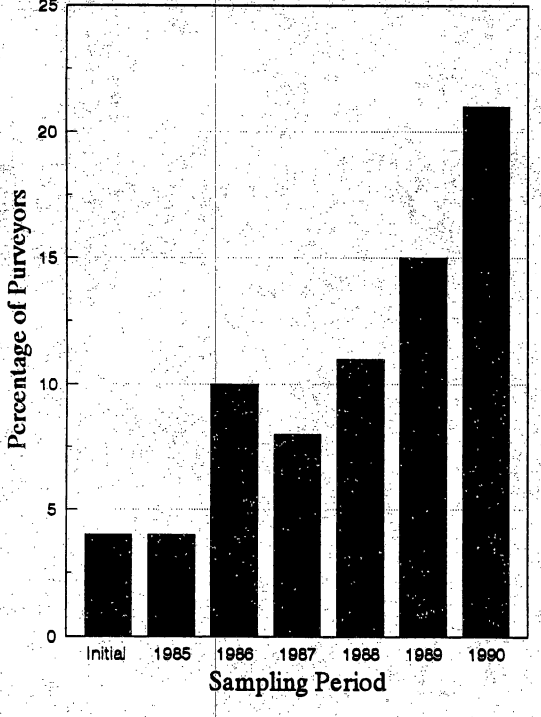
FIGURE 3

Distribution of Public Community Water Systems Reporting Detectable Levels of Hazardous Contaminants

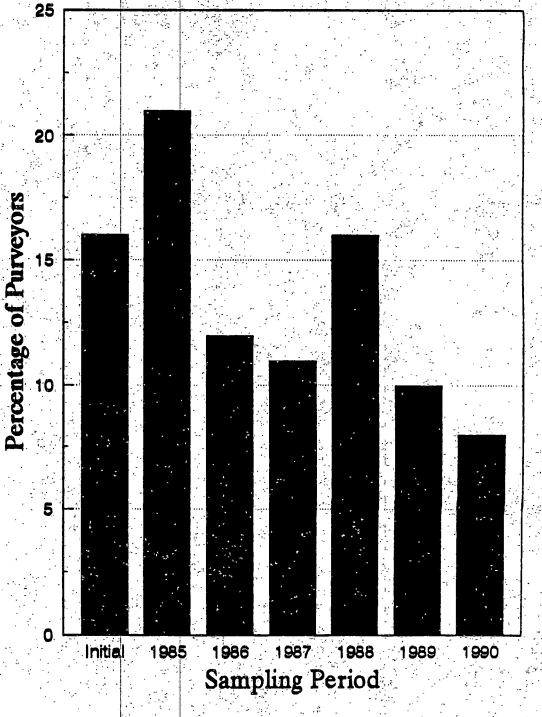
No Detected Contaminants



Detected Contaminants <MCL



Detected Contaminants >MCL



through 1990 represent the results of two rounds of sampling; whereas, the initial sampling represents only one round of sampling. Thus, the initial round of sampling does not reflect a comparable number of samples. These figures show a general downward trend for detection of levels above the current 1989 MCLs over time (21% in 1985 to 8% in 1990) with the exception of the 1988 data. The percentage of purveyors reporting detectable levels of contaminants above the MCLs in 1988 increased relative to 1986 and 1987. A long, hot dry spell during the summer of 1988 produced record peak consumption levels that may have contributed to this increase. During this time, a number of PCWS which were not using wells contaminated by low levels of VOCs were advised to turn these wells back on in order to provide needed water supply capacities.

The percentages of PCWS with detected concentrations of A-280 contaminants were also evaluated utilizing the federal MCLs (refer to Appendix B). For 14 of the A-280 hazardous contaminants (plus isomers), the federal MCLs are higher than those adopted by the department; for four other chemicals, the MCLs are the same. The percentage of PCWS with contamination above the federal MCLs also decreased over time from 11% in 1985 to 2% in 1990, except in 1988 for the same reasons described above.

A comparison of the percentages of purveyors which reported concentrations of contaminants greater than the A-280 MCLs was performed for 1984-1990. There was a significant linear trend ($p = 0.001$, Cochran's Test). Despite the difficulties in evaluating the data over time (primarily due to changes in detection limits), this trend indicates modest improvements in water quality since the inception of the A-280 program. In contrast, the percentage of purveyors reporting detected contamination at concentrations below the MCLs appears to be increasing, particularly comparing 1985 (4%) to 1989 (15%) and 1990 (21%). As previously discussed, this increase in trace levels of contamination detected during 1989 and 1990 is suspected to be related to the concurrent decrease in detection limits.

In addition, the occurrence data for the individual A-280 contaminants have been evaluated and are presented in Table 7. The data in Table 7 are presented on a per sample basis versus the purveyor basis depicted in Figures 2 and 3. The contaminants are listed according to frequency of occurrence. The total number of samples analyzed in a given sampling period is listed at the bottom of each column. All columns except for the "Initial" sampling column represent two rounds of sampling.

The most frequently reported contaminants were 1,1,1-trichloroethane, trichloroethylene and tetrachloroethylene. This is consistent with the results of the national groundwater supply survey which reported these contaminants as the most frequently detected compounds (Westrick et al., 1984). A more detailed discussion of these contaminants is presented in the following section. The reported presence of methylene chloride, the fourth most frequently reported contaminant, in drinking water samples has been evaluated by OQA. After comparing quality assurance/quality control information for drinking water samples collected in a separate department study and analyzed by the same USEPA 500 series methods used in the A-280 program, OQA concluded that methylene chloride detected in the drinking water samples may be due to laboratory contamination during analysis. The possibility of laboratory contamination cannot be eliminated when evaluating sample analyses prior to 1989. Currently, sufficient QC information to rule out laboratory contamination is submitted with the reported detection of methylene chloride.

TABLE 7
HAZARDOUS CONTAMINANT OCCURRENCE AND PERCENT OCCURRENCE PER YEAR[1]

Contaminant	Total Occurrence		Initial Sampling[2] Positive Results		1985 Positive Results		1986 Positive Results		1987 Positive Results		1988 Positive Results		1989 Positive Results		1990 Positive Results	
	#	%	#	%	#	%	#	%	#	%	#	%	#	%	#	%
1,1,1-Trichloroethane	623	7	41	6	89	6	80	5	103	7	87	7	88	7	135	10
Trichloroethylene	603	7	48	7	90	6	103	7	110	8	108	8	83	6	61	4
Tetrachloroethylene	566	6	45	6	101	6	89	6	96	7	103	8	69	5	63	5
Methylene Chloride	276	3	25	4	76	5	30	2	46	3	27	2	30	2	42	3
trans-1,2-Dichloro-ethylene	181	2	14	2	24	2	65	4	57	4	12	1	7	<1	2	<1
Carbon Tetrachloride	108	1	6	1	5	<1	11	<1	5	<1	17	1	24	3	40	3
1,2-Dichloroethane	96	1	4	<1	17	1	24	2	18	1	9	<1	8	1	16	
1,1-Dichloroethylene	90	1	6	1	9	<1	14	<1	18	1	21	2	16	1	6	<1
para-Dichlorobenzene	48	<1	6	1	12	<1	2	<1	3	<1	6	<1	9	1	10	<1
meta-Xylene	44	<1	4	<1	5	<1	4	<1	8	<1	6	<1	6	<1	11	<1
Benzene	39	<1	12	2	8	<1	6	<1	3	<1	3	<1	1	<1	11	<1
cis-1,2-Dichloro-ethylene	39	<1	-	-	-	-	-	-	-	-	12	1	15	1	12	1
Chlorobenzene	36	<1	3	<1	4	<1	7	<1	5	<1	3	<1	3	<1	11	<1
ortho-Xylene	33	<1	4	<1	6	<1	2	<1	7	<1	3	<1	3	<1	10	<1
ortho-Dichlorobenzene	22	<1	-	-	11	<1	2	<1	1	<1	1	<1	1	<1	6	<1
Vinyl Chloride	20	<1	1	<1	1	<1	2	<1	2	<1	3	<1	10	1	1	<1
para-Xylene	20	<1	4	<1	1	<1	2	<1	4	<1	2	<1	3	<1	4	<1
1,2,4-Trichlorobenzene	12	<1	-	-	5	<1	1	<1	-	-	3	<1	2	<1	-	-
meta-Dichlorobenzene	10	<1	2	<1	3	<1	-	-	-	-	1	<1	1	<1	2	<1
Chlordane	1	<1	-	-	1	<1	-	-	-	-	-	-	-	-	-	-
Arochlor 1254	1	<1	-	-	-	-	-	-	-	-	-	-	-	-	1	<1
Arochlor 1016	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arochlor 1221	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arochlor 1232	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arochlor 1242	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arochlor 1248	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arochlor 1260	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Number of Samples	**9,213**		**704**		**1,571**		**1,491**		**1,434**		**1,333**		**1,291**		**1,389**	

[1] Contaminants are listed according to ranking order - most to least frequently detected.

[2] Initial represents only one round of sampling in 1984; whereas, 1985 through 1990 represent two rounds of sampling.

Other contaminants reported in greater than 1% of the samples, in ranked order, are trans-1,2-dichloroethylene, carbon tetrachloride, 1,2-dichloroethane and 1,1-dichloroethylene. Polychlorinated biphenyls, presented in Table 7 as Arochlors, were reported and confirmed for the first time in 1990. Chlordane at a concentration less than the MDL was reported once in 1985. The presence of chlordane was never confirmed and without access to the raw data, its actual presence remains questionable. Due to low water solubility, it is not surprising that PCBs and chlordane are rarely detected in delivered water supplies. The following four contaminants have never been detected above the MCL: dichlorobenzenes, chlordane, polychlorinated biphenyls and xylenes.

C. 1,1,1-Trichloroethane, Trichloroethylene, and Tetrachloroethylene Occurrence Data

1,1,1-Trichloroethane (TCA), trichloroethylene (TCE) and tetrachloroethylene (PCE) are common ingredients in industrial and household solvents and degreasers. Of these three compounds, trichloroethylene and tetrachloroethylene are frequently detected together in a common water source.

Frequency distributions for detection of 1,1,1-trichloroethane, trichloroethylene and tetrachloroethylene are presented in Tables 8, 9 and 10, respectively. When reviewing the frequency distribution tables, it is important to note that since 1986 when the bureau's reduced sampling program began, fewer purveyors are required to test in the second round of sampling during a given year. In 1990, approximately 99 supplies were on the reduced sampling program. Testing intervals P86-2, P87-2, P88-2, P89-2, P90-2 are biased slightly towards higher proportions of both medium and small systems with recently reported contamination. In other words, only small and medium purveyors reporting no detected contamination are eligible for the reduction program and those systems are not represented in the second sampling period of each year. Therefore, the two sampling periods of each year are not directly comparable. Increases and decreases in each category can best be made over time by comparing the first rounds of sampling (P85-1, P86-1, P87-1, P88-1, P89-1 and P90-1) when all purveyors except certain water supplies that bulk purchase water are required to submit analyses. The reader is reminded when reviewing the frequency distributions (Tables 8, 9 and 10) and distributions of PCWS reporting detectable contamination (Figures 2 and 3) that percentages of either samples or PCWS containing detectable levels, not the actual numbers of samples or PCWS, are being compared.

One of the best methods to graphically display data distributions is through the use of box and whisker plots. Box and whisker plots for 1,1,1-trichloroethane, trichloroethylene and tetrachloroethylene are presented in Figures 4-9. For each sampling period, the distribution of detected values is depicted. Box plots make it possible to illustrate how much above the MCL these detections are and how much variability exists within a sampling period for that particular contaminant. For each box, the lower horizontal bar is set at the concentration below which 25% of the samples fall, the middle bar is set at the 50% (median) mark and the top of the box represents the concentration below which 75% of the samples fall. The whiskers extend only to those points that are within 1.5 times the length of the box. If no data points exist up to 1.5 times the length of the box, the whiskers will be shorter in length. Values greater than the range included in the whiskers are represented as individual points. The larger the box, the greater the range of detected values and the longer the

whisker. Log base 10 scale plots of the same data provide a more detailed view of the distributions.

1,1,1-Trichloroethane: MCL = 26 ug/l

A frequency distribution for samples reporting 1,1,1-trichoroethane is provided in Table 8. The percentage of samples containing no detectable levels of 1,1,1-trichloroethane have remained about the same over time. Most detected values are below the MCL. However, the percentage of samples reporting detectable levels below the MCL increased from about 5% for each first round of sampling from 1985 to 1989 to 10% for P90-1. Whether or not this 1990 increase represents a significant increase in the presence of low levels of this contaminant will be determined by future rounds of sampling. Although there was a noticeable increase in the number of samples reporting detectable levels in both rounds of sampling in 1990, only two sample results were above the MCL. The presence of 1,1,1-trichloroethane was detected at about the same frequency as trichloroethylene and tetrachloroethylene between 1984 and 1990, however, 1,1,1-trichloroethane was detected at levels above the MCL in only twenty of the 9,217 samples or 0.2% of samples collected primarily because the MCL for 1,1,1-trichloroethane is much higher than the MCLs for trichloroethylene and tetrachloroethylene. In order to further investigate the concentrations above the MCL, the number of samples containing levels above 50 ug/l was determined. None of the samples collected in the last three rounds contained levels above 50 ug/l. The box plots in Figures 4 and 5 reveal a general decrease in the values detected over time as reflected by median values, the range of the 25-75 percentiles of the data represented by the boxes, and the whiskers.

The USEPA MCL for 1,1,1-trichloroethane is 200 ug/l. As can be seen in Figure 4, one sample submitted to the bureau for the A-280 program exceeded the federal MCL since the A-280 program began.

Trichloroethylene: MCL = 1 ug/l

According to the frequency distribution data shown in Table 9, the percentages of samples containing no detectable levels of TCE and detectable levels below the MCL appear constant over time. To evaluate the magnitude of the contamination above the MCL, the values were further divided into two categories: above the MCL but less than 10 ug/l and above 10 ug/l. When evaluating the first round of semi-annual test results, it appears that the number of samples with concentrations above the MCL and below 10 ug/l began to decrease since the MCL went into effect in 1989. Also over time, fewer samples had contaminant levels above 10 ug/l. There were no samples with concentrations above 10 ug/l in the last three rounds of sampling. Box plots in Figures 6 and 7 present samples with concentrations above the detection limits. Note that the upper range of the values has also decreased over time. As with 1,1,1-trichloroethane, there is a general decrease in the values detected over time. The median values in the last three out of four rounds of testing are below the MCL.

The federal MCL for trichloroethylene is 5 ug/l. Evaluation of the total number of samples submitted showed that 1.9% of samples submitted exceeded the federal MCL for TCE of 5 ug/l as compared to the 4.2% that exceeded the state MCL of 1 ug/l. The actual number of samples exceeding the federal MCL decreased from 52 in 1985 to zero in 1990.

TABLE 8

FREQUENCY DISTRIBUTION OF SAMPLES BY CONCENTRATION AND BY SAMPLING PERIOD FOR 1,1,1-TRICHLOROETHANE

Concentration Range in ug/L	Sampling Period												
	Initial	P85-1	P85-2	P86-1	P86-2	P87-1	P87-2	P88-1	P88-2	P89-1	P89-2	P90-1	P90-2
1. non-detectable	664 94	717 94	765 95	721 94	699 95	684 94	641 91	643 95	603 92	628 95	575 92	615 90	639 91
2. Detectable and < MCL	39 5.5	44 5.8	38 4.7	44 5.8	33 4.5	41 5.7	62 8.8	36 5.3	47 7.2	34 5.1	52 8.3	69 10	64 9.1
3. > MCL and < 50 ug/L	1 0.14	2 0.26	2 0.25	0 0.00	1 0.14	0 0.00	0 0.00	1 0.15	1 0.15	0 0.00	1 0.16	2 0.29	0 0.00
4. >50 ug/L	1 0.14	1 0.13	2 0.25	0 0.00	2 0.27	0 0.00	0 0.00	0 0.00	2 0.31	1 0.15	0 0.00	0 0.00	0 0.00
Total # of Samples	705	764	807	765	735	725	703	680	653	663	628	686	703

For each concentration range, the top number is the number of samples reported within that sampling period and the bottom number is the percentage of samples within that concentration range for the period. The MCL is 26 ug/L.

FIGURE 4

RANGE AND DISTRIBUTION OF DETECTED VALUES FOR
1,1,1-TRICHLOROETHANE BY SAMPLING PERIOD - BOX PLOT

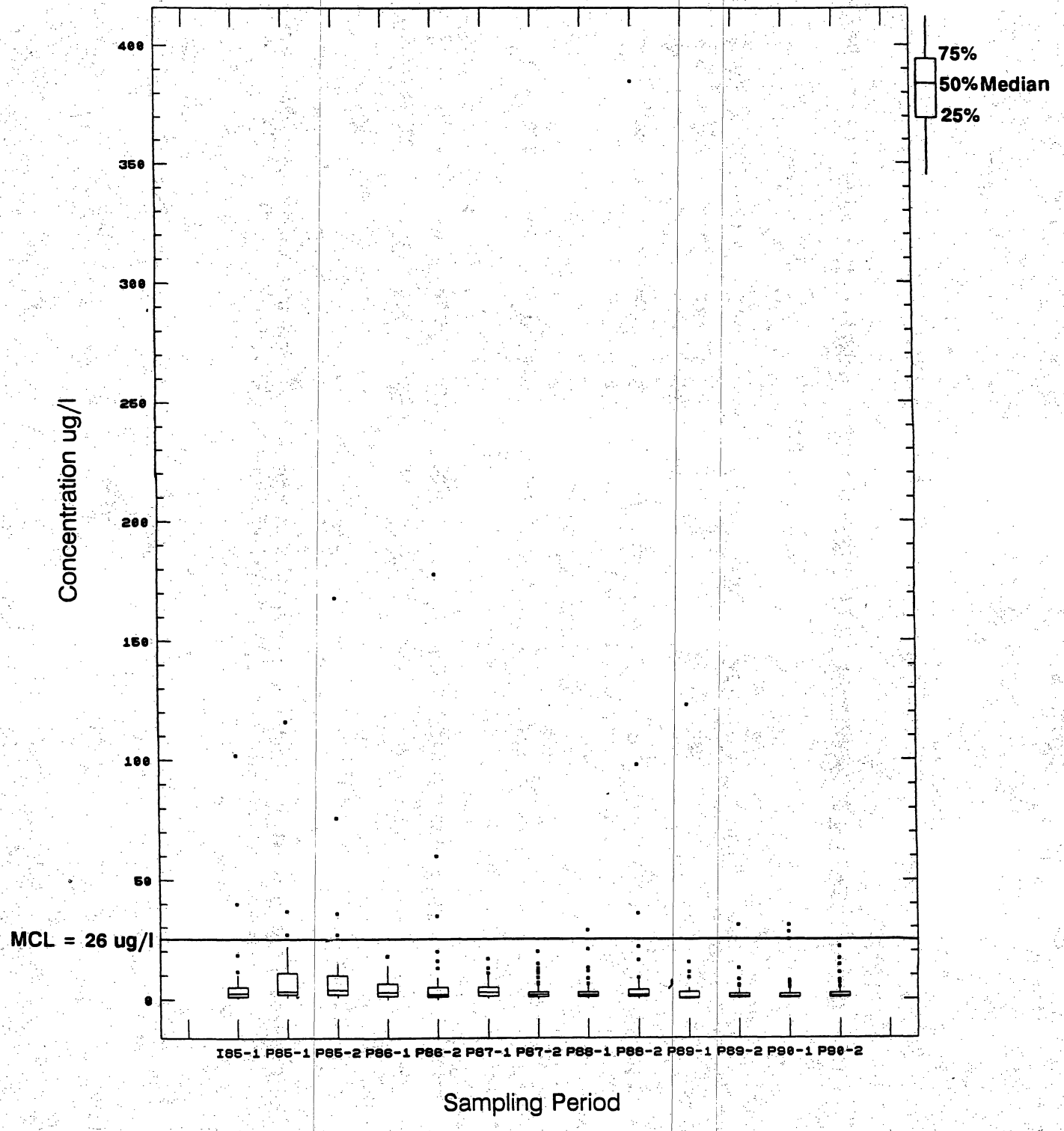


FIGURE 5

RANGE AND DISTRIBUTION OF DETECTED VALUES FOR
1,1,1-TRICHLOROETHANE BY SAMPLING PERIOD - LOG 10 BOX PLOT

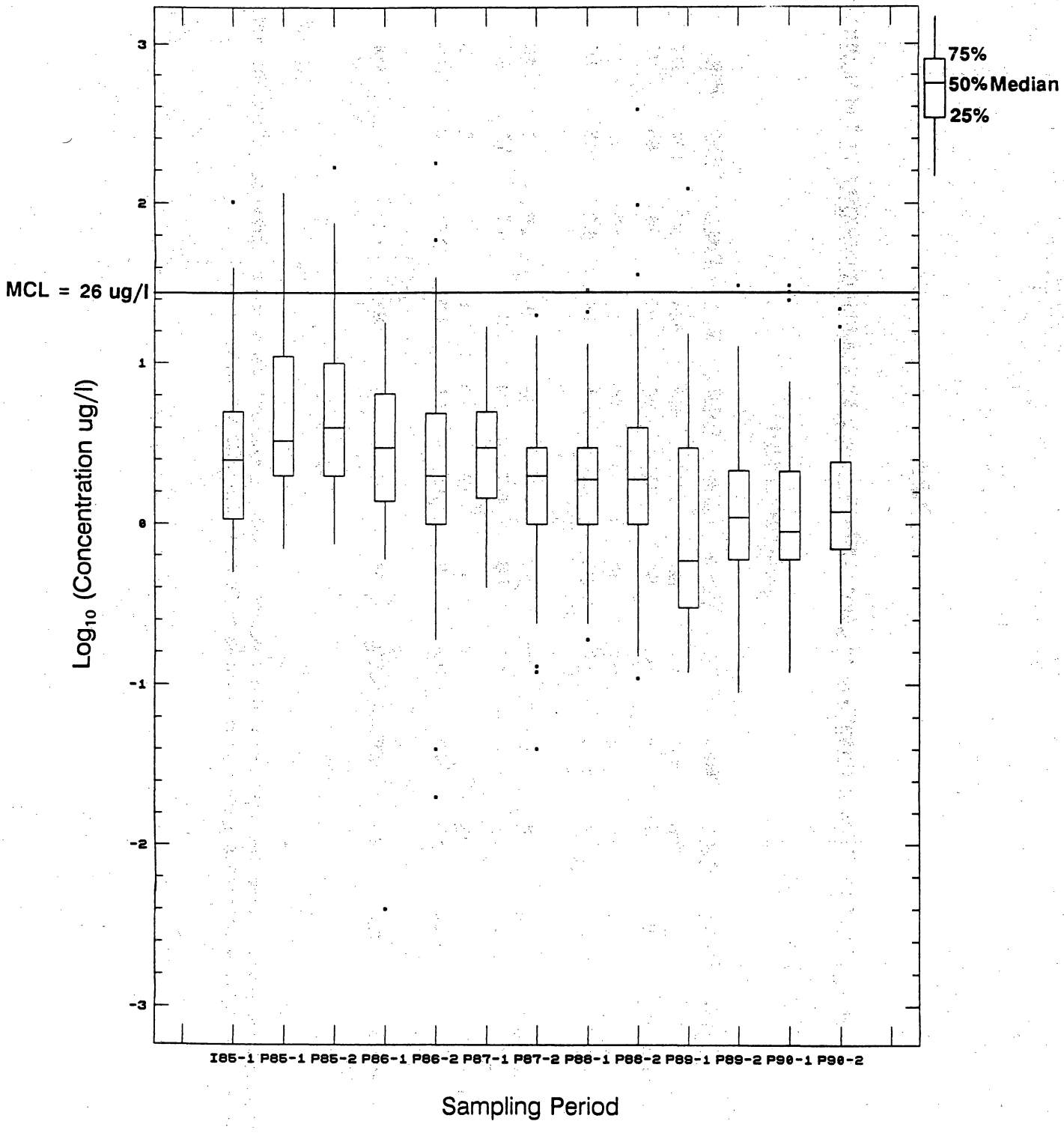


TABLE 9

FREQUENCY DISTRIBUTION OF SAMPLES BY CONCENTRATION AND BY SAMPLING PERIOD FOR TRICHLOROETHYLENE

Concentration Range in ug/L	Sampling Period: Initial	P85-1	P85-2	P86-1	P86-2	P87-1	P87-2	P88-1	P88-2	P89-1	P89-2	P90-1	P90-2
1. non-detectable	656 93	719 94	761 97	707 92	692 94	672 93	653 92	634 93	595 91	631 95	577 93	653 95	673 96
2. Detectable and < MCL	14 2.0	11 1.4	4 0.50	12 1.6	19 2.6	9 1.2	20 2.8	13 1.9	27 4.1	23 3.5	25 4.0	20 2.9	21 3
3. > MCL and < 10 ug/L	28 4.0	18 2.4	25 3.1	31 4.0	13 1.8	27 3.7	28 3.9	25 3.7	26 4.0	7 1.1	26 4.1	11 1.6	9 1.3
4. >10 ug/L	6 0.85	16 2.1	16 2.0	17 2.2	11 1.5	17 2.3	9 1.3	11 1.6	5 0.77	2 0.30	0 0.00	0 0.00	0 0.00
Total # of Samples	704	764	806	767	735	725	710	683	653	663	628	684	703

For each concentration range, the top number is the number of samples reported within that sampling period and the bottom number is the percentage of samples within that concentration range for the period. The MCL is 1 ug/L.

FIGURE 6

RANGE AND DISTRIBUTION OF DETECTED VALUES FOR TRICHLOROETHYLENE BY SAMPLING PERIOD - BOX PLOT

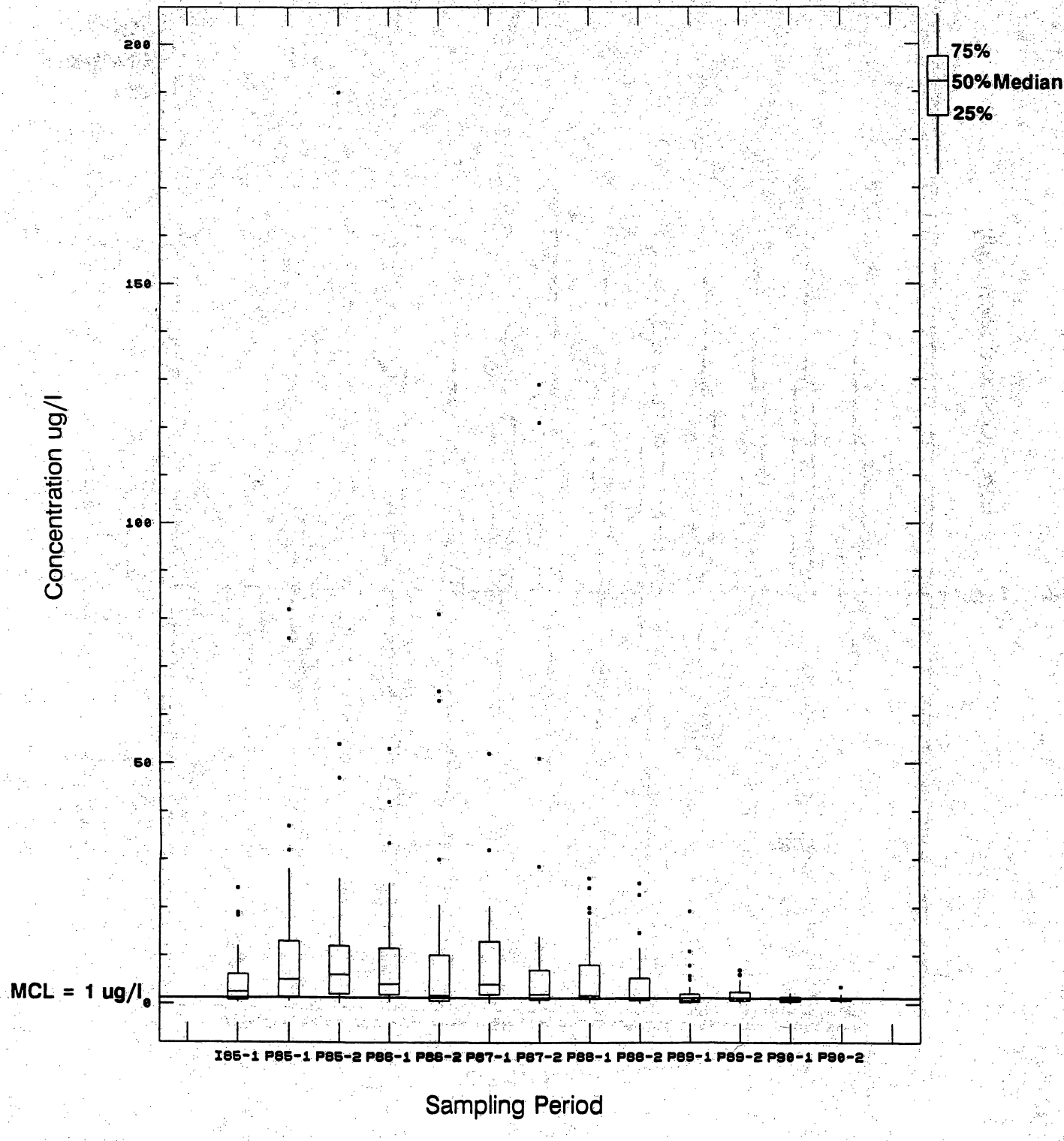


FIGURE 7

RANGE AND DISTRIBUTION OF DETECTED VALUES FOR TRICHLOROETHYLENE BY SAMPLING PERIOD - LOG 10 BOX PLOT

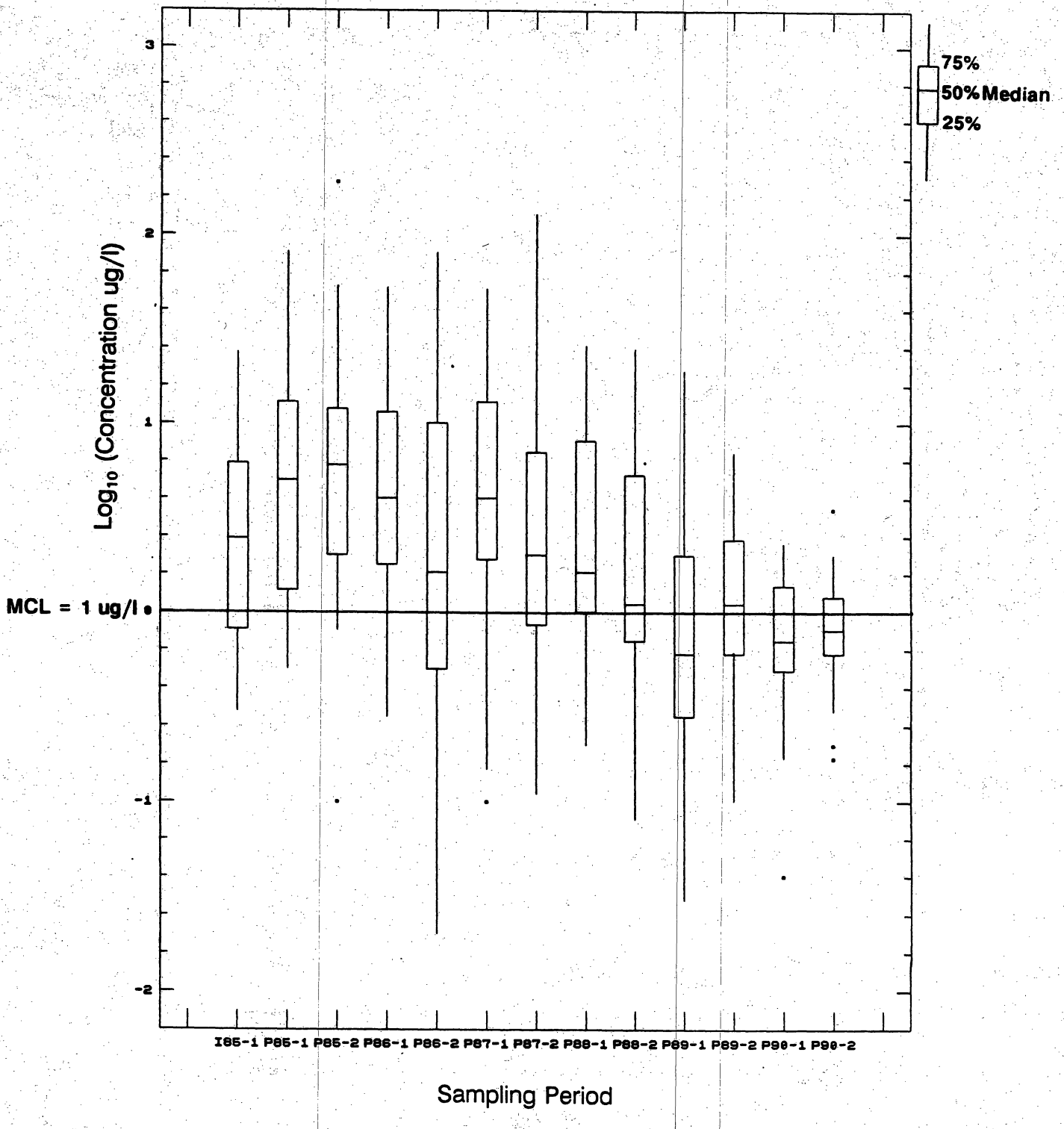


TABLE 10

FREQUENCY DISTRIBUTION OF SAMPLES BY CONCENTRATION AND BY SAMPLING PERIOD FOR TETRACHLOROETHYLENE

Concentration Range in ug/L	Sampling Period												
	Initial	P85-1	P85-2	P86-1	P86-2	P87-1	P87-2	P88-1	P88-2	P89-1	P89-2	P90-1	P90-2
1. non-detectable	659 94	715 94	754 93	709 93	704 96	672 93	666 94	629 93	601 92	636 96	586 93	649 95	677 96
2. Detectable and < MCL	11 1.6	5 0.66	3 0.37	12 1.6	10 1.4	16 2.2	14 2.0	15 2.2	12 1.8	16 2.4	26 4.1	18 2.6	13 1.9
3. > MCL and < 10 ug/L	21 3.0	32 4.2	36 4.5	31 4.1	15 2.0	30 4.1	23 3.2	28 4.1	31 4.8	9 1.4	14 2.2	18 2.6	11 1.6
4. >10 ug/L	13 1.9	11 1.4	14 1.7	14 1.8	7 0.95	7 0.97	6 0.85	8 1.2	9 1.4	1 0.15	3 0.48	1 0.15	2 0.28
Total # of Samples	704	763	807	766	736	725	709	680	653	662	629	686	703

For each concentration range, the top number is the number of samples reported within that sampling period and the bottom number is the percentage of samples within that concentration range for the period. The MCL is 1 ug/L.

FIGURE 8

RANGE AND DISTRIBUTION OF DETECTED VALUES FOR TETRACHLOROETHYLENE BY SAMPLING PERIOD - BOX PLOT

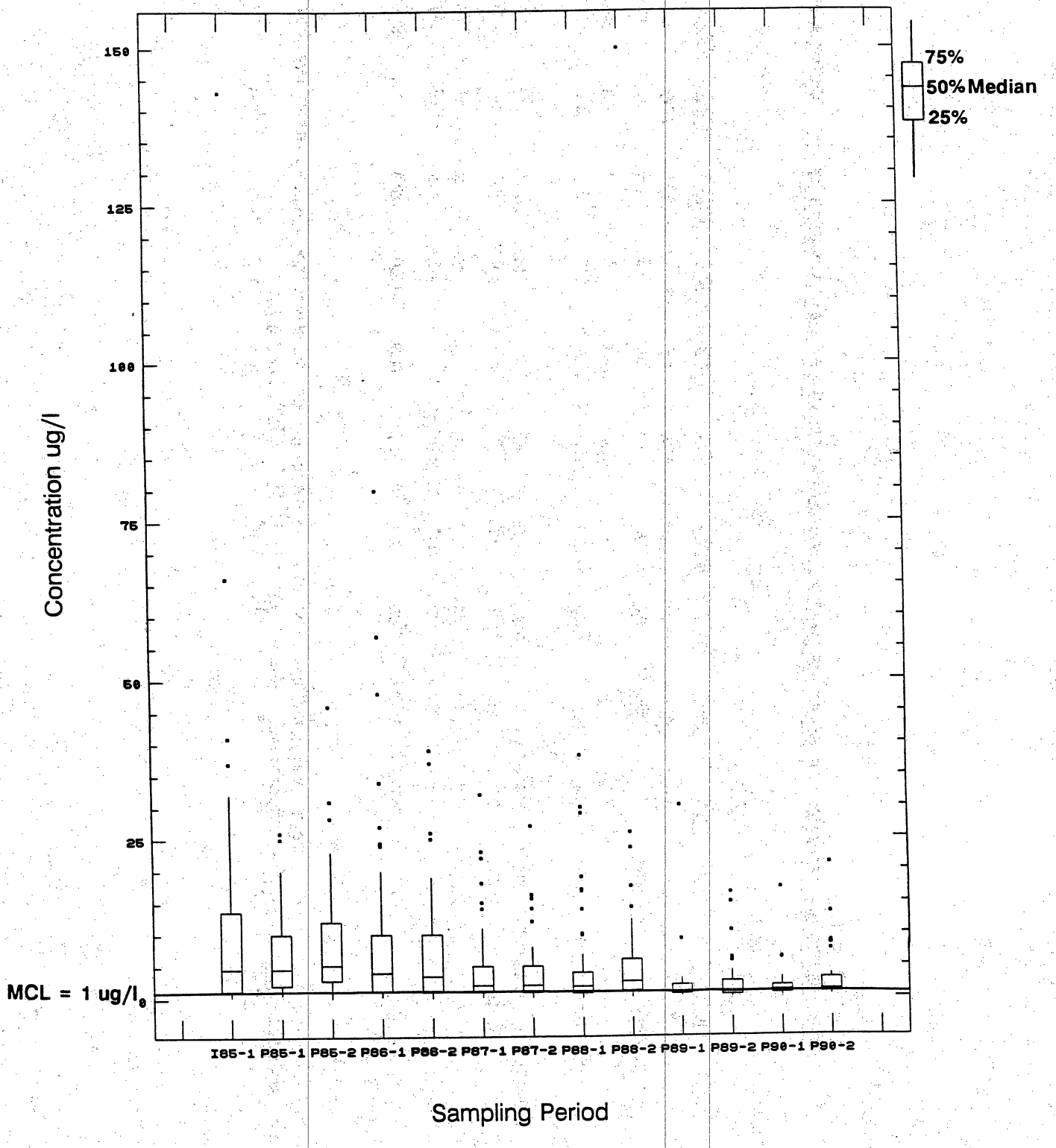
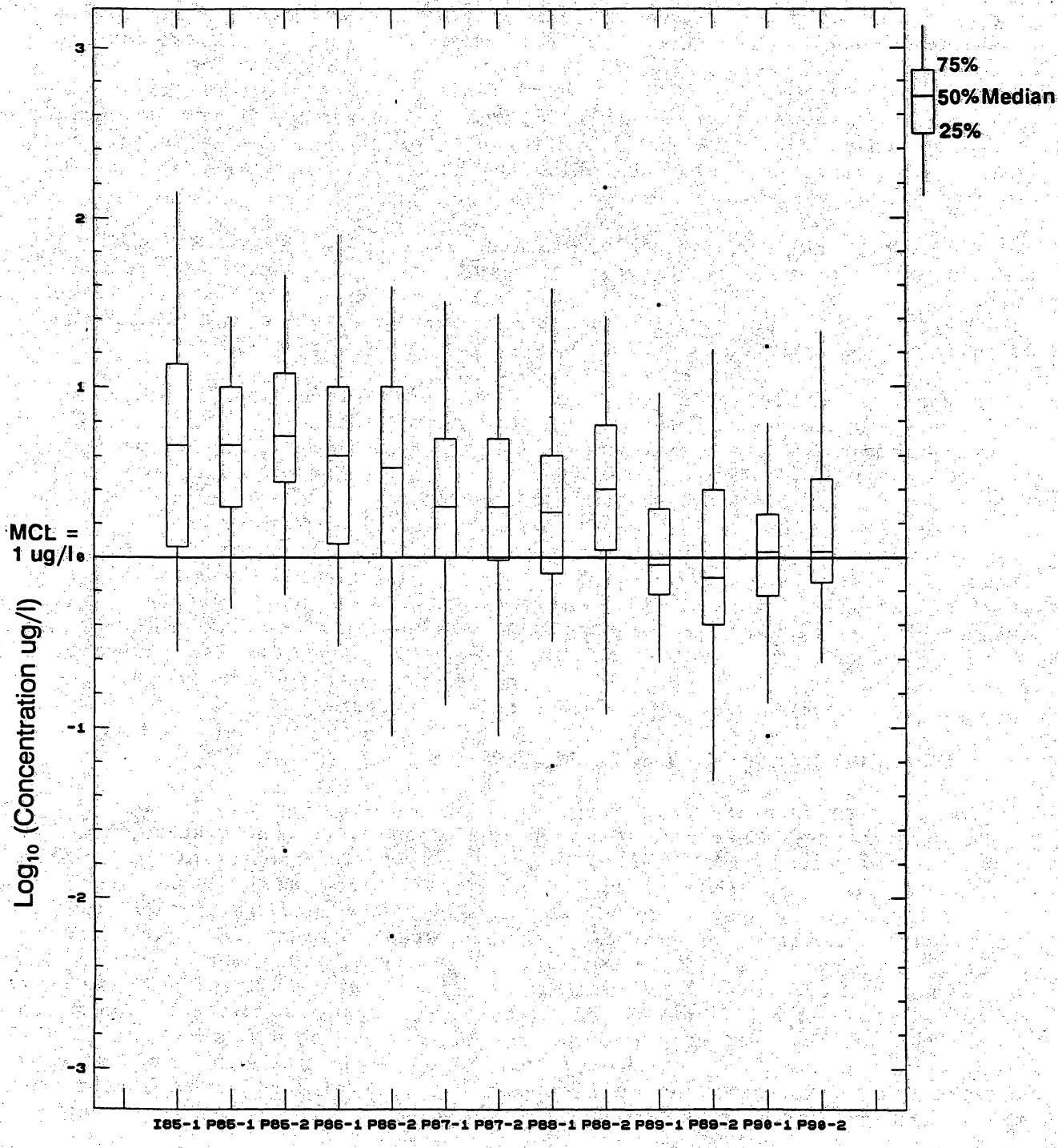


FIGURE 9

RANGE AND DISTRIBUTION OF DETECTED VALUES FOR TETRACHLOROETHYLENE BY SAMPLING PERIOD - LOG 10 BOX PLOT



Tetrachloroethylene: MCL = 1 ug/l

The frequency distributions of tetrachloroethylene, provided in Table 10, parallel those of trichloroethylene. The percentages of samples containing no detectable levels and levels less than the MCL appear to remain constant over time. An assessment of the magnitude of the contamination above the MCL was completed using the ranges of concentrations as were used to evaluate trichloroethylene. It appears that the number of samples with concentrations of tetrachloroethylene above the MCL and below 10 ug/l began to decrease after the MCL went into effect in 1989. Over time, fewer samples had levels of the contaminant in concentrations above 10 ug/l. Box plots for tetrachloroethylene are presented in Figures 8 and 9. The median values for the last four rounds of testing are either just above or below the MCL. This is similar to the decrease seen for trichloroethylene.

The federal MCL for tetrachloroethylene is 5 ug/l. When the total number of samples submitted were evaluated with respect to this federal MCL, as with TCE, fewer samples exceeded the federal MCL (1.8% vs 4.3%) for PCE than the State MCL of 1 ug/l. The actual number of samples exceeding the federal MCL decreased from 60 in 1985 to 8 in 1990.

A preliminary review of U.S. production (U.S. International Trade Commission, 1980-1990) and N.J. use (NJDEPE, 1989; Community Right to Know, 1990) of the three chemicals indicates increased use of 1,1,1-trichloroethane and decreased use of tetrachloroethylene from 1980-1990. The reported increased use of 1,1,1-trichloroethane may be a contributory factor to what appears to be a 1990 increase in reported 1,1,1-trichloroethane trace contamination levels in New Jersey's water supplies. The trends with trichloroethylene are not as clear. TCE production decreased from 1970-1980, however, the decreases from 1980-1990 are only implied. Only two manufacturers were listed after 1981, and their production quantities are confidential. In addition, the number of reported major facilities ($\geq$25,000 pounds manufactured or $\geq$10,000 pounds otherwise used) reporting TCE has decreased from 1988-1990. A more detailed evaluation of use patterns in NJ counties with continued detectable levels is in progress.

3. PROFILE OF SYSTEMS DETECTING CONTAMINATION

In order to identify any common characteristics among public community water systems which have repeatedly reported the presence of contaminants, the systems were analyzed according to several factors which include source of the water, size of the system and location by county. The fact that a purveyor reports contamination in a given round of sampling does not in itself indicate a significant contamination problem, because repeat sampling may not confirm the original reported level of contamination. Until mid-1989 when the requirements for submitting QC forms became mandatory, inadequate or missing QC information prevented the identification of laboratory contamination in some cases. Currently, detected values attributed to laboratory contamination are labeled as such. For the purposes of this report, all purveyors reporting any detected contamination (excluding lab contamination) were evaluated as to whether or not the situation could be considered persistent according to the following criteria:

Pre-MCL

A system was considered to have been persistently reporting pre-MCL contamination (i.e., prior to the implementation of the MCLs in January, 1989), if

the purveyor reported the presence of any contaminant in more than half of the samples collected from 1984 through 1988. In other words, the purveyor would have reported detected contamination in 5 or more of the 9 rounds of sampling (initial through the second round of 1988 sampling). A total of 49 PCWS or approximately 8% of the PCWS met this definition.

Current or Post-MCL

Systems reporting the detection of contaminants in more than half of the samples collected in 1989 and 1990 were identified as having persistent post-MCL contamination. The purveyors would have reported contamination in 3 or more of the 4 rounds of sampling (first round of 1989 sampling through the second round of 1990 sampling). Forty-nine PCWS or approximately 8% of the PCWS met this criterion. The systems may or may not have ever reported levels above the MCL.

Based on the above definitions of persistent pre- and post-MCL contamination, the bureau targeted a total of 76 purveyors (approximately 12% of all purveyors) for a water quality evaluation. These systems were evaluated further for common characteristics. The first characteristic investigated was the water source. A comparison between ground and surface water sources revealed that the contaminated source for 74 of 76 systems was groundwater. This is not surprising given the nature of the A-280 contaminants, which are primarily volatile compounds. The two surface water systems reporting contamination are located downstream of publicly owned treatment works (sewage treatment plants) or direct industrial dischargers.

The second characteristic investigated was the size of the system. Table 10 provides a breakdown of the number of PCWS in each size category based on the number of people served and the number in each category reporting persistent pre and post-MCL contamination. There was a slight increase in the number of small and large sized systems reporting persistent post-MCL contamination while the number of medium sized systems decreased (see Table 11). The greatest number of supplies with persistent post-MCL contamination was found in small systems.

Table 12 presents the reporting profile of systems based on location by county, size of system and date of sampling relative to the MCLs taking effect. The percentage of water systems reporting persistent pre- and post- MCL contamination on a county basis is listed after each total. Due to the differences in the number of systems in each county, and the relatively low member of systems reporting persistent contamination it is not possible to conduct an in-depth comparison of water quality among the counties. Morris County, the county with the largest number of public community water systems along with Sussex County, had the greatest absolute number of water supplies with pre- and post- MCL persistent contamination. A comparison of the number of systems reporting persistent pre-MCL contamination to the number with post-MCL contamination shows that more counties experienced either a decrease or no change. Figure 10 shows a map of New Jersey counties. Of the 21 counties in the State, four counties (Cape May, Hudson, Mercer and Salem) have never had any systems with persistent contamination before or after the MCLs went into effect. Another two counties (Atlantic and Union) have had no change in the number of systems persistently reporting contamination. Seven counties reported a decrease in the number of systems with problems: Bergen, Camden, Cumberland, Essex, Ocean, Passaic and Sussex. Eight counties reported a net increase in the number of systems persistently reporting contamination, four of which had no problem systems prior to 1989 (Burlington, Middlesex, Monmouth and Warren) and four of which did (Gloucester, Hunterdon, Morris and Somerset). Middlesex County showed the

TABLE 11

Public Community Waters Systems with Persistent Contamination by Size

	Total # of Systems	Pre-MCL #	Pre-MCL %	Post-MCL #	Post-MCL %	Pre and Post MCL
Small (25-10,000 people)	497	22	(4)	26	(5)	8
Medium (10,000-50,000 people)	112	23	(21)	18	(16)	12
Large (>50,000 people)	26	4	(15)	5	(19)	2
Total	635	49		49		22

TABLE 12

SUMMARY OF SYSTEMS TARGETED FOR PRE- AND POST MCL WATER QUALITY EVALUATION BY SIZE AND BY COUNTY

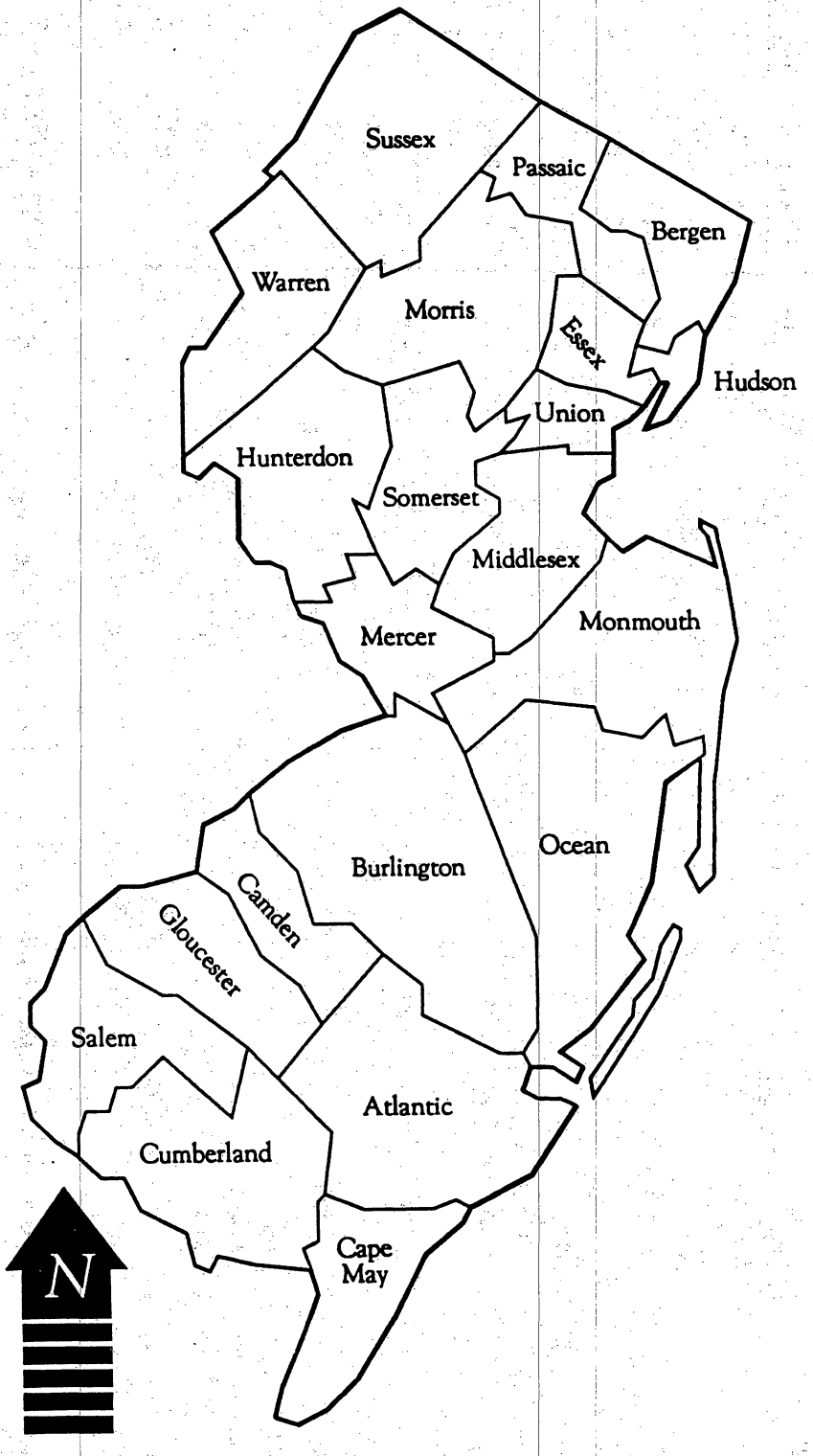
County Name	Total PCWS	SMALL		MEDIUM		LARGE		TOTALS			
		Pre MCL	Post MCL	Pre MCL	Post MCL	Pre MCL	Post MCL	Pre MCL		Post MCL	
Atlantic	36	4	4	-	-	-	-	4	11%	4	11%
Bergen	20	-	1	4	3	1	-	5	25%	4	20%
Burlington	51	-	-	-	1	-	-	-		1	<1%
Camden	25	-	-	4	2	-	1	4	16%	2	8%
Cape May	30	-	-	-	-	-	-	-		-	
Cumberland	18	-	-	3	1	-	-	3	17%	1	6%
Essex	20	1	1	4	2	1	-	6	30%	3	15%
Gloucester	28	1	2	-	-	-	-	1	4%	2	7%
Hudson	6	-	-	-	-	-	-	-		-	
Hunterdon	21	1	1	-	1	-	-	1	5%	2	10%
Mercer	10	-	-	-	-	-	-	-		-	
Middlesex	19	-	2	-	1	-	2	-		5	26%
Monmouth	44	-	1	-	-	-	-	-		1	2%
Morris	78	5	6	3	5	1	1	9	12%	12	15%
Ocean	72	4	2	2	-	1	1	7	10%	3	4%
Passaic	28	1	-	2	1	-	1	3	11%	2	7%
Salem	13	-	-	-	-	-	-	-		-	
Somerset	8	1	2	-	-	-	-	1	12%	2	25%
Sussex	78	4	3	-	-	-	-	4	5%	3	4%
Union	4	-	-	1	1	-	-	1	25%	1	25%
Warren	26	-	1	-	-	-	-	-		1	4%
Totals	635	22	26	23	18	4	5	49		49	

PRE-MCL: PCWS reporting any detected contamination in 5 or more out of 9 rounds of period samples collected between Initial through 1988 (>50%).

POST-MCL: PCWS reporting any detected contamination in at least three out of 4 rounds of period samples collected during 1989 and 1990 (>50%).

FIGURE 10

MAP OF NEW JERSEY COUNTIES



greatest increase in the number of systems consistently reporting post-MCL contamination while Ocean County reported the greatest decrease.

Forty-nine systems reported persistent pre-MCL contamination, twenty-seven of which corrected the problems by 1989. Forty-nine systems reported persistent post-MCL contamination, twenty-seven of which were systems which had no prior history of contamination and twenty-two of which had historical contamination problems. A breakdown of the twenty-two systems by size includes two large, twelve medium and eight small systems.

4. PCWS RESPONSE TO CONTAMINATION

A key question to determining the effectiveness of the A-280 program in improving drinking water quality is: Have the MCL regulations resulted in the purveyors taking action to address contamination problems? An evaluation of those systems which reported problems before and after the MCLs went into effect revealed that 27 of the 49 (or 55%) systems with persistent pre-MCL contamination corrected the problem by the time the MCLs took effect in early 1989. As the program progresses, the department expects to see systems take immediate corrective action upon discovery of new cases of contamination. An estimated 265 public community wells have reported unacceptable levels of volatile organic compounds since testing began in 1984. More economical sources of water were found for a number of these wells. To date, the Department has approved construction permits for 52 treatment and transmission facilities totaling over 34.7 million dollars. A summary of the number of projects approved to treat VOC contamination in order to comply with the A-280 standards is provided in Table 13.

Although the DEPE does not track where the funding for these improvements comes from, we know that most of the improvements made have been with funds from the utilities. There are state funding sources that can be used to upgrade water utilities, such as the Spill Compensation Fund, Hazardous Discharge Bond Fund and the Water Supply Loan Program. Each water supply case is individually evaluated to determine if an appropriate funding source exists.

5. SUMMARY

Between 1985 and 1990, 71-81% of the PCWS did not detect any level of contamination with the A-280 contaminants. Each A-280 sample result reported to the department contains analytical results for approximately 17 different synthetic organic chemicals; only 2% of these analytical results received annually reported the presence of the A-280 contaminants (plus isomers). Although analyses of temporal water quality trends are limited for the reasons identified at the beginning of this section, the general conclusions to be drawn from the information indicate that contamination problems are being identified and addressed and that water quality has been improving. Specifically, even though analytical methods and laboratories are capable of routinely detecting lower levels of contaminants than could previously be detected, the percentage of systems reporting non-detectable contamination has remained relatively constant. The percentage of systems with levels of contamination greater than the 1989 MCLs is clearly decreasing. This improvement is the result of the construction of treatment facilities to remove volatile organic compounds as well as the use of alternative sources of water supply. Of the contaminants found, the three most commonly reported were 1,1,1-trichloroethane, trichloroethylene and tetrachloroethylene. Almost all of the VOC contamination identified was associated with groundwater sources.

TABLE 13

Summary of Projects Submitted, and Approved* to Treat Volatile Organic Chemicals Regulated by the A-280 Program

	1985	1986	1987	1988	1989	1990	1991
# of Projects Submitted	4	4	8	5	7	22	13
# of Projects Approved*							
GAC[1] Treatment	1	1	-	-	1	3	-
AS[2] Treatment	1	3	4	4	5	13	11
Combination of GAC and AS	-	-	3	-	-	-	-
Transmission Line	-	-	-	-	-	2	-
Estimated Cost (Millions of Dollars)	1.4	2.5	5.0	3.6	2.4	10.5	9.3

1 - GAC: Granulated Activated Carbon
2 - AS: Air Stripper (Packed Tower Aeration)
* - Applicant has three years to complete project once approved by the Bureau of Safe Drinking Water.

SECTION III: ACHIEVEMENTS AND DIRECTIONS OF THE SAFE DRINKING WATER PROGRAM

1. ACCOMPLISHMENTS

The Department of Environmental Protection and Energy, as directed by the Legislature, accomplished the following within twelve months of the passage of the A-280 Amendments. The Department:

* Revised the laboratory certification regulations to include methods for analyzing VOCs, PCBs and chlordane in drinking water and began certifying laboratories for the hazardous contaminants testing program;

* Revised the Safe Drinking Water Act monitoring regulations to include 16 hazardous contaminants identified by the A-280 Amendments;

* Informed the approximately 630 public community water systems of their monitoring responsibilities under this new program; and

* Began collecting and assessing monitoring results submitted by the 630 public community water systems (NJDEP, 1986b; Krietzman et al., 1987). This monitoring began in New Jersey ahead of the federal requirements for testing for the hazardous organics. These results create a unique data base which provides a continuous record of drinking water quality provided to New Jersey public water supply consumers for the 16 hazardous contaminants.

* Established a drinking water research program.

Numerous other tasks accomplished since the development of the A-280 program include the following (detailed descriptions of each task can be found in the Section noted by parenthesis):

* Establishment of the New Jersey Drinking Water Quality Institute (Section I.1.A.).

* Assessment of the levels of contaminants in the water supply systems (NJDEP, 1986b; Krietzman et al., 1987; McGeorge et al., 1987; Section II.B.).

* Development of "Interim Guidelines, Action Levels and Recommendations for Selected Organics in Drinking Water" until final MCLs and regulations were adopted (Appendix B).

* Adoption of final MCLs and regulations (Section I.1.B).

* Publication of the Special Water Treatment Study to identify treatment methods.

* Remediation of the contaminated drinking water source either by the construction of treatment facilities or by removing wells from service (Section II.3).

2. DRINKING WATER QUALITY RESEARCH

Many of the accomplishments listed above were possible because of the department's drinking water research and related technical support program. As described in the A-280 amendments, the focus of New Jersey's drinking water

research program is to investigate the sources, occurrence, transport, treatment and potential effects of contaminants in potable water. This comprehensive state research program which is targeted specifically toward a better understanding of drinking water contamination, provides New Jersey with unique information on which to build a sound foundation for its water quality evaluation and improvement efforts.

The research program is managed by scientists within DSR and is conducted utilizing in-house expertise as well as assistance from external scientists. Many of the past research and technical support activities, which were key to the development of the MCLs and the overall implementation of the A-280 amendments, related to human health risk assessment and analytical methodologies. A number of these completed research/technical evaluation studies are listed below with their related investigator's institutions. Current research activities are listed in the following section. For more information regarding any individual study, DSR should be contacted.

Health Effects Evaluations

"Assessment of Candidate Studies for Derivation of MCL Values for 22 Selected Drinking Water Contaminants." (ICAIR Life Systems, Inc., 1985).

"MCL Peer Reviews for the Office of Science and Research, NJDEPE." (ICF Clement, 1986).

"Quantitative Risk Assessment for Selected Volatile Organics in Drinking Water." (K.S. Crump and Company, Inc., 1986).

"Epidemiologic Analysis of Benzene." (K.S. Crump and Company, Inc., 1986).

Analytical Methods Evaluation

"USEPA 600 Series Validation Study." (Rutgers University, 1986).

"Analytical Method Development for A-280 Compounds." (Battelle Laboratories, 1989).

"Determination of Practical Quantitation Levels for Organic Compounds in Drinking Water." (DSR, 1989).

3. CURRENT ACTIVITIES

The department and the Institute continue to work together to develop MCLs for additional compounds as well as to evaluate new health effects information on regulated contaminants, review new federal rulings and proposals and revise existing MCLs. Appendix B provides a complete listing of all contaminants currently regulated under state and federal programs as well as those scheduled for future regulation.

The bureau is presently updating the department's regulations regarding all aspects of operating both public and nonpublic drinking water systems. The revisions will include updated and new construction standards, and all current New Jersey MCLs and testing requirements. The revisions will be consistent with recent USEPA rulings and are expected to be proposed by the end of 1992. The focus on fostering communication between the regulators and the regulated community and ongoing research provides the tools required for responsible management and planning of the state's drinking water program.

A. Current Drinking Water Quality Program Activities

1. Develop MCLs for the remaining 2a list contaminants. The department is conducting research studies to develop analytical techniques for the four remaining 2a list contaminants ethylene glycol, formaldehyde, n-hexane and methyl ethyl ketone. Methyl ethyl ketone and n-hexane can be analyzed using a modification to an existing USEPA analytical method. Outstanding issues regarding ethylene glycol analysis are currently being evaluated by department staff. Health-based levels for these contaminants were developed in 1987 and need to be updated. Treatment techniques for these contaminants also need further evaluation. The occurrence of these four contaminants in New Jersey's public water supplies is unknown. The listed contaminant kerosene is actually a mixture of contaminants and the department has suggested replacing it with naphthalene which is a component of kerosene. Naphthalene is a 2b list contaminant.

2. Develop MCLs for the 2b list contaminants. A variety of outstanding issues remain before MCLs can be established. Health-based levels have been developed for all six of the selected 2b contaminants which need to be updated if more current information is now available. The program expects to recommend MCLs for 1,1-dichloroethane, 1,1,2-trichloroethane, 1,1,2,2-tetra- chloroethane, naphthalene and methyl tertiary butyl ether in the near future. Further evaluation of the treatability of 2,4,6-trichlorophenol to health-based levels is required.

3. Identify new contaminants to regulate. The department is continually reviewing new drinking water occurrence studies for contaminants of concern. This information is used in conjunction with contaminant occurrence information gathered from other department programs for possible contaminant candidates. Reliable analytical methods for the candidate compounds are reviewed when available.

4. Review proposed USEPA MCLs for consistency with the A-280 legislation. The A-280 legislation directs that MCLs for carcinogens be set at the level which permits an increase of cancer incidence in no more than one in a million (10^{-6} theoretical risk level) persons ingesting that contaminant in drinking water over a lifetime. These health-based MCLs are modified based on technological and analytical factors. The USEPA has proposed MCLs for regulated carcinogens at levels ranging from one in a million to one in ten thousand (10^{-4}) risk levels. For those federal proposed standards which exceed the A-280 target risk level the program evaluates the practicability and feasibility of quantifying and removing the contaminant to the 10^{-6} risk level.

5. Correlate water quality data with health effects information. The bureau has collected and organized a comprehensive database characterizing New Jersey's drinking water quality. The A-280 analysis results form a unique data base for assessing potential exposure to VOCs and trihalomethanes providing part

of the basis for studies by the Department of Health to determine if exposures correlate with selected health outcomes.

6. Review previously set health-based MCLs. As new health studies are published, the rationale for setting a health-based MCL is evaluated. The Lists and Levels Subcommittee is presently reevaluating several health-based MCLs for 2a and 2b list contaminants for which new information has become available.

7. Promote improved relations with certified laboratories. The bureau and Office of Quality Assurance (OQA) periodically meet with the certified laboratories to explain reporting requirements and form processing. These meetings promote communication between the commercial laboratories and A-280 program staff and foster the resolution of problems associated with the laboratories.

B. Current Drinking Water Quality Research Activities

As previously described, New Jersey has a unique state drinking water research program which focuses on potable water quality issues. Major categories of current investigation include the following: (1) sampling methods, (2) analytical methods, (3) contaminant occurrence in New Jersey water supplies, including both regulated and unregulated substances, (4) human health effects of contaminants, (5) treatment techniques, (6) microbiological contaminant occurrence and (7) the vulnerability of water supplies to contamination. Some examples of ongoing research efforts in these various areas are listed below.

1. Development and application of methods for the determination of disinfection by-products. Disinfection practices used to control microbial pathogens in drinking water also produce generally low levels of disinfection by-product contaminants. New Jersey is among the few states using the new draft USEPA methods for analyzing the occurrence of disinfection by-products (e.g., haloacids, aldehydes and amines) beyond the trihalomethanes. Currently, a number of public water systems in the state are being sampled to investigate the potential for the formation of these disinfection by-products. This information will be used to guide policy decisions on the regulation of disinfection techniques and their by-products.

2. Investigation of methods for developing Practical Quantitation Levels. Previously, the Institute utilized interlaboratory studies to determine what levels of contaminants could be reliably quantified by certified laboratories. Although this approach is preferred, it is labor intensive, time consuming and expensive. DSR is currently evaluating other techniques for developing PQLs which would be used to identify target levels in a more efficient manner.

3. Development and implementation of approaches to conduct pesticide vulnerability assessments. Recent federal regulations offer states the option to require monitoring for pesticides only where supplies are likely to be vulnerable due to pesticide usage patterns and/or general susceptibility of the raw water resource itself. Such a process promotes efficient use of monitoring resources in those areas where contamination is most likely to occur. New Jersey is developing a technical approach which will evaluate the susceptibility of each source of water to pesticide contamination, taking both pesticide use and hydrogeologic factors into account.

4. Evaluation of routes of exposure to contaminants other than ingestion. Ingestion has generally been the only path of exposure to contaminants in drinking water considered for the development of health-based MCLs by New Jersey and by USEPA. The relative contribution of two additional routes of exposure, inhalation and dermal absorption, is being evaluated. Contributions of these additional routes may lead to the revision of some state health-based MCLs.

5. Correlation of water quality parameters with the occurrence of lead and copper in school drinking water. There is increasing concern regarding the potential health effects of exposure to low levels of lead. This concern is particularly strong for children, as they represent a susceptible population to the effects of this metal. This study provides an assessment of the lead and copper levels in New Jersey school drinking water, and their relationship to other water quality and plumbing characteristics.

6. Evaluation of mercury levels in groundwater. Levels of mercury exceeding the federal and state MCL of 2 ug/l have been detected in numerous groundwaters sampled in South Jersey. These levels have ranged up to 60 ug/l. The potential human health effects of mercury exposure, as well as the investigation of possible sources of this contamination, partially depend on understanding the form of mercury which is present. This study evaluates the species of mercury present in these South Jersey potable water supplies.

Many of the above ongoing projects, as well as a number of completed research projects, were recently presented at a DSR/Institute sponsored Drinking Water Research Symposium held in Trenton in April of 1992. This major technology transfer effort attracted 180 participants from the purveyor community, academia, environmental consultants, environmental groups, the legislative branch, USEPA, and the department and NJDOH. The department will continue to use similar technology transfer mechanisms to relay the findings of its research efforts to those involved and interested in New Jersey's drinking water quality.

4. Future Issues

Initially, the A-280 program was designed to fill a void left by the federal program by addressing volatile organic compound contamination of drinking water. This program was successfully initiated well in advance of federal mandates. With recent EPA rulings closing the gap in developing standards for the regulation of numerous VOC and pesticide contaminants, the program will continue to address drinking water contaminants of concern to New Jersey.

As USEPA increases regulation of nontransient, noncommunity systems, the drinking water program will be expanding to meet the needs of smaller systems. Many of these systems are operated by part-time staff and rely on the state for essential technical and regulatory assistance. Under the auspices of the USEPA Mobilization Program and in conjunction with the New Jersey Rural Water Association, the bureau conducted seminars in March 1992 to update the approximately 1200 nontransient noncommunity systems and the local health officers on recent changes in regulations and monitoring requirements. The bureau will schedule seminars on similar topics in the future.

The drinking water program will expand in the future to meet the needs of the public and purveyors by providing educational assistance on safe drinking water issues. Once considered a simple issue, the definition of safe drinking water is becoming more dynamic and complicated as the Department and USEPA continues to

promulgate new regulations for a growing number of contaminants. Since consumers are often receive numerous media messages and solicitations containing conflicting information about drinking water, consumers are concerned about the safety of their public water supply. For many purveyors, especially smaller ones, the department is a resource for assistance with the concerns about drinking water quality posed by the public, for understanding new regulations and for resolving problems. The bureau plans to further educate the general public, the purveyors, certified laboratories and health officers through publications, newsletters and seminars.

References

1. 40 Code of Federal Regulations Part 136. Guidelines Establishing Test Procedures for the Analysis of Pollutants.

2. 40 Code of Federal Regulations 141.32. Public notification.

3. 40 Code of Federal Regulations 141.61. Maximum contaminant levels for organic contaminants.

4. Krietzman, S., G. Bukowski, D. Leslie, L. McGeorge, J. Oxenford. 1987. Results of Testing for Hazardous Contaminants in Public Water Supplies Under Assembly Bill A-280. Periodic Testing Intervals: January 9 through June 30, 1985 and July 1 through December 31, 1985. Final Report.

5. McGeorge, L., S. Krietzman, G. Bukowski, B. Hamill. 1987. Implementation and Results of a Mandatory Statewide Program for Organic Contaminant Analysis of Delivered Water. Presented at the AWWA Water Quality Technology Conference, Baltimore, Maryland.

6. Methods for the Determination of Organic Compounds in Drinking Water, 1988. EPA - 600/4-88/039, December 1988.

7. NJDEP, 1986a. Drinking Water Guidance. Interim Action Levels and Recommendations for Responses for Selected Organics in Drinking Water. Office of Science and Research and Division of Water Resources. January, 1986.

8. NJDEP, 1986b. Final Report. Results of Initial Testing for Hazardous Contaminants in Public Water Supplies Under Assembly Bill A-280 through January 9, 1985. Office of Science and Research and Division of Water Resources.

9. NJDEPE, 1989. The Community Right to Know Annual Report for the Survey Year 1989, Bureau of Hazardous Substances Information.

10. NJDEPE. Unpublished data for the 1990 Community Right to Know reporting year, Bureau of Hazardous Substances Information.

11. New Jersey Drinking Water Quality Institute, 1987. Maximum Contaminant Level Recommendations for Hazardous Contaminants in Drinking Water.

12. Oxenford, J., L. McGeorge, S. Jenniss. 1989. Determination of Practical Quantitation Levels for Organic Compounds in Drinking Water. Journal AWWA, April. 149-154.

13. Tucker, R. 1981. Groundwater Quality in New Jersey. An Investigation of Toxic Contaminants. New Jersey Department of Environmental Protection Report, Office of Toxic Substances and Cancer Research.

14. U.S. International Trade Commission. Synthetic Organic Chemicals, United States Production and Sales, 1980-1990, Washington, D.C..

15. Warner, J., M. Bicking, H. Burkholder, D. Zimmerman. 1989. Analytical Method Development for A-280 Compounds. Battelle Laboratories, Columbus Division, Ohio. Report to the Division of Science and Research, NJDEPE.

16. Westrick, J., J. Mello, R. Thomas 1984. The Groundwater Supply Survey. Journal AWWA, May. 52-59.

APPENDIX A

MEMBERS OF THE NEW JERSEY DRINKING WATER QUALITY INSTITUTE

The New Jersey Drinking Water Quality Institute (Institute) is a fifteen member body created by amendments to the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq., P.L. 1977, C.224 as amended and supplemented by P.L. 1983, C.443). Nine members are appointed, three by the Speaker of the General Assembly, three by the President of the Senate and three by the Governor and represent major purveyors, the academic scientific community and the public. Six members serve ex officio and include representatives of the New Jersey Department of Environmental Protection and Energy, the New Jersey Department of Health, and the Water Supply Advisory Council.

Currently serving the Institute (1992)

Appointed Members

Richard Sullivan (Chairman)	(public)
Thomas Cawley	(purveyor)
Ronald Cohen, Ph. D.	(public)
Robert Fischer, Ph.D.	(deceased)
Joseph Hunter, Ph.D.	(academic)
Wendell Inhoffer	(purveyor)
David Marino	(purveyor)
Kenneth Ruehl, Ph.D.	(academic)
Gisela Witz, Ph. D.	(academic)

Ex Officio Members

Commissioner of Environmental Protection
Scott A. Weiner
Commissioner of Health
Designee: Stephen Jenniss, M.S., Director, Environmental and Chemical Laboratory Services
Chairman of the Water Supply Advisory Council
Eugene Golub, Ph.D.
Director of the Division of Water Resources
Designee: Steve Nieswand, Administrator, Water Supply Program
Director of the Division of Science and Research
Designee: Leslie McGeorge, M.S.P.H., Deputy Director
Director of the Office of Occupational and Environmental Health
Designee: Perry Cohn, Ph.D., M.P.H., Drinking Water Project Manager

Appendix B

Safe Drinking Water Act of 1986 : CONTAMINANTS REQUIRED TO BE REGULATED BY USEPA

Inorganics
antimony
arsenic
asbestos
barium
beryllium
cadmium
chromium
copper
cyanide
fluoride
lead
mercury
nickel
nitrate
nitrite
selenium
sulfate
thallium

Pesticides
alachlor
aldicarb
aldicarb sulfoxide
aldicarb sulfone
atrazine
carbofuran
chlordane
2,4-D
dalapon
dibromochloropropane (DBCP)
1,2-dichloropropane
dinoseb
diquat
endothall
endrin
epichlorohydrin
ethylene dibromide (EDB)
glyphosate
heptachlor
heptachlor epoxide
lindane
methoxychlor
picloram
simazine
2,4,5-TP (silvex)
vydate (oxamyl)

Organics (SOCs)
acrylamide
adipates
benzene
carbon tetrachloride
chlorobenzene
dichlorobenzene
1,2-dichloroethane
1,1-dichloroethylene
cis-1,2-dichloroethylene
trans-1,2-dichloroethylene
ethyl benzene
hexachlorocyclopentadiene
methylene chloride
PAHs (polyaromatic hydrocarbons)
PCBs (polychlorinated biphenyls)
pentachlorophenol
phthalates
styrene
2,3,7,8-TCDD (dioxin)
tetrachloroethylene
trichlorobenzene
1,1,1-trichloroethane
1,1,2-trichloroethane
trichloroethylene
toluene
toxaphene
vinyl chloride
xylene

Micro. & Turbid.
Giardia lamblia
Legionella
standard plate count
total coliforms
turbidity
viruses

Radionuclides
gross alpha particle activity
beta particle & photon radioactivity
radium 226
radium 228
radon
uranium

USEPA DRINKING WATER PRIORITY LIST (1991)

Inorganics
aluminum
boron
chloramines
chlorate
chlorine
chlorine dioxide
chlorite
cyanogen chloride
hypochlorite ion
manganese
molybdenum
strontium
vanadium
zinc

Pesticides
asulam
bentazon
bromacil
cyanazine
dcpa (and acid metabolites)
dicamba
ethylenethiourea
fomesafen
lactofen/acifluorfen
metalaxyl
methomyl
metolachlor
metribuzin
parathion degradation product (4-nitrophenol)
prometon
2,4,5-t
thiodicarb
trifluralin

Organics (SOCs)
acrylonitrile
bromobenzene
bromochloroacetonitrile
bromodichloromethane
bromoform
bromomethane
chlorination/chloramination by-products
chloroethane
chloroform
chloromethane
chloropicrin
o-chlorotoluene
p-chlorotoluene
dibromoacetonitrile
dibromochloromethane
dibromomethane
dichloroacetonitrile
1,3 -Dichlorobenzene
dichlorodifluoramethane
1,1-dichlorethane
2,2-dichloropropane
1,3-dichloropropane
1,1-dichloropropene
1,3,-dichloropropene
2,4-dinitrophenol
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
fluorotrichloromethane
hexachlorobutadiene
heaxachloroethane
isophorone
methyl ethyl ketone
methyl isobutyl ketone
methyl-t-butyl ether (MTBE)
naphthalene
nitrobenzene
ozone by-products
1,1,1,2-tetrachloroethane
1,1,2,2-tetrachloroethane
tetrahydrofuran
trichloroacetonitrile
1,2,3-trichloropropane

Microrganisms
cryptosporidium

CURRENT USEPA STANDARDS

Inorganics

aluminum (0.05-0.2) + ▼
antimony (0.01/0.006) ■
arsenic (0.05)
asbestos ($7x10^6$ fibers/L >10 um) ▼
barium (2.0) ▼
beryllium (0.004) ■
cadmium (0.005) ▼
chromium (0.1) ▼
chloride (250) +
copper (1.3) °
corrosivity (+1 to -1 L.I.) +
cyanide (0.2) ■
fluoride (4 natural)
fluoride (1-2 added) +
hardness (NJ 50-250) +
iron (0.3) +
lead (0.015) °
manganese (0.05) +
mercury (0.002) ▼
nickel (0.1) ■
nitrate (10) ▼
nitrite (1) ▼
nitrate + nitrite (10) ▼
pH (6.5-8.5) +
selenium (0.05) ▼
silver (0.1) + ▼
sodium (NJ 50) +
sulfate (250) +
thallium (0.002) ■
zinc (5) +

Radiological
gross alpha (15 pCi/L)
gross beta & photon (4 mrem/yr)
radium 226/228 (5 pCi/L sum)

Pesticides

alachlor (0.002) ▼
aldicarb (0.003) ▼
aldicarb sulfone (0.002) ▼
aldicarb sulfoxide (0.004) ▼
atrazine (0.003) ▼
carbofuran (0.04) ▼
chlordane (0.002) ▼
2,4-D (0.07) ▼
dalapon (0.2) ■
DBCP (0.0002) ▼
dinoseb (0.007) ■
diquat (0.02) ■
EDB (0.00005) ▼
endothall (0.1) ■
endrin (0.002) ■
glyphosate (0.7) ■
heptachlor (0.0004) ▼
heptachlor epoxide (0.0002) ▼
lindane (0.0002) ▼
methoxychlor (0.04) ▼
oxamyl (0.2) ■
pentachlorophenol (0.001) ▼
picloram (0.5) ■
simazine (0.004) ■
toxaphene (0.003) ▼
2,4,5-TP (silvex) (0.05) ▼

Organics

acrylamide (treatment) ▼
adipates, as di(ethylhexyl)adipate (0.4) ■
benzene (0.005)
bromodichloromethane (100 total THMs)
bromoform (100 total THMs)
carbon tetrachloride (0.005)
chloroform (100 total THMs)
dibromochloromethane (100 total THMs)
dichloromethane (methylene chloride) (0.005) ■
hexachlorocyclopentadiene (0.05) ■
hexachlorobenzene (0.001) ■
o-dichlorobenzene (0.6) ▼
p-dichlorobenzene (0.075)
1,2-dichloroethane (0.005)
1,1-dichloroethylene (0.007)
cis-1,2-dichloroethylene (0.07) ▼
trans-1,2-dichloroethylene (0.1) ▼
epichlorohydrin (treatment) ▼
ethylbenzene (0.7) ▼
monochlorobenzene (0.1) ▼
PAHs, as benzo(a)pyrene (0.0002) ■
PCBs as decachlorobiphenyl (0.0005) ▼
phthalates, di(ethylhexyl)phthalate (0.006) ■
styrene (0.1) ▼
tetrachloroethylene (0.005) ▼
2,3,7,8-tetrachlorodibenzo-p-dioxin ($3x10^{-8}$) ■
1,2,4-trichlorobenzene (0.07) ■
1,1,1-trichloroethane (0.2)
1,1,2-trichloroethane (0.005) ■
trichloroethylene (0.005)
toluene (1) ▼
vinyl chloride (0.002)
xylenes (10) ▼

Micro. & Turbid.

ABS/LAS (foaming agents) (0.5) +
color (15 units, NJ 10 units) +
odor (3 units) +
taste (nonobjectionable) +
total coliforms (0 col/100ml)
total dissolved solids (500) +
turbidity (5 units; NJ 1 unit) +

PROPOSED USEPA STANDARDS

Radionuclides (FR 7/18/91)
beta particle & photon emitters excl. Ra-228 (4 mrem ede/yr)
adjusted gross alpha emitters excl. Ra-226, U, & Rn-222 (15 pCi/L)
radium 226 (20 pCi/L)
radium 228 (20 pCi/L)

+ Secondary standards.
▼ MCLs for these contaminants will become effective on July 30, 1992.
° These are action levels. MCLs remain as lead 0.050 and copper 1.0 until December 7, 1992.
Values in parenthesis are current drinking water standards or health levels (in the absence of standards) in units of milligrams of contaminant per liter of water (mg/L) unless noted otherwise.
■ MCL's for these contaminants will became effective in November,1993. (Phase V)

NEW JERSEY REGULATED COMPOUNDS (A-280): 2A List of Contaminants

benzene (0.001)
carbon tetrachloride (0.002)
chlordane (0.0005)
chlorobenzene (MCB) (0.004)
dichlorobenzene(s)
  o- (0.6)
  m- (0.6)
  p- (withdrawn)
1,2-dichloroethane (0.002)
1,1-dichloroethylene (0.002)
1,2-dichloroethylene
  total cis- + trans(0.01)
ethylene glycol (0.290*)
formaldehyde (0.110*) ◆
n-hexane (0.033*)
kerosene**
methyl ethyl ketone (0.270*)
methylene chloride (0.002)
PCBs (0.0005)
tetrachloroethylene (0.001)
trichlorobenzenes measured as
  1,2,4-trichlorobenzene (0.008)
1,1,1-trichloroethane (0.026)
trichloroethylene (0.001)
vinyl chloride (0.002)
xylene(s) (0.044)

NEW JERSEY COMPOUNDS TO BE REGULATED (A-280): 2B Working List of Contaminants

1,1,2,2-tetrachloroethane (0.001*)
1,1,2-trichloroethane (0.0027*)
naphthalene (2.879*)
2,4,6-trichlorophenol (0.001*)
1,1-dichloroethane (0.046*)
methyl-tert-butyl ether (MTBE) (0.7*)

* *Health-based values - not MCLs.*
** *No MCL or health-based value established for this compound.*
◆ *This health-based value was revised by the department and has not been formally adopted by the Institute.*

Values in parenthesis are current drinking water standards or health levels (in the absence of standards) in units of milligrams of contaminant per liter of water (mg/L) unless noted otherwise.

August 31, 1992

APPENDIX C[1]

INTERIM ACTION LEVELS (UG/L) AND RECOMMENDATIONS FOR RESPONSES FOR SELECTED ORGANICS IN DRINKING WATER[2]

Hazardous Contaminant	Group [3]	Level I	Level II	Level III	Level IV
Benzene	A	0-0.68	>0.68 ≤ 6.8	>6.8 ≤ 68	>68
Carbon Tetrachloride	A	0-0.27	>0.27 ≤ 2.7	>2.7 ≤ 27	>27
Chlordane	B	0-0.8	>0.8 ≤ 32	>32 ≤ 63	>63
Dichlorobenzene(s)	C	0-94	>94 ≤ 425	>425 ≤ 750	>750
1,2-Dichloroethane	A	0-0.7	>0.7 ≤ 7	>7 ≤ 70	>70
1,1-Dichloroethylene	B	0-7	>7 ≤ 53	>53 ≤ 100	>100
trans-1,2-Dichloroethylene	C	0-27	>27 ≤ 148	>148 ≤ 270	>270
Methylene Chloride	A	0-4.8	>4.8 ≤ 47	>47 ≤ 479	>479
Polychlorinated Biphenyls	A	0-0.007	>0.007 ≤ 0.07	>0.07 ≤ 0.7	>0.7
Tetrachloroethylene	A	0-0.67	>0.67 ≤ 6.6	>6.6 ≤ 66	>66
1,1,1-Trichloroethane	B	0-20	>20 ≤ 110	>110 ≤ 200	>200
Trichloroethylene	A	0-3.1	>3.1 ≤ 30	>30 ≤ 309	>309
Vinyl Chloride	A	0-0.015	>0.015 ≤ 0.15	>0.15 ≤ 1.5	>1.5
Xylene(s)	C	0-100	>100 ≤ 550	>550 ≤ 1200	>1200

Summary of Responses

Level I - No recommended action, random spot check sampling.

Level II - Confirm sampling results; periodic monitoring; recommend alternative water sources and/or appropriate treatment techniques.

Level III - Confirm sampling results; monthly monitoring; develop within one year alternative water supplies and /or appropriate treatment techniques for public community water systems; recommend appropriate remedial actions to public noncommunity water systems; and quarterly progress reports from both public community and public noncommunity water systems.

Level IV - Confirm sampling results; immediate remedial action for both public community and public noncommunity water systems.

[1] Appendix C was prepared by the Division of Water Resources and the Office of Science and Research of the New Jersey Department of Environmental Protection in January 1986.

[2] All units in Levels I, II, III and IV are presented in micrograms per liter (ug/l) which also equals parts per billion (ppb). The symbol > means "greater than" and ≤ means "less than or equal to".

[3] The column titled "Group" represents categorization of the listed hazardous contaminants based upon the weight of evidence of its carcinogenicity. For example, Group A refers to known or probable human carcinogens, Group B refers to possible human carcinogens and Group C refers to insufficient or negative data available on carcinogenicity.

APPENDIX D
NON-REPORTING PUBLIC COMMUNITY WATER SUPPLIES

Non-reporting Public Community Water Supplies sampled by the Bureau of Safe Drinking Water. Each year of noncompliance is indicated. Samples were analyzed by either the NJDEPE or NJDOH State Laboratories. No samples were collected by the Bureau in 1987.

PWSID No.	PWS Name	1985	1986	1988	1989	1990
Atlantic						
0108004	Normsdale MHP				X	
0111004	Pomona MHP				X	
Burlington						
0311001	Fenimore TP				X	
0326001	California Villa MHP No. 1		X			
0326005	Cedar Grove Apts.			X		
0326009	Wagon Wheel Estates	X	X		X	
0326010	California Villa MHP No.2		X			
0326011	California Villa MHP No.3		X			
0329006	Sunbury Village Water Co.		X	X		
0333003	Richards Mobile Home Court	X		X	X	
Cape May						
0506012	Presidential Courts				X	
0511003	Shore Acres Mobile Park			X		
0511004	N.J. Marine Science Consortium			X	X	
Cumberland						
0604001	Fortesque Realty Company	X	X	X		X
0604003	South Fortesque Water Company	X	X	X	X	X
0605002	Tips Trailer Park & Sales			X	X	
0612001	Tullertown II				X	
Essex						
0720001	Verona MUA				X	
Gloucester						
0809001	Penns Grove WS Co. Brg. Div.				X	
0810005	Manor Water Assoc. Inc.				X	
0819001	Wenonah WD				X	
0812001	Westville WD				X	
Hudson						
0901001	Bayonne WD				X	
Hunterdon						
1006001	Cedar Heights Water Co.		X	X		
1007001	Delaware Twp. MUA		X			
1013001	Hampton Boro WD		X			
1019003	Spruce Run TP		X			
1023001	Stockton WD					X
Middlesex						
1218002	Prospect Civic Assn.					X
Monmouth						
1314001	Farmingdale WD				X	
1321001	Keansburg MUA				X	X
1330001	Aberdeen Twp. MUA			X	X	
Morris						
1414006	Loziers Trailer Park			X		
1414007	Madoc Water Co.	X	X	X	X	X
1414013	Sun Valley Park Co.				X	
1414016	Vassar Rd. Water Co.			X		
1414017	Aztec Water Co.		X			

APPENDIX D (cont'd)
NON-REPORTING PUBLIC COMMUNITY WATER SUPPLIES

PWSID No.	PWS Name	1985	1986	1988	1989	1990
1414018	DMH Water Co.		X			
1415001	Fayson Lakes Water Co. Inc.			X		
1426002	Mt. Arlington Service Co. Inc.			X		
1434001	Rockaway Boro WD					X
Ocean						
1511004	Maple Glen MHC	X	X			
1511011	Luxury Mobile Terrace	X				
1523004	Oak Grove MHP	X	X		X	
Salem						
1707001	Penns Grove WS				X	
1710003	Picnic Grove MH				X	
Somerset						
1809001	Mt. Top Prop. Owners Assn.	X				
1817001	Rocky Hill WD				X	
Sussex						
1902004	Andover Water Corp.	X	X	X	X	X
1905001	Country Village Apts.	X				
1912009	Highcrest Water Assn.					X
1912010	Charles St. Community Assoc.			X	X	
1918003	Highland Water Co.		X		X	X
1922001	Barry Lakes WC				X	X
1922003	Sussex Co. WC-Aspen Woods	X	X		X	X
1922004	Sussex Co. WC-Cliffwood	X	X		X	X
1922005	Sussex Co. WC-Grandview	X	X		X	X
1922006	Sussex Co.-Sussex Hills No. 1	X	X		X	X
1922007	Sussex Co.-Sussex Hills No. 2	X	X		X	X
1922009	D.M. Borstad WC-Oak Hills	X	X			
1922012	Baldwin Well Drilling	X	X		X	X
1922013	D.C. Water Co.		X	X	X	X
1922018	Baldwin WC - Stayman/Mott				X	X
1922019	Baldwin WC - Omega Dr				X	X
1922020	Baldwin WC - Vanderhoff Ct.				X	
1922021	Baldwin WC - Predmore Es.				X	X
1922022	Baldwin WC - Sammis Rd				X	X
1922023	Baldwin WC - MacIntosh Sup.				X	X
1922024	Baldwin WC - Courtland Rd.				X	X
1922025	Baldwin WC - Warren Dr.				X	X
Warren						
2110001	Brainard's Mutual W. Assoc.				X	
2116001	Diamond Hill Water Co. Inc.					X

KEY:

MHC = Mobile Home Court
MHP = Mobile Home Park
MUA = Municipal Utilities Authority
TP = Trailer Park
WC = Water Company
WD = Water Department
WS = Water Supply