NEW JERSEY DRINKING WATER QUALITY INSTITUTE

Maximum Contaminant Level

Recommendations for

Hazardous Contaminants in Drinking Water

Submitted to:

New Jersey Department of Environmental Protection

March 2009

State of New Jersey

Jon S. Corzine
Governor

Department of Environmental Protection

Mark Mauriello
Commissioner

March 4, 2009

Acting Commissioner Mark Mauriello
New Jersey Department of Environmental Protection
PO Box 402
Trenton, NJ 08625-0402

Dear Acting Commissioner Mauriello:

The members of the New Jersey Drinking Water Quality Institute are pleased to submit to you their recommendations for new and revised Maximum Contaminant Levels for hazardous contaminants in drinking water.

We have reexamined the MCL for each of the currently regulated contaminants as promulgated under the 1984 amendments to the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.). Where credible scientific findings since a MCL was set so indicate, we have recommended revision of that MCL.

As provided in the statute, we have also reviewed information on contaminants not currently regulated but which may be found in our public water supplies. If the evidence on a contaminant warrants, we have proposed a new MCL for that contaminant.

Review, analysis and presentation of scientific data by staff in the Bureau of Safe Drinking Water Technical Assistance, Division of Water Supply, and the Division of Science, Research and Technology of your agency, as well as other expert support from NJDEP, New Jersey Department of Health and Senior Services, and Rutgers University, provided the basis for our MCL recommendations.

Sincerely,

Mark Gregory Robson, PhD, MPH
Chairman DWQI
Professor of Entomology
Dean for Agricultural and Urban Programs

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Acknowledgments

The New Jersey Drinking Water Quality Institute (Institute) would like to acknowledge the efforts of the staff of the New Jersey Department of Environmental Protection (NJDEP) and the New Jersey Department of Health and Human Services (NJDHSS) in the development of the Institute's recommendations.

The Health Effects Subcommittee included David Pringle (Chair; Institute public representative), Dr. Judith Klotz (Institute academic representative), Dr. Gloria Post (Institute and NJDEP-Division of Science, Research and Technology), Dr. Perry Cohn (Institute and NJDHSS-Consumer and Environmental Health Services), and Leslie McGeorge (Institute and NJDEP-Water Monitoring and Standards), with assistance from Dr. Keith Cooper (Rutgers University-Biochemistry and Microbiology). Staff support was provided by Kristin Hansen (NJDEP-Bureau of Safe Drinking Water Technical Assistance).

The Testing Subcommittee included Steve Jenniss (Chair; Institute and NJDHSS-Environmental Laboratory Services), Barker Hamill (Institute and NJDEP-Water Supply Operations) and Jean Matteo (Institute water purveyor representative). Staff support was primarily provided by Linda Bonnette (NJDEP-Bureau of Safe Drinking Water Technical Assistance). Further assistance came from Dr. Lee Lippincott (NJDEP-Division of Science, Research and Technology), Jonathan Meyers (NJDEP-Bureau of Safe Drinking Water Technical Assistance), Julian Trexler (NJDHSS-Environmental Laboratory Services) and Dr. Bernie Wilk (NJDEP-Office of Quality Assurance).

The Treatment Subcommittee included Paul LaPierre (Chair; Institute public representiative), Laura Cummings (Institute water purveyor representative), Dr. Russell Ford (Institute academic representative) and Carol Storms (Institute water purveyor representative). Ravi Patraju (NJDEP-Division of Science, Research and Technology) managed the contract with Black & Veatch to assess treatment methods.

Dr. Eileen Murphy, Director, NJDEP-Division of Science, Research and Technology, participated as a member of the Institute during this review's early stages, and attended Treatment Subcommittee meetings after Dr. Post became her representative on the Institute. Karen Fell (NJDEP-Bureau of Safe Drinking Water Implementation), Linda Walsh (NJDEP-Bureau of Safe Drinking Water Technical Assistance), and Diane Pupa (formerly of NJDEP-NJDEP-Bureau of Safe Drinking Water Technical Assistance) also assisted in the early stages of this review, as did Sue Shannon (NJDEP-Division of Science, Research and Technology). Sandra Krietzman (Chief, NJDEP-Bureau of Safe Drinking Water Technical Assistance) provided oversight of the review's later stages.

Dr. Branden B. Johnson (NJDEP-Bureau of Safe Drinking Water Technical Assistance) wrote the main report.

Executive Summary

The New Jersey Drinking Water Quality Institute (Institute) makes recommendations to the Commissioner of the New Jersey Department of Environmental Protection (NJDEP) on Maximum Contaminant Levels (MCLs) or standards for hazardous contaminants in drinking water. In 1987, MCLs were recommended for 16 of the 22 contaminants listed in 1984 amendments to the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.). In 1994, the basis of these MCLs was reviewed, and revised MCLs were recommended for five of these 16 contaminants. Additionally, six new contaminants not listed in 1984 amendments were evaluated for MCL development based on their occurrence in drinking water and potential health effects, and MCLs were recommended for five of these. The Institute has completed a review of existing MCLs to determine if any require revision, and whether MCLs for contaminants not previously addressed should be recommended. The Institute's Health Effects, Testing, and Treatment Subcommittees were charged with both reviewing existing MCLs and potentially developing new MCLs.

Health-based MCLs were established based on specific criteria outlined in the 1984 amendments to the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.) and subsequent Institute decisions. For carcinogenic contaminants, health-based levels were established at levels which would not, within the limits of medical, scientific and technological feasibility (including analytical capability), permit cancer in more than one in one million persons ingesting the contaminant over a lifetime. For noncarcinogens, health-based levels were established at levels which eliminate all adverse physiological effects following ingestion within the limits of practicability and feasibility. The health-based levels were used as the bases for MCLs; these levels were modified, where necessary, to reflect analytical and treatment limitations.

Based on the Subcommittee reviews, the Institute offers to the NJDEP recommendations on 31 contaminants (Table ES-1). Of these, five contaminants have new MCLs (Table ES-2); 11 contaminants have revised MCLS (Table ES-2); 13 contaminants have no MCL recommendation to change current MCLs (Table ES-3); ethylene glycol has no MCL recommendation because there is no currently feasible treatment technology to remove it from drinking water; and 2,4,6-trichlorophenol has no MCL recommendation because the Testing Subcommittee deferred consideration of a PQL.

Table ES-1: New Jersey Drinking Water Quality Institute Recommendations for Maximum Contaminant Levels in Drinking Water
(in micrograms per liter)

Contaminant	Type	USEPA MCL	NJ MCL	Health-Based MCL	PQL	Treatment	Suggested MCL	Change in MCL
Benzene	2a	5	1	0.12	0.8	AS/AC	0.8	Lower
Carbon tetrachloride	2a	5	2	0.39	0.9	Nr	0.9	Lower
Chlordane	2a	2	0.5	0.013	0.5	Nr	0.5	None
Chlorobenzene	2a	100	50	50	2	Nr	50	None
1,2-Dichlorobenzene	2a	600	600	600	5	Nr	600	None
1,3-Dichlorobenzene	2a	None	600	6.3	1	AC/AS	6	Lower
1,4-Dichlorobenzene	2a	75	75	14	1	AC/AS	10	Lower
1,2-Dichloroethane	2a	5	2	0.29	1	Nr	1	Lower
1,1-Dichloroethylene	2a	7	2	63	0.9	Nr	7*	Higher
cis-1,2-Dichloroethylene	2a	70	70	70	2	Nr	70	None
trans-1,2-Dichloroethylene	2a	100	100	100	2	Nr	100	None
Ethylene glycol	2a	None	None	10,000	10,000	BD/AO	None	No MCL
Formaldehyde	2a	None	None	100	5	BD/AO	100	New
n-Hexane	2a	None	None	33	3	AS/AC	30	New
Methyl ethyl ketone	2a	None	None	4,200	2	AO/BD	4,000	New
Methylene chloride	2a	5	3	2.5	1	AS/AC	3	None
Polychlorinated biphenyls	2a	0.5	0.5	0.02	0.5	Nr	0.5	None
Tetrachloroethylene	2a	5	1	0.44	1	Nr	1	None
1,2,4-Trichlorobenzene	2a	70	9	18	1	Nr	20	Higher
1,1,1-Trichloroethane	2a	200	30	2,000	0.9	Nr	200	Higher
Trichloroethylene	2a	5	1	1.2	1	Nr	1	None
Vinyl chloride	2a	2	2	0.023	1	AS/AC	1	Lower
Xylenes	2a	10,000	1,000	1,000	2	Nr	1,000	None
DCPA and degradates	2b	None	None	28	1	M/BD	30	New
1,1-Dichloroethane	2b	None	50	23	1	AS/AO	20	Lower
Methyl tertiary butyl ether	2b	None	70	70	1	Nr	70	None
Naphthalene	2b	None	300	300	2	Nr	300	None
1,1,2,2-Tetrachloroethane	2b	None	1	0.18	1	Nr	1	None
1,1,2-Trichloroethane	2b	5	3	0.61	1	AS/AC	1	Lower
2,4,6-Trichlorophenol	2b	None	None	3.1	None	AC/AO	None	No MCL
1,2,3-Trichloropropane	2b	None	None	0.0013	0.03	AC/AO	0.03	New

Type: Hazardous contaminant listed in Section 2a, P.L. 1983, c. 443; hazardous contaminant selected by Institute for regulation based on occurrence and potential health effects according to Section 2b, P.L. 1983, c. 443.

Treatment: Recommended best technology/recommended second best technology, respectively; AC=activated carbon; AO=advanced oxidation; AS=air stripping; BD=biological degradation; M=membranes; Nr=not reviewed by Black & Veatch.

*Federal MCL of 7 µg/L is below suggested Health-based MCL of 63 µg/L. State MCLs may not be less stringent than Federal MCLs.

Table ES-2: New Jersey Drinking Water Quality Institute Recommended Changes to Existing Maximum Contaminant Levels and Recommended New Maximum Contaminant Levels

(in micrograms per liter)

Contaminant	Current MCL	Recommended MCL	Change in MCL
Benzene	1	0.8	Lower
Carbon tetrachloride	2	0.9	Lower
DCPA and degradates	None	30	New
1,3-Dichlorobenzene	600	6	Lower
1,4-Dichlorobenzene	75	10	Lower
1,1-Dichloroethane	50	20	Lower
1,2-Dichloroethane	2	1	Lower
1,1-Dichloroethylene	2	7	Higher
Formaldehyde	None	100	New
n-Hexane	None	30	New
Methyl ethyl ketone	None	4,000	New
1,2,4-Trichlorobenzene	9	20	Higher
1,1,1-Trichloroethane	30	200	Higher
1,1,2-Trichloroethane	3	1	Lower
1,2,3-Trichloropropane	None	0.03	New
Vinyl chloride	2	1	Lower

Table ES-3: New Jersey Drinking Water Quality Institute Maximum Contaminant Levels with No Recommended Changes
(in micrograms per liter)

Contaminant	Current MCL
Chlordane	0.5
Chlorobenzene	50
1,2-Dichlorobenzene	600
cis-1,2-Dichloroethylene	70
trans-1,2-Dichloroethylene	100
Methylene chloride	3
Polychlorinated biphenyls	0.5
Tetrachloroethylene	1
Trichloroethylene	1
Xylenes	1,000
Methyl tertiary butyl ether	70
Naphthalene	300
1,1,2,2-Tetrachloroethane	1

List of Abbreviations and Definitions

Act	1984 Amendments to the New Jersey Safe Drinking Water Act, N.J.S.A.58:12A-1 et seq. (P.L. 1983, c. 443), signed into law on January 9, 1984.
A-280	Assembly Bill 280 (1984 Amendments to the New Jersey Safe Drinking Water Act, N.J.S.A. 58:12A-1 et seq. (P.L. 1983, c. 443)).
Community water system	A public water system which serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents.
Institute	New Jersey Drinking Water Quality Institute.
MCL	Maximum Contaminant Level–maximum level of a contaminant allowed in drinking water.
MDL	Method Detection Limit–minimum concentration of a substance that can be measured and reported with 99% confidence the concentration is greater than zero.
NJDEP	New Jersey Department of Environmental Protection.
NJDHSS	New Jersey Department of Health and Senior Services.
PCBs	Polychlorinated biphenyls
PQL	Practical Quantitation Level – the level above the MDL at which quantitation can be achieved by most laboratories within acceptable levels of uncertainty.
USEPA	United States Environmental Protection Agency
VOC	Volatile organic chemical
WSO	Water Supply Operations Element of the New Jersey Department of Environmental Protection, Division of Water Supply
"2a" list	The 22 hazardous contaminants listed in N.J.S.A. 7:12A-13a, which originally appeared in Section 2a of P.L. 1983, c. 443.
"2b" list	A list of pesticides and related compounds, metals and base/neutral extractable organic compounds and acid extractable compounds believed to be found in drinking water, developed by the Institute according to Section 2b of P.L. 1983, c. 443 or N.J.S.A. 7:12A-13b.
µg/l	micrograms per liter or parts per billion (ppb).

I. Introduction

A. Background

In 1984, landmark legislation amended the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.) to require 1) monitoring of community water systems for 22 synthetic organic chemicals ("2a" list); 2) adding contaminants for possible regulation ("2b" list); 3) timeframes for addressing contamination in community water systems; and 4) development of Maximum Contaminant Levels (MCLs) or standards for 2a and 2b contaminants based on specified risk assessment, analytical capability and treatability criteria. The law authorized the New Jersey Department of Environmental Protection (NJDEP) to study contaminants in drinking water, and established the New Jersey Drinking Water Quality Institute (Institute).

B. New Jersey Drinking Water Quality Institute

The Drinking Water Quality Institute is a 15-member advisory group to NJDEP, with specific duties. Six members of the Institute serve *ex officio*, defined in the Act as the Commissioner of NJDEP, the Commissioner of Health, the Chairman of the Water Supply Advisory Council, the Director of the Division of Water Resources (NJDEP), the Director of the Office of Science and Research (NJDEP), and the Director of the Office of Occupational and Environmental Health (DHSS). Reorganization of State government has changed several of these names. Nine members are appointed, three of which represent water purveyors (at least one whose primary source is groundwater), three represent the academic scientific community, and three represent the public (with background in environmental health). One person in each of these three groups will be appointed by the Governor, the President of the Senate, and the Speaker of the Assembly, respectively. A list of current Institute members, including those representing *ex officio* members, appears in Table 1.

The Institute is responsible for providing recommendations to NJDEP on implementation of the State's drinking water quality program. The Health Effects Subcommittee recommends health-based Maximum Contaminant Levels (HBMCLs) for 2a contaminants; HBMCLs are target drinking water levels based solely on health effects (equivalent to the U.S. Environmental Protection Agency's Maximum Contaminant Level Goals). This Subcommittee also develops recommendations on the list of 2b contaminants based on their occurrence in New Jersey drinking water and potential health effects, and recommends HBMCLs for these substances. The Testing Subcommittee reviews existing analytical methods to identify those methods with practical quantitation levels (PQLs) as close to health-based levels as possible. The Subcommittee also develops analytical methods as needed, and recommends appropriate monitoring frequencies for contaminants. The Treatment Subcommittee evaluates best available treatment technologies for removal of contaminants from drinking water, and also conducts overall program review.

Table 1. Members of the New Jersey Drinking Water Quality Institute in 2009

Appointed Members	**Type** (organizational affiliation)
Laura Cummings	Water purveyor (Passaic Valley Water Commission)
Russell Ford	Academic (Stevens Institute of Technology; CH2M Hill)
Judith Klotz	Academic (University of Medicine and Dentistry of New Jersey)
Paul LaPierre	Public (Land Dimensions Engineering)
Jean Matteo	Water purveyor (consultant representing United Water New Jersey)
Dave Pringle	Public (New Jersey Environmental Federation)
Mark Robson (Chair)	Academic (Rutgers University—New Jersey Agricultural Experiment Station)
Carol Storms	Water purveyor (Aqua New Jersey)
Vacant	Public
***Ex Officio* Members or Their Representatives**	
Barker Hamill (retired)	Assistant Director, Water Supply Operations, Division of Water Supply
Steve Jenniss	Director, Environmental and Chemical Laboratory Services, NJDHSS
Eugene Golub	Chair, Water Supply Advisory Council
Leslie McGeorge	Administrator, Water Monitoring and Standards, NJDEP
Gloria Post	Research Scientist, Division of Science, Research and Technology, NJDEP
Perry Cohn	Research Scientist, Consumer and Environmental Health Services, NJDHSS

C. Review of Earlier Recommendations from the Institute

The Institute's main activity since it was established in 1985 has been recommendation of MCLs based on review and evaluation of relevant data.

The 1984 amendments to the New Jersey Safe Drinking Water Act state that MCLs for carcinogens must be set, within limits of technological feasibility, at a level which would not permit cancer in more than one in one million persons ingesting the chemical for a lifetime. MCLs for noncarcinogens must be set at levels that eliminate, within limits of practicability and feasibility, all adverse physiological effects resulting from ingestion. The Institute concluded that both the ability of current analytical testing technology to reliably quantify levels of contaminants in drinking water and ability of available treatment technology to remove them should be considered when establishing MCLs for both carcinogens and non-carcinogens.

For carcinogenic contaminants, most health-based levels developed for the 2a list were at or below the method detection limit (MDL) of the test procedure. The MDL is the minimum concentration of a substance measurable with 99% confidence that the analyte concentration is greater than zero (40 CFR 136 Appendix B). As regulation at MDL levels is not possible due to analytical variability across instruments and analysts at these low concentrations, the Institute adopted the USEPA approach of establishing a practical quantitation limit (PQL), the

level above the MDL at which quantification can be achieved by most laboratories within acceptable levels of uncertainty (52 CFR 130, pp. 25690-25717). For contaminants with PQLs at or above health-based levels, the Institute recommended use of the PQL as the MCL only until improving testing technology allows lowering the MCL to the health-based level.

As noted above, evaluation of treatment capabilities involves assessment of technology effectiveness (where such data are available), and of feasibility of implementing such technology at a level consistent with achieving potential MCLs.

Recommendations for MCLs are thus set at whichever number—the health-based MCL, the PQL, or the level achievable by treatment technology—is highest.

The Institute made two major sets of MCL recommendations, and four other recommendations on single contaminants. In 1987 the Institute recommended 18 MCLs for 16[1] of the 22 2a contaminants (plus isomers) listed in the 1984 Safe Drinking Water Act amendments. These recommendations were adopted in NJDEP regulations (effective 1989) with two exceptions. NJDEP adopted the stricter USEPA standards at that time for 1,4-dichlorobenzene and vinyl chloride because both the federal Safe Drinking Water Act (P.L. 93-523, 42 U.S.C. s.300 et al.) and the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.) state that State MCLs must be at least as strict as federal drinking water standards. In 1994, the Instititute recommended five revised MCLs and five new MCLs,[2] which were adopted in NJDEP regulations in 1996. In 2002, the Institute concluded that the USEPA MCL of a gross alpha limit of 15 pCi/L, excluding uranium and radon, protects the public from radium-224 in drinking water, provided that rapid (within 48 hours) gross alpha-particle analysis is required. The Institute also recommended MCLs for arsenic in 2003 (adopted by NJDEP in 2004) and perchlorate in 2005 (the NJDEP rule for this MCL was proposed in March 2009).

In 2006 an ad hoc Radon Subcommittee was formed at the request of the Commissioner of the New Jersey Department of Environmental Protection to consider whether radon should be regulated in New Jersey drinking water supplies. Radon infiltrating directly into air poses a greater risk than radon in drinking water, but the latter also poses substantive risk. Consideration of an MCL for radon raised radon-specific issues, including its unique exposure route among regulated drinking water contaminants (89% of the risk comes from inhalation of radon volatilized from water). The outcome of this Subcommittee was the recommendation of a MCL for radon in drinking water, and that NJDEP and the Legislature cooperate to develop further mandatory policies to reduce exposure to radon in indoor air overall. The report on

[1] Three isomers of dichlorobenzene, listed as a single 2a contaminant in the law, were separated to address their differing toxicities. This is why the statutory list of 2a contaminants had 22 compounds, but in this report comprises 23 (22 minus dichlorobenzene plus its three isomers minus kerosene [see footnote 2 below]), and why in 1987 18 MCLs were recommended for 16 2a contaminants listed in the Act for which MCLs were recommended.

[2] One of the new (2b) MCLs recommended in 1994 was for the most frequent water-soluble component of kerosene, naphthalene, as an indicator of kerosene/petroleum contamination. Kerosene appears on the statutory 2a list, but the Institute recommended substituting naphthalene as kerosene is a mixture of compounds whose composition varies across manufacturers.

radon recommendations was submitted to NJDEP in February 2009. The Radon Subcommittee will offer recommendations on how to address radon in private well water in a future report.

In addition to recommending MCLs, the Institute also recommended that 1) MCLs be reviewed every three years to insure the most recent scientific information has been incorporated into New Jersey drinking water standards; 2) MCLs may be developed for 2a contaminants not yet detected in New Jersey drinking water supplies (the Act merely says MCL development is not required for non-detected contaminants), and 3) natural contaminants (such as radionuclides) should not be subject to the one-in-one-million criterion for health-based MCLs.

The most recent review of MCLs began in 2005. The Health Effects Subcommittee reviewed 31 contaminants, only two of which did not have existing health-based MCLs. The Testing Subcommittee reviewed 29 contaminants to determine if lower PQLs were achievable with current analytical methods and instruments. The Treatment Subcommittee reviewed 17 contaminants that were either not currently regulated or regulated but whose MCLs were expected to be lowered based on the recommendations of the Health Effects and Testing subcommittees. Subsequent chapters cover the work of the three Subcommittees in turn, followed by conclusions and appendices containing the reports of the Subcommittees.

II. Health Effects Subcommittee Recommendations

A. Process

The Health Effects Subcommittee reviewed current health-based MCLs to determine if new data warranted change. The subcommittee also identified as-yet-unaddressed (2b) contaminants that raise public health concerns and occur in drinking water for possible development of new health-based MCLs. The Subcommittee evaluated several risk assessment databases and the relevant primary scientific literature to make these decisions.

The main change since the last full review (1994) was a new approach to chemicals classified as possible human carcinogens under USEPA's 1986 cancer risk assessment guidelines, or as suggestive carcinogens under USEPA's 2005 cancer risk assessment guidelines. This new approach, used by NJDEP and the Subcommittee since 2000, applies a carcinogen slope factor at the 10^{-6} risk level if available and scientifically defensible, and uses the Reference Dose with an additional uncertainty factor of 10 if this slope factor is not available.

Reasons for reviewing health data on current and new contaminants included whether there were new toxicological or epidemiological studies, applicable risk assessment methods, interpretations of existing toxicity data, or data relevant to relative source contribution since the 1994 review. Application of the 2000 suggestive carcinogen policy also might have changed previous conclusions.

All contaminants reviewed by the Health Subcommittee had prior health-based MCLs except for DCPA (dacthal) and its degradates, and 1,2,3-trichloropropane. DCPA is used as an herbicide to control annual grasses and some broad-leaf weeds—in New Jersey mostly on cabbage, other cole crops (broccoli, cauliflower, etc.), and leafy greens—but it has few uses currently and little is found in food. The Synthetic Organic Compound Waiver Sampling Program (40 CFR 141.24(h)(5 and 6)) detected DCPA or its degradates and metabolites in some community water systems. Given its occurrence in New Jersey drinking water and its status as a suggestive carcinogen, selection of DCPA and its degradates for possible development of a health-based MCL was recommended. 1,2,3-trichloropropane is a contaminant of nematocides/fumigants applied to soil, also used for other industrial purposes. It is stable in the environment, and has been detected in public water systems, private wells, and in ground water at contaminated sites in New Jersey. There is no federal MCL for 1,2,3-trichloropropane. In 1999, NJDEP developed a drinking water guidance value of 0.025 ug/L for 1,2,3-trichloropropane, based on the analytical practical quantitation limit (PQL). Given its occurrence in New Jersey drinking water and its status as a potent carcinogen, selection of 1,2,3-trichloropropane for possible development of a health-based MCL was recommended.

Appendix A provides further details on the health-based MCL development process, both in general and for specific contaminants.

B. Results

The 31 contaminants reviewed by the Health Effects Subcommittee appear in Table 2. Existing health-based MCLs for 14 2a contaminants and two 2b contaminants were left unchanged, as no studies published since the last review supported changing the slope factor or Reference Dose. Changes were recommended for health-based MCLs for nine 2a contaminants (four lower, five higher) and four 2b contaminants (three lower, one higher). Two MCL recommendations are for new 2b contaminants. Documents discussing the basis for suggested health-based MCL revisions for each contaminant appear in Appendix A.

Table 2. Revised Health-Based Maximum Contaminant Levels Suggested by the Health Effects Subcommittee
(in micrograms per liter)

Contaminant	Type	Current Health-Based MCL	Change in Health-Based MCL	Suggested Health-Based MCL
Benzene	2a	0.15	Y	0.12
Carbon tetrachloride	2a	0.39	N	0.39
Chlordane	2a	0.013	N	0.013
Chlorobenzene	2a	50	N	50
1,2-Dichlorobenzene	2a	600	N	600
1,3-Dichlorobenzene	2a	600	Y	6.3
1,4-Dichlorobenzene	2a	150	Y	14
1,2 Dichloroethane	2a	0.29	N	0.29
1,1-Dichloroethylene	2a	1	Y	63
cis-1,2-Dichloroethylene	2a	70	N	70
trans-1,2-Dichloroethylene	2a	100	N	100
Ethylene glycol	2a	290	Y	10,000
Formaldehyde	2a	100	N	100
n-Hexane	2a	33	N	33
Methyl ethyl ketone	2a	270	Y	4,200
Methylene chloride	2a	2.5	N	2.5
Polychlorinated biphenyls	2a	0.02	N	0.02
Tetrachloroethylene	2a	0.44	N	0.44
1,2,4-Trichlorobenzene	2a	8.6	Y	18
1,1,1-Trichloroethane	2a	26	Y	2,000
Trichloroethylene	2a	1.2	N	1.2
Vinyl chloride	2a	0.084	Y	0.023
Xylenes	2a	1,000	N	1,000
DCPA and degradates	2b	None	New	28
1,1-Dichloroethane	2b	46	Y	23
Methyl tertiary butyl ether	2b	70	N	70
Naphthalene	2b	300	N	300
1,1,2,2-Tetrachloroethane	2b	1	Y	0.18
1,1,2-Trichloroethane	2b	3	Y	0.61
2,4,6-Trichlorophenol	2b	1	Y	3.1
1,2,3-Trichloropropane	2b	None	New	0.0013

Type 2a chemicals are listed in the Act; 2b chemicals were identified by the Institute based on occurrence data and potential health effects. All values in micrograms per liter.

III. Testing Subcommittee Recommendations

A. Process

The Testing Subcommittee reviews current Practical Quantitation Limits (PQLs) and develops new PQLs as needed. A PQL is the level at which quantification of concentrations of a substance in drinking water can be achieved by most laboratories within acceptable levels of uncertainty (USEPA, 1985). Of the 31 contaminants reviewed by the Health Effects Subcommittee, the Testing Subcommittee made decisions about PQLs for 30 contaminants. Current PQLs for 17 2a contaminants and five 2b contaminants were reviewed and results appear in Table 3. Six other 2a contaminants and two 2b contaminants did not require any review, because health-based levels were much higher than the respective current PQLs (Table 4). Further review of the PQL for polychlorinated biphenyls, recommended to stay at its current level for now, will occur when analytical techniques with lower method detection limits are available (below). The review of 2,4,6-trichlorophenol has been deferred. The Subcommittee's report is Appendix B.

Monitoring data were assessed as part of the review of current PQLs. Fourteen of fifteen volatile organic compounds (VOCs) had occurrence data from the Safe Drinking Water Information System and Private Well Testing Act (PWTA) databases. The latter database includes data only on regulated VOCs, so was of limited value for obtaining analytical performance data for unregulated contaminants such as methyl ethyl ketone. Median method detection limits (MDLs) were calculated using the most recent three-year compliance period (2005-2007), based on USEPA Method 524.2 MDLs only (due to fewer laboratories being certified for USEPA Method 502.2 and the lower median MDL values produced by the latter). Average median MDLs for each VOC were multiplied by a factor of five to determine PQLs, by Institute convention (DWQI, 1987).

Two groups of contaminants posed challenges. First, chlordane and polychlorinated biphenyls (PCBs) are synthetic organic compounds (SOCs) comprised of isomers and congeners. Available data were limited because all New Jersey community and nontransient noncommunity water systems were issued waivers from monitoring for SOCs per the federal regulations at 40 CFR 124. In the most recent monitoring period, 2005 to 2007, 160 chlordane screening samples from potentially vulnerable systems were collected. The Subcommittee decided not to revise the current PQL of 0.5 micrograms per liter for chlordane due to lack of detection in state waters, absence of major advances in chlordane analysis, and general fate and transport characteristics of the contaminant in the environment. Given the lack of PCB occurrence data and the possibility that concentrations in New Jersey waters might be near or above the health-based MCL of 0.02 micrograms per liter (orders of magnitude lower than method detection limits), NJDEP plans to analyze water samples from 12 vulnerable sites using EPA method 1668A. The current PQL will be reviewed again for possible revision based on those results when they become available.

The second challenging group of contaminants included n-hexane and formaldehyde. Health-based MCLs and PQLs had been developed for these contaminants, but MCLs had not been recommended due to lack of treatment capability. The Testing Subcommittee chose to determine the recommended PQL for n-hexane by multiplying the maximum allowed median MDL value by five. One New Jersey-certified laboratory, analyzing about 8% percent of Private Well Testing Act data, uses USEPA Method 502.2 exclusively, but under a new n-hexane regulation would need to be certified with USEPA Method 524.2 to continue analyzing n-hexane. Based on national and New Jersey monitoring data for formaldehyde, and the difficulties of reliably reporting a contaminant like formaldehyde which is often found at background levels, the Testing Subcommittee chose to define the PQL as equal to the minimum reporting level for the most discriminating analytical methods. This PQL will be re-evaluated once the MCL is adopted and monitoring data are available.

The Testing Subcommittee had difficulty finding a method for analysis of ethylene glycol in water with a detection limit lower than 10,000 micrograms per liter (μg/l). As a modified USEPA SW846 8015 method can meet this detection limit, which coincides with the health-based MCL, the Testing Subcomittee recommends a PQL of 10,000 μg/L for ethylene glycol.

B. Results

Results of the Testing Subcommittee's review of PQLs appear in Table 3: 14 PQLs are suggested to be lowered, three are new, five are unchanged, and one (2,4,6-trichlorophenol) will be reviewed later. For eight contaminants on which decisions were made, the PQL exceeded the suggested health-based MCL, and thus became the limiting factor on recommended MCLs. The eight other current PQLs were not reviewed by the Testing Subcommittee and are unchanged because the MCLs are much higher than the current PQLs (see Table 4). All PQLs were rounded to the nearest single significant figure.

Table 3. Revised Practical Quantitation Limits Suggested by the Testing Subcommittee
(in micrograms per liter)

Contaminant	Type	Suggested Health-based MCL	Current PQL	PQL Change	Suggested PQL
Benzene	2a	0.12	1	Lower	0.8
Carbon tetrachloride	2a	0.39	2	Lower	0.9
Chlordane	2a	0.013	0.5	No	0.5
1,3-Dichlorobenzene	2a	6.3	5	Lower	1
1,4-Dichlorobenzene	2a	14	5	Lower	1
1,1-Dichloroethylene	2a	63	2	Lower	0.9
1,2-Dichloroethane	2a	0.29	2	Lower	1
Methyl ethyl ketone	2a	4200	20	Lower	2
Ethylene glycol	2a	10,000	None	New	10,000
Formaldehyde	2a	100	41	Lower	5
Methylene chloride	2a	2.5	2	Lower	1
n-Hexane	2a	33	5	Lower	3
Polychlorinated biphenyls	2a	0.024	0.5	No	0.5
Tetrachloroethylene	2a	0.44	1	No	1
1,2,4-Trichlorobenzene	2a	18	5	Lower	1
1,1,1-Trichloroethane	2a	1000	1	Lower	0.9
Vinyl chloride	2a	0.023	5	Lower	1
DCPA and degradates	2b	28	None	New	1
1,1-Dichloroethane	2b	23	1	No	1
1,1,2-Trichloroethane	2b	0.61	2	Lower	1
1,1,2,2-Tetrachloroethane	2b	0.18	1	No	1
2,4,6-Trichlorophenol	2b	3.1	None	Review deferred	
1,2,3-Trichloropropane	2b	0.0013	None	New	0.03

Type 2a chemicals are listed in the Act; 2b chemicals were identified by the Institute based on occurrence data and potential health effects. All values in micrograms per liter.

Table 4. Practical Quantitation Limits Not Reviewed by the Testing Subcommittee*

Contaminant	Type
Chlorobenzene	2a
1,2-Dichlorobenzene	2a
Cis-1,2-Dichloroethylene	2a
Trans-1,2-Dichloroethylene	2a
Trichloroethylene	2a
Xylenes	2a
Methyl tertiary butyl ether	2b
Naphthalene	2b

Current PQLs were less than suggested or existing health-based MCLs, therefore no review of the existing PQLs in this table was undertaken. Type 2a listed in original Act; 2b identified by Institute based on occurrence data and potential health effects.

IV. Treatment Subcommittee Recommendations

A. Process

NJDEP contracted with Black & Veatch Corporation to assess treatment technology for fourteen contaminants, expected to have lower health-based MCLs upon review by the Health Effects Subcommittee of the Institute (Table 5). Treatments evaluated included activated carbon, air stripping, advanced oxidation, and membranes.

The Treatment Subcommittee reviewed the Black & Veatch Report (Appendix C), assessed two contaminants not covered by Black & Veatch (carbon tetrachloride and 1,2-dichloroethane), and made suggestions to the Institute. Tertiary butyl alcohol was reviewed by Black & Veatch, but due to deferred Health Effects Subcommittee evaluation was not part of this Institute review and is omitted from this report otherwise.

B. Results

Table 5 shows best technologies for each contaminant according to Black & Veatch, based on effectiveness, cost, and flexibility. Ethylene glycol, formaldehyde, methyl ethyl ketone, DCPA and DCPA degradates may require multiple processes to achieve needed removals. Black & Veatch noted advanced oxidation partially converts organic chemicals and thus might not achieve acceptable removal on its own. Biological degradation can occur on biologically active GAC, but as its added benefit is rarely planned, no reliable data exist on its effectiveness.

Table 5. Best Available Technology for Selected Contaminants in Drinking Water

Contaminant	Best Available Treatment	Second Best Treatment
Benzene	Air stripping	Granular activated carbon
1,3-Dichlorobenzene	Activated carbon	Air stripping
1,4-Dichlorobenzene	Activated carbon	Air stripping
Ethylene glycol	Biological degradation	Advanced oxidation
Formaldehyde	Biological degradation	Advanced oxidation
Methyl ethyl ketone	Advanced oxidation	Biological degradation
Methylene chloride	Air stripping	Activated carbon
n-Hexane	Air stripping	Activated carbon
Vinyl chloride	Air stripping	Activated carbon
DCPA and degradates	Membranes	Biological degradation
1,1-Dichloroethane	Air stripping	Advanced oxidation
1,1,2-Trichloroethane	Air stripping	Activated carbon
2,4,6-Trichlorophenol	Activated carbon	Advanced oxidation
1,2,3-Trichloropropane	Activated carbon	Advanced oxidation

Data in this table from Black & Veatch report (Appendix C of this report), Table 3-7.

Based on data from drinking water treatment experience in New Jersey, Black & Veatch estimated capital and annual operation and maintenance (O & M) costs as shown in Table 6:

Table 6. Estimated Capital and Annual O & M Costs for Treatment Technologies

Type of Treatment	**Capital Costs ($ thousands)**	**O & M Costs/Year ($ thousands)**
Granular activated carbon (pressure type for small systems)		
< 10,000 gallons per day	NA	NA
< 100,000 gallons per day	200-300	10-15
0.1-0.5 mgd	300-500	20-75
0.5-1.0 mgd	600-1,200	50-100
Aeration system		
< 10,000 gallons per day	NA	NA
< 100,000 gallons per day	100-200	15-30
0.1-0.5 mgd	150-300	25-45
0.5-1.0 mgd	250-450	25-50
Ozone system		
< 10,000 gallons per day	NA	NA
< 100,000 gallons per day	380-460	70
0.1-0.5 mgd	418-700	75
0.5-1.0 mgd	720-1,200	80
Ultraviolet hydrogen peroxide system		
< 10,000 gallons per day	NA	NA
< 100,000 gallons per day	35-40	5
0.1-0.5 mgd	40-140	5-15
0.5-1.0 mgd	280-3,500	25-50
RO membrane		
< 10,000 gallons per day	100	15
< 100,000 gallons per day	300	30-120
0.1-0.5 mgd	500-1,000	50-300
0.5-1.0 mgd	1,000-2,000	100-600

NA=not available. Data from Black & Veatch report, Tables 3-1 to 3-6.

Based on the results of the Black & Veatch Report, the Treatment Subcommittee made the following recommendations to the Institute. Decisions were made on the basis of technology effectiveness, as the Act only stipulates cost as a criterion for Institute-recommended MCLs for non-carcinogens. The economic impact of the MCLs will be considered as part of the proposed NJDEP rules.:

- No MCL should be recommended for ethylene glycol, as current technology cannot reliably remove it from drinking water supplies. Treatment is thus the limiting factor for this contaminant.
- All other suggested MCLs for contaminants reviewed by Black & Veatch can be met with existing technology.

For contaminants not reviewed by Black & Veatch, the Treatment Subcommittee concluded that MCLs of 0.9 µg/l for carbon tetrachloride and 1 µg/l for 1,2-dichloroethane are feasible with existing air stripping and activated carbon technologies.

V. Conclusions

Based upon the Health Effects, Testing, and Treatment Subcommittee reviews, the Drinking Water Quality Institute recommends the actions summarized in Table 7:

- Lower the MCL for eight contaminants: benzene, carbon tetrachloride, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 1,1-dichloroethane, 1,2-dichloroethane, 1,1,2-trichloroethane, and vinyl chloride.
- Raise MCLs for three contaminants: 1,1-dichloroethylene, 1,2,4-trichlorobenzene, and 1,1,1-trichloroethane.
- Leave unchanged MCLs for 13 contaminants: chlordane, chlorobenzene, 1,2-dichlorobenzene, cis-1,2-dichloroethylene, trans-1,2-dichloroethylene, methyl tertiary butyl ether, methylene chloride, naphthalene, polychlorinated biphenyls, 1,1,2,2-tetrachloroethane, tetrachloroethylene, trichloroethylene, and xylenes.
- Establish MCLs for five contaminants not currently regulated: DCPA and degradates, formaldehyde, n-hexane, methyl ethyl ketone, and 1,2,3-trichloropropane.
- Establish no MCL for ethylene glycol at this time; the health-based maximum contaminant level and the practical quantitation limit are both 10,000 μg/L.
- Establish no MCL for 2,4,6-trichlorophenol at this time; the health-based maximum contaminant level is 3 μg/L, but the Testing Subcommittee has deferred review of a practical quantitation limit.
- Review the current MCL for polychlorinated biphenyls again for possible revision when data are available from an anticipated NJDEP screening study in vulnerable systems.

Table 7: New Jersey Drinking Water Quality Institute Recommendations for Maximum Contaminant Levels in Drinking Water

(in micrograms per liter)

Contaminant	Type	USEPA MCL	NJ MCL	Health-Based MCL	PQL	Treatment	Suggested MCL	Change in MCL
Benzene	2a	5	1	0.12	0.8	AS/AC	0.8	Lower
Carbon tetrachloride	2a	5	2	0.39	0.9	Nr	0.9	Lower
Chlordane	2a	2	0.5	0.013	0.5	Nr	0.5	None
Chlorobenzene	2a	100	50	50	2	Nr	50	None
1,2-Dichlorobenzene	2a	600	600	600	5	Nr	600	None
1,3-Dichlorobenzene	2a	None	600	6.3	1	AC/AS	6	Lower
1,4-Dichlorobenzene	2a	75	75	14	1	AC/AS	10	Lower
1,2-Dichloroethane	2a	5	2	0.29	1	Nr	1	Lower
1,1-Dichloroethylene	2a	7	2	63	0.9	Nr	7*	Higher
cis-1,2-Dichloroethylene	2a	70	70	70	2	Nr	70	None
trans-1,2-Dichloroethylene	2a	100	100	100	2	Nr	100	None
Ethylene glycol	2a	None	None	10,000	10,000	BD/AO	None	No MCL
Formaldehyde	2a	None	None	100	5	BD/AO	100	New
n-Hexane	2a	None	None	33	3	AS/AC	30	New
Methyl ethyl ketone	2a	None	None	4,200	2	AO/BD	4,000	New
Methylene chloride	2a	5	3	2.5	1	AS/AC	3	None
Polychlorinated biphenyls	2a	0.5	0.5	0.02	0.5	Nr	0.5	None
Tetrachloroethylene	2a	5	1	0.44	1	Nr	1	None
1,2,4-Trichlorobenzene	2a	70	9	18	1	Nr	20	Higher
1,1,1-Trichloroethane	2a	200	30	2,000	0.9	Nr	200	Higher
Trichloroethylene	2a	5	1	1.2	1	Nr	1	None
Vinyl chloride	2a	2	2	0.023	1	AS/AC	1	Lower
Xylenes	2a	10,000	1,000	1,000	2	Nr	1,000	None
DCPA and degradates	2b	None	None	28	1	M/BD	30	New
1,1-Dichloroethane	2b	None	50	23	1	AS/AO	20	Lower
Methyl tertiary butyl ether	2b	None	70	70	1	Nr	70	None
Naphthalene	2b	None	300	300	2	Nr	300	None
1,1,2,2-Tetrachloroethane	2b	None	1	0.18	1	Nr	1	None
1,1,2-Trichloroethane	2b	5	3	0.61	1	AS/AC	1	Lower
2,4,6-Trichlorophenol	2b	None	None	3.1	None	AC/AO	None	No MCL
1,2,3-Trichloropropane	2b	None	None	0.0013	0.03	AC/AO	0.03	New

Type: Hazardous contaminant listed in Section 2a, P.L. 1983, c. 443; hazardous contaminant selected by Institute for regulation based on occurrence and potential health effects according to Section 2b, P.L. 1983, c. 443.

Treatment: Recommended best technology/recommended second best technology, respectively; AC=activated carbon; AO=advanced oxidation; AS=air stripping; BD=biological degradation; M=membranes; Nr=not reviewed by Black & Veatch.

*Federal MCL of 7 µg/L is below recommended Health-based MCL of 63 µg/L. State MCLs may not be less stringent than Federal MCLs.