Land Use Management
Water Supply Administration
Safe Drinking Water Program

Opportunity for Public Comment on possible regulatory strategies to address the occurrence of unregulated organic contaminants in drinking water

Discussion paper to generate dialogue on several approaches for reducing unregulated synthetic organic contamination from public drinking water supplies.

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I. Summary

The New Jersey Department of Environmental Protection (the Department) is seeking input and requesting comments regarding several approaches to address the occurrence of unregulated organic contaminants in New Jersey's drinking water. While the intent is to devise a program to address all drinking water sources in the state, many of the options described herein focus on ground water systems. For those options, ground water systems would be the first addressed, followed by surface water and mixed source water systems.

The concept arose after numerous internal and external discussions regarding the best options for protecting public health in response to the results of a number of studies conducted in New Jersey showing the occurrence of unregulated contaminants in groundwater, surface water and finished drinking water (1, 2, 3). Most of the unregulated semi-volatile and non-volatile organic contaminants found are not part of the suite of contaminants routinely analyzed for as part of the drinking water program. Some appear on the U.S. Environmental Protection Agency's (USEPA) Contaminant Candidate List and some are target analytes (though not regulated contaminants) detectable using routine analytical methods. Human health information is lacking for many of the contaminants, so it is difficult to assess whether they pose a threat to human health either on an individual basis or as contaminant mixtures. Given this uncertainty, the Department is considering several options to address the occurrence of these contaminants in the state's drinking water. Through these options, the Department seeks to address the question of what, in the absence of information on human health information on these contaminants, its response should be to this new information. In order to solicit public input as early as possible, the Department has prepared this discussion paper to generate dialogue on the issue. This paper describes: the results of recent studies showing the presence of unregulated and tentatively identified compounds in New Jersey groundwater, surface water and finished drinking water; the current federal and state approach to setting standards for drinking water contaminants; the current federal and state approach to addressing the occurrence of unregulated contaminants; and the various options for discussion regarding the issue of unregulated contaminants in drinking water in New Jersey.

Several options have been introduced for consideration. They include: classifying contaminants by their health endpoint, such as carcinogenicity, and regulating these carcinogens at a uniform level, such as the "no detect" level; classifying contaminants by their chemical characteristics and regulating the chemical groups as generic classes; investigating the potential presence of unregulated contaminants through more thorough and intense scrutiny of contaminated sites; expanding the current approaches to addressing unregulated contaminants to include and accommodate the larger number being detected; and providing more broad-based water treatment such as granular activated carbon in addition to existing treatment on contaminated water supplies, or on supplies potentially subject to contamination.

II. Introduction

In the late 1980s and early 1990s, there was a great deal of activity at the state and federal level in standard-setting for organic chemicals using a chemical-specific approach. The A-280 Amendments to the New Jersey Safe Drinking Water Act became effective in 1984. The amendments were adopted in response to a lack of drinking water standard-setting activity by the federal government, and numerous reports of volatile organic chemicals in New Jersey water supplies. The amendments mandate: periodic testing of New Jersey public community water supplies for a specified list of 22 contaminants; adoption of maximum contaminant levels for these specified contaminants, which are primarily volatile organic chemicals; and future adoption of maximum contaminant levels for additional chemicals including pesticides, semi-volatile organic chemicals, and metals. Maximum contaminant levels were adopted into regulation for 18 of these compounds (16 parent compounds and two (2) isomers) by the Department in January 1989. The remaining compounds on the list were deemed to be inappropriate for standard development because they are not single compounds or are not detectable by routine analytical techniques. In 1996, 14 years after the adoption of maximum contaminant levels for the original 22 organic chemicals, regulations for five additional chemicals and revisions to six of the existing standards, based on newer health effects information, were adopted. No new drinking water standards for organic contaminants have been finalized in New Jersey since 1996.

On the federal level, the National Interim Primary Drinking Water Regulations were published on December 24, 1975, which included chemical maximum contaminant levels and monitoring requirements for 10 inorganic contaminants and six pesticides. In 1986, USEPA finalized the Phase 1 Rule for Volatile Organic Contaminants, which set maximum contaminant levels for eight volatile organic chemicals. This was followed in 1991 with additional standard development for 38 volatile organic chemicals, and in 1992, for 23 semi-volatile organic chemicals (mostly pesticides). A timeline of the regulatory activity of USEPA is shown in Table 1.

By 1992, most of the current state and federal drinking water maximum contaminant levels for organic chemicals were set. Indeed, most of the organic chemicals that pose the greatest health risk on an individual basis and that are detected with some frequency in the nation's drinking water have been addressed using the current chemical-specific approach. Presently, New Jersey drinking water regulations have been developed for 26 volatile organic chemicals and 33 semi-volatile organic chemicals (mostly pesticides) out of a universe of more than 60,000 organic chemicals that are used commercially. This includes both the New Jersey-specific maximum contaminants levels those that were developed by the federal government and adopted in New Jersey automatically. Table 2 shows the current standards for organic contaminants at the state and federal level. Where appropriate, the corresponding standards developed by the World Health organization are included for comparison purposes.

The current chemical-specific system, however, does not address the recent information showing the occurrence of multiple unregulated contaminants at low levels in drinking water. It does not seem appropriate to regulate on a chemical-specific basis a compound that appears infrequently (statewide or nationally) and that, when detected, is at very low levels (at or below 1 μg/L, or 1 ppb). The concern today, based on the results of the recent studies, is what do to, if anything, about chemical mixtures in drinking water.

Estimates of the numbers of chemicals in commercial use today range from 60,000 to over 100,000. This does not include chemical metabolites and degradation by-products that are formed once the chemicals are released to the environment (reactions with other chemicals, with light, and by microbial activity). Combinations of contaminants may exist in drinking water. Any one contaminant may not be of concern, but when combined with other contaminants, may pose a health issue.

One way to approach the occurrence of chemicals in drinking water (indeed, in the environment) is to regulate them at the manufacturing stage. In fact, this is being done to some degree in the United States and especially in Europe. This approach addresses the issue of commercial products but does not address spills and leaks, past use of chemicals, former hazardous waste sites and illegal dumps, and domestic use of commercially available products. Despite attempts to reduce the amount and number of potentially toxic chemicals in the environment, we simply cannot address the multitude of contaminants already present. Further, new research is showing that some residentially used chemicals are reaching water supplies and that some of these chemicals (e.g., pharmaceuticals and pesticides and their degradation by-products) may have reproductive effects at very low levels, levels lower than previously considered safe. For instance, atrazine, which is regulated in drinking water at 2 μg/L, has been associated with reproductive effects in frogs at levels much lower than the drinking water standard. It is not known at what level atrazine can have reproductive effects on humans. As science provides more information about the deleterious effects of chemicals at levels once considered safe, it is prudent to consider action to reduce exposure.

The mere presence of contaminants in drinking water may or may not be indicative of a public health problem. However, an intensive study conducted in New Jersey by the Department of Health and Senior Services (NJDHSS) with the Agency for Toxic Substances and Disease Registry (ATSDR) (4) reports associations between drinking water source and specific childhood cancer. Though the link was not definitive, the study illustrates the significance of uncertainty on public perception. Even when the evidence is inconclusive, the public clearly is not willing to accept contamination in the drinking water supply. Take for instance, the recent action in California where the City of Monrovia has installed water treatment on a drinking water supply that has levels of organic chemical contamination below the current maximum contaminant levels (5). Although there was no requirement for the City to install water treatment, the Water Quality Supply Authority in that state provided a grant to the supply because it agreed that a proactive approach was appropriate.

As the state and the federal governments devise methods for identifying additional chemicals to consider for regulation in drinking water, research studies are finding that many industrial and commercial chemicals are present in raw waters used as drinking water sources, and that some of these chemicals survive the treatment process and appear in finished drinking water. The chemical-specific approach, while useful for the development of drinking water standards for single, high-concentration contaminants that were seen in the 1980's and early 1990's and for some chemicals currently under consideration, may not represent the optimum approach for addressing low level contamination with multiple chemicals today. Therefore, the Department is considering various approaches to reduce human exposure to currently unregulated drinking water contaminants.

III. Occurrence of Unregulated Contaminants and Tentatively Identified Compounds in New Jersey Waters

Discussion on possible regulatory strategies to address currently unregulated contaminants in drinking water was prompted by the recent release of studies showing that many more contaminants are present in raw and finished drinking water supplies than are currently regulated. Studies conducted by the Department with the Environmental and Occupational Health Sciences Institute (EOHSI) of New Jersey (1) and the US Geological Survey (USGS) with NJDEP (2) and the federal Centers for Disease Control and Prevention (CDC) (3) have shown that water samples analyzed by advanced analytical methods contain low levels of household, commercial, and industrial compounds. Current analytical methods used for regulatory purposes are not capable of detecting these compounds.

In the USGS surface water studies (2,3), using analytical methods developed specifically to detect target chemicals, the types of compounds found were primarily pesticides, prescription and non-prescription pharmaceuticals, fragrances, flame retardants, plasticizers, and household chemicals and their metabolites. The compounds detected in the ground water study (1), using analytical methods developed to "screen" water samples for a broad range of semi- and non-volatile organic chemicals, were reported as "tentatively identified compounds". A tentatively identified compound is one that can be seen by an analytical testing method, but its identity and concentration cannot be confirmed without further analytical investigation. Tentatively identified compounds are reported in virtually all analytical tests for organic compounds, but laboratories vary in how they deliver this information. A photograph can be used as an analogy to describe a tentatively identified compound. The photograph's subjects, analogous to the target compounds, are located in the foreground and are in focus and identifiable to the viewer. The photograph also captures background information, analogous to the tentatively identified compounds, and, often, this information is fuzzy and not identifiable to the viewer. The photographer can ask others to identify the fuzzy components and name them, but since he has not identified them for himself, they remain tentative identifications.

Despite the differences among the studies described above, there are several noteworthy similarities in their conclusions:

- Analytical methods are capable of detecting hundreds of organic chemicals at levels below one part per billion, ppb (a.k.a., microgram per liter, µg/L) in surface, ground and drinking water samples.

- Some contaminants survive existing water treatment.

- Some contaminants are introduced during water treatment or appear as a result of chemical interactions during treatment (e.g., chlorination or ozonation).

- Most water samples contained more than one organic contaminant.

- Only a fraction of the detected compounds in the studies have regulatory standards, guidelines, or criteria.

- Little is known about human health effects and even less about ecological effects of the compounds detected.

- Quality assurance procedures are vital for interpretation of results (certain compounds were detected in both water samples and blank samples)

Summaries and full reports for the completed portions of these studies are available at http://www.state.nj.us/dep/dsr/ and http://toxics.usgs.gov/regional/emc.html.

Human health effects data for many of the unregulated and tentatively identified compounds have not been generated. It is not possible for the Department to develop the toxicological study data needed to establish a maximum contaminant level for all these compounds, given the large numbers of them (several hundred) and the amount of time and expense associated with developing the toxicological data. For example, to conduct toxicity studies on one unregulated contaminant present in the drinking water supply in Toms River, New Jersey, it has taken over 5 years and $5 million. Further, there is little information or guidance available about the health effects of mixtures of two or more compounds, as researchers continue to pursue this field of study (8, 9).

1. Ground Water

The NJDEP-EOHSI (1) study investigated the potential presence of non-volatile and semi-volatile organic chemicals in New Jersey drinking water supplies that use ground water as their source. All the water systems selected for this study had historical organic contamination, according to Bureau of Safe Drinking Water records (except for the control system, which was selected because it had never had any instance of organic contamination). Further, all the systems had some type of treatment designed to reduce the contamination (either air strippers or carbon filters or both). One surface water system was selected in order to compare the raw surface water quality of a system with known organic chemical contamination to that of contaminated ground water and to investigate the efficiency of water treatment from a surface water system. Ultimately, 20 New Jersey water systems were sampled as part of this study. Several generalizations can be made: 1) each water system impacted by identified hazardous waste sites has distinct and sometimes unique tentatively identified chemicals associated with it; 2) tentatively identified chemicals are generally low in concentration, most being estimated at a concentration below one µg/L; and 3) many organic chemicals reported as tentatively identified chemicals did not actually occur in the water sampled but were detected in the analysis due to sampling and/or laboratory contamination.

Air-stripping for removing volatile organic contaminants is the most commonly used treatment technology used by the systems to reduce the contamination. A volatile compound "evaporates" readily into the air. A non-volatile compound evaporates much more slowly or not at all. A semi-volatile compound falls somewhere in between. Many of the unregulated contaminants tentatively identified in the studies are non-volatile and semi-volatile in nature. The study indicates that unregulated contaminants tend to occur at those ground water systems where elevated levels of a regulated contaminant are already present. That is, the highest numbers of tentatively identified contaminants in drinking water occurred in those systems that already had some type of treatment in place to reduce levels of a regulated contaminant, in most instances, a volatile organic contaminant. Statistical analysis could not be performed in the New Jersey study due to the small sample size and the fact that the systems sampled were selected in a non-random way; that is, water systems having historical contamination by a regulated contaminant(s) were selected for study. Ground water systems sampled as part of the New Jersey study were those that had a history of contamination by regulated volatile organic compounds and that were located within one mile of a hazardous waste site. In some instances, the site responsible for the contamination of the water supply had already been identified. Systems having the highest concentration of volatile organic compounds in raw water tended to have the highest number of tentatively identified compounds in their water samples. In a study conducted by the USEPA (6), a direct correlative association was not observed between regulated volatile organic compounds and regulated semi-volatile compounds. However, for ground water systems, in the high-occurrence state (state having the highest percentage of public water systems with organic contamination), of 69% systems with any type of organic contamination, 12% showed co-occurrence of both semi-volatiles and volatiles. Only 5% contained semi-volatile contamination only (with no volatile contamination). For the low-occurrence state (state having the lowest percentage of public water systems with organic contamination), of the 15% of ground water systems that had some type of organic contamination, 1% had both semi-volatiles and volatiles, and 2% had semi-volatile contamination without volatile contamination. While a correlative association may not be overtly apparent, it seems that semi-volatile contamination in the absence of volatile contamination is rare.

A follow-up study by NJDEP and EOHSI will investigate whether or not unregulated contaminants reach public supply wells where there are no maximum contaminant level violations and where contaminated sites are located within the Source Water Assessment area for the wells. A brief description of the Source Water Assessment Program is presented in Section V.2. of this paper. More detailed information on the program is available at http://www.state.nj.us/dep/swap.

2. Surface Water

The USGS studies (2, 3) utilized newly developed laboratory methods at its Denver laboratories to provide baseline information on the environmental occurrence of a wide range of organic wastewater contaminants in surface water used or having the potential to be used as sources of drinking water. Analytical methods were developed for the determination of more than 100 contaminants typically found in domestic, industrial, and agricultural wastewaters. Examples of these unregulated contaminants include pharmaceuticals, antibiotics, hormones, personal care product ingredients, and various industrial and commercial products. Thirty stream sampling locations were selected in New Jersey, mostly located downstream or near potential sources of human wastewaters. The strategic field sampling plan for this project involved a vulnerability assessment that utilized the basin hydrodynamics, land use coverage, and percent wastewater contribution to stream flow as elements. Some locations had no wastewater discharges upstream, and the maximum number of such discharges upstream from a sampling location was 51. Over 90 percent of the stream water samples contained detectable concentrations of one or more of the target compounds. The number of compounds detected per sample ranged from zero to 32, with a median of 11. The total number and concentration of target compounds detected per sample correlates significantly with the percentage of streamflow contributed by sewage treatment plants, indicating that the likely primary source for many of these compounds is effluent from the wastewater treatment process.

In addition, 24 water samples were collected at selected locations throughout a water-treatment facility and from the two streams that serve the facility. Several compounds frequently detected in raw-water supplies were also frequently detected in samples of finished water including prescription and non-prescription pharmaceuticals and their metabolites, fragrance compounds, flame retardants and plasticizers, cosmetic compounds, and a solvent.

Results from these studies indicate that organic contaminants that represent a broad suite of uses and origins can enter and persist in environmental waters and subsequently occur in finished drinking water supplies. Also, the studies indicate that unregulated contaminants tend to occur at those surface water systems where the percentage of streamflow contributed by sewage treatment plants is high. That is, the highest numbers (and highest concentrations) of wastewater contaminants occurred in surface water intakes that were downstream of a wastewater discharger. In most instances, the water systems did not have air-stripping present. This is not surprising, as volatile contaminants are often reduced to below detectable levels from the water before they can reach the intakes. On the other hand, the semi- and non-volatiles are able to remain in the water phase and reach the intake.

3. Dover Township Cancer Cluster Study

In 2003, The New Jersey Department of Health and Senior Services (DHSS) and the Agency for Toxic Substances and Disease Registry completed a New Jersey study and released a final report, *Case-Control Study of Childhood Cancers in Dover Township (Ocean County), New Jersey* (4). The overall objective of the study was to identify possible disease risk factors that might explain why leukemia and brain and nervous system cancers were elevated among children in Dover Township, New Jersey. This exploratory epidemiological study examined several specific questions about the relationship between these childhood cancers and certain environmental exposure pathways identified in the community, including: exposures to specific public drinking water supply sources; exposure to contaminated private wells; and potential exposure to major air pollution sources.

The results of the study showed an association between several environmental exposures and leukemia in female children, specifically for the prenatal period, based on a combination of evaluation criteria for the risk factors and their association with cancers. The associations between environmental exposures and leukemia were not found in male children. Among the specific associations cited in the report was one between prenatal exposure to a specific drinking water well field serving the water system in the area and leukemia in female children.

A report on the water quality assessment conducted in the area can be retrieved at the DHSS website, http://www.state.nj.us/health/eoh/assess/trdwhcfin.pdf. In summary, samples from certain wells at the Parkway well field and parts of the United Water-Toms River distribution system, taken in March and April 1996, were found to contain low levels of trichloroethylene and a previously unidentified substance later determined to be styrene-acrylonitrile (SAN) trimer. The SAN trimer had been reported as a tentatively identified compound in earlier analytical tests. These contaminants are attributable to the Reich Farm hazardous waste site (CERCLIS #NJD980529713). Two of the Parkway wells (#26 and #28) had been treated by packed tower aeration since 1988 to remove trichloroethylene, but a third well (#29) showed sporadic contamination with trichloroethylene during this testing period. In response to the discovery of SAN trimer in November 1996, the United Water-Toms River Water Company voluntarily shut down the Parkway well field. By May 1997, activated carbon treatment to remove SAN trimer had been installed on wells #26 and #28, and the treated water was discharged to the ground (although this treated water could be pumped into the distribution system at times of high water demand). In June 1999, activated carbon treatment was installed for wells #29 and #22 at the Parkway well field, to protect against sporadic or potential contamination, and a new well (#26B) was installed to assist in the control of the contaminated ground water plume.

Though the results from the epidemiological report are considered to be inconclusive, the study illustrates the significance of uncertainty on public perception. Due to public pressure, water from the contaminated well is not being used by the water system despite being treated with both air-stripping and granulated carbon filter technologies. Even after extensive treatment has been installed to remove organic contamination to undetectable levels, some members of the public are still clearly not willing to accept the water.

IV. The Current Approach to Regulation of Contaminants in Drinking Water

1. Federal Role in Setting Drinking Water Standards

Drinking water standards are regulations set by USEPA to control the level of contaminants in the nation's drinking water. These standards are part of the Safe Drinking Water Act's "multiple barrier" approach to drinking water protection, which includes assessing and protecting drinking water sources; making sure water is treated by qualified operators; ensuring the integrity of distribution systems; and making information available to the public on the quality of their drinking water. With the involvement of USEPA, states, tribes, drinking water utilities, communities and citizens, these multiple barriers ensure that tap water in the United States and territories is safe to drink. In most cases, USEPA delegates responsibility for implementing drinking water standards to states and tribes.

There are two categories of federal drinking water standards:

A **National Primary Drinking Water Regulation** is a legally- enforceable standard that applies to public water systems. Primary standards protect drinking water quality by limiting the levels of specific, individual contaminants that can adversely affect public health and are known or anticipated to occur in water.

A **National Secondary Drinking Water Regulation** is a non-enforceable guideline regarding contaminants that may cause cosmetic effects (such as skin or tooth discoloration) or aesthetic effects (such as taste, odor, or color) in drinking water. USEPA recommends secondary standards to water systems but does not require systems to comply. However, states may choose to adopt them as enforceable standards.

In developing drinking water standards, EPA must first make determinations about which contaminants to regulate. These determinations are based on health risks and the likelihood that the contaminant occurs in public water systems at levels that may cause harmful human health effects. The National Drinking Water Contaminant Candidate List, published on March 2, 1998, lists contaminants that are not regulated under the Safe Drinking Water Act, may have adverse health effects, and are known or anticipated to occur in public water systems. The regulation describing the list is discussed in the section on how the federal government addresses unregulated contaminants, Section VI.1..

Once it is determined that a contaminant should be regulated, USEPA sets a Maximum Contaminant Level Goal (MCLG), the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which allows an adequate margin of safety. MCLGs are non-enforceable public health goals. Adequate studies of the health effects of the specific chemical by exposure pathways relevant to drinking water are necessary in order to develop an MCLG. When determining an MCLG, USEPA considers the risk to sensitive subpopulations (infants, children, the elderly, and those with compromised immune systems) of experiencing a variety of adverse health effects. As MCLGs are based only on health effects and do not consider the limits of detection or treatment technology, they may be set at levels that are not measurable or quantifiable by currently available analytical methods.

- **Non-Carcinogens (not including microbial contaminants)**: For chemicals that are of concern because they can cause adverse non-cancer health effects, the MCLG is based on the reference dose. A reference dose (RfD) is an estimate of the amount of a chemical that a person can be exposed to on a daily basis that is not anticipated to cause adverse health effects over a person's lifetime. In RfD calculations, sensitive subgroups are considered, and the uncertainty in the RfD may span an order of magnitude.
    - The RfD is combined with exposure assumptions, including typical adult body weight (70 kg) and daily water consumption (2 liters) to provide a Drinking Water Equivalent Level (DWEL).
    - The DWEL is multiplied by the percentage of the total daily exposure assumed to be contributed by drinking water (often 20 percent), known as the Relative Source Contribution factor, to determine the MCLG.

- **Carcinogens:** If there is evidence that a chemical may cause cancer in humans, and that this may occur through a non-threshold mechanism, the MCLG is set at zero. If carcinogenicity is judged to occur through a mechanism which has a threshold, the MCLG is set at a level above zero at which there is considered to be no risk.

- **Microbial Contaminants:** For microbial contaminants that may present public health risk, the MCLG is set at zero because ingesting one protozoa, virus, or bacterium may cause adverse health effects. USEPA is conducting studies to determine whether there is a safe level above zero for some microbial contaminants. So far, however, this has not been established.

Once the MCLG is determined, USEPA sets an enforceable standard. In most cases, the standard is a maximum contaminant level, the maximum permissible level of a contaminant in water that is delivered to any user of a public water system.
The maximum contaminant level is set as close to the MCLG as feasible, taking into consideration analytical detection limits, best available treatment technology, and cost. When there is no reliable analytical method that is economically and technically feasible to measure a contaminant, a treatment technique is set rather than a maximum contaminant level. A treatment technique is an enforceable procedure or level of technological performance that public water systems must follow to ensure indirect control of a contaminant. Examples of treatment technique rules are the Surface Water Treatment Rule (disinfection and filtration) and the Lead and Copper Rule (optimized corrosion control).

After determining a maximum contaminant level or treatment technique, USEPA must complete an economic analysis to determine whether the benefits of that standard justify the costs. If not, USEPA may adjust the standard to a level that "maximizes health risk reduction benefits at a cost that is justified by the benefits." USEPA may not adjust the standard if the benefits justify the costs to large systems and to small systems that are unlikely to receive variances. (States are authorized to grant variances from standards for systems serving up to 3,300 people under certain conditions. However, exemptions cannot be granted for microbial contaminants.)

2. New Jersey Role in Setting NJ-specific Drinking Water Standards

The Department adopts all federal primary drinking water regulations by reference (N.J.A.C. 7:10-5.1). Where both the state and federal government have standards for a given contaminant, the more stringent standard is used in New Jersey, by statute. In the absence of a federal maximum contaminant level, New Jersey may set its own standard, using the methodology outlined in the New Jersey Safe Drinking Water Act. Currently, over 90 biological and chemical (organic and inorganic) contaminants are regulated in drinking water in New Jersey, using the criteria established in both the federal and New Jersey acts.

In 1984, the governor of New Jersey signed landmark legislation in the form of amendments to the New Jersey Safe Drinking Water Act (N.J.S.A. 58:12A-1 et seq.), commonly called the “A-280 amendments.” This legislation outlined several new drinking water programs for the protection of public health. It required semi-annual monitoring of public community water systems for 22 synthetic organic contaminants; selection of additional contaminants or future regulation in drinking water; mandated timeframes for the correction of contamination problems in public community water systems; and required maximum contaminant levels be established based on risk assessment, analytical capability and treatability criteria as specified in the legislation. These amendments were passed following the release of several reports in the 1980s showing both statewide and nation-wide volatile organic contamination in ground water supplies. Although the state and federal governments had required monitoring of public community water systems for microbiological parameters, inorganics, radiological contaminants and certain disinfection by-products since the 1970's and there were maximum contaminant levels or standards developed for these parameters, there were no enforceable standards available for the volatile organic compounds being detected in groundwater. In 1983, the USEPA indicated its intent to regulate 13 volatile organic compounds but did not promulgate standards for several years.

The A-280 amendments also established the Drinking Water Quality Institute, a 15-member advisory body tasked with recommending maximum contaminant levels to the Commissioner of the Department using the process outlined in the act. The standard-setting process in New Jersey is a chemical-specific approach and is similar to that used by the USEPA. First, a health-based level is determined using the most currently available toxicological data with appropriate safety factors. The drinking water health-based goal is a one in one million excess cancer risk over a lifetime of exposure for carcinogens in New Jersey, and a goal of no adverse physiological effects for noncarcinogens.

After determining the health-based level, a practical quantitation level for each chemical contaminant is established. Established USEPA analytical methodologies are always used to analyze drinking water for compliance purposes. NJDEP's approach to determining the practical quantitation limits is similar to USEPA's. The practical quantitation level is the level where quantitation can be achieved with acceptable variability among most laboratories. The practical quantitation level is determined either through the use of inter-laboratory study data or, in absence of sufficient information, through the use of a multiplier of 5 to 10 times the method detection limit. USEPA has conducted water supply performance evaluation studies twice a year for the last twenty years. Data from these studies are used for the determination of practical quantitation level determinations. Using graphical or linear regression analysis of the water supply data, the Agency sets a practical quantitation level at a concentration where at least 75% of the laboratories (generally USEPA and State laboratories) can perform within an acceptable level of precision and accuracy. The Department has access to these data and currently uses the database to determine NJ-specific practical quantitation levels. The detection limit itself is never used by the Department or USEPA to determine the lowest level at which a chemical can be reliably detected in drinking water among laboratories.

The method detection limit is a measure of method sensitivity and it is defined as "the minimum concentration of a substance that can be reported with 99% confidence that the analyte concentration is greater than zero." Method detection limits can be operator, method, laboratory, and matrix specific. Due to normal day-to-day and run-to-run analytical variability, method detection limits may not be reproducible within a laboratory or between laboratories.

Once the health-based values and practical quantitation limits have been determined, the respective technological feasibility of water treatment techniques is evaluated to determine if the chemicals can be effectively reduced to below detectable levels from drinking water. For noncarcinogens only, cost can also be considered in standard setting New Jersey.

In 1987, three years after the A-280 amendments were signed, maximum contaminant levels were recommended for 18 compounds representing 16 of the 22 hazardous contaminants (plus isomers) listed in the A-280 amendments. The Department adopted these into regulations in 1989. Included in the recommendations was a suggestion that the health information used to derive the maximum contaminant levels should be reviewed every three years and the maximum contaminant levels updated accordingly. In 1993, revised health-based levels for six regulated contaminants were recommended, based on new information or on reinterpretation of previous data. The revision of the health-based levels resulted in more stringent maximum contaminant levels for all six contaminants and were incorporated into New Jersey regulations in 1996. Additionally, maximum contaminant levels for five additional chemicals were adopted at this time.

The slight variations in the standard-setting process between the USEPA and NJDEP have resulted in differences in maximum contaminant levels. In New Jersey, there are 13 maximum contaminant levels that are more stringent than Federal maximum contaminant levels for the same chemical. Further, NJDEP regulates five additional chemicals that are not regulated by USEPA. There are currently maximum contaminant levels for 26 volatile organic contaminants and 30 synthetic organic contaminants (mainly pesticides) in New Jersey. There are also standards for microbiological, inorganic, and radiological contaminants. New Jersey maximum contaminant levels are listed at http://www.state.nj.us/dep/watersupply/standard.htm. Both federal and state standards are in Table 1 and include World Health Organization standards for comparison purposes, as appropriate.

Once a maximum contaminant level is established, the 600 community water systems (i.e., a public water system that serves at least 15 service connections used by year-round residents or regularly serves at least 25 year-round residents, an example of which is a township water system or a mobile home park) and approximately 900 nontransient, noncommunity water systems (i.e., a public water system that is not a public community water system and that regularly serves at least 25 of the same persons for more than six months in any given calendar year, and example of which is a school) are required to add the contaminant to the list of chemicals for monitoring and reporting according to a schedule established in both state or federal regulation. The owner of the water system is responsible for resolving violations of the maximum contaminant level when a violation is determined. Violations are typically resolved by obtaining water of acceptable quality from another system, finding and using a new source of water supply (i.e., drill a new well), or providing treatment to remove the contaminant. Depending on the contaminant, treatment costs are provided by the owner of the water system, the Spill Compensation Fund, or those responsible for causing the contamination.

V. New Jersey’s Current Approach to Addressing Unregulated Contaminants in Drinking Water

1. Chemical-Specific Approaches

There are several ways that the Department currently addresses the presence of unregulated compounds in drinking water when there are no corresponding maximum contaminant levels.

1. Develop a new drinking water maximum contaminant level.
2. Use ground water quality standards, including generic standards.
3. Use guidance based on available information sources such as the USEPA Integrated Risk Information System database or USEPA Health Advisories.
4. Use generic drinking water policy.

1. The first approach is to set a new maximum contaminant level. The Department has the authority to regulate more contaminants than those on the original list of 22 included in the A-280 amendments, provided that the contaminant occurs with some frequency in New Jersey drinking water. In 1996, the Department used this procedure to identify and regulate five additional contaminants. Criteria for selecting additional compounds to regulate are: 1) frequency of occurrence in drinking water; 2) availability of toxicity data on which to base a chemical-specific risk assessment; 3) availability of an analytical technique capable of detecting the compound; and 4) availability of a treatment methodology to reduce concentrations of the compound to below the maximum contaminant level from water. Since 1996, no additional organic contaminants have been regulated. However, recently the Department proposed a maximum contaminant level for arsenic which differs from the federal standard and is the most stringent arsenic standard in the country. The process depends on the deliberations and recommendations of the Drinking Water Quality Institute and the proposal and adoption of Departmental rules.

2. Another way the Department addresses the occurrence of unregulated contaminants is through the use of the Ground Water Quality Standards (N.J.A.C. 7:9-6). Ground water quality standards, listed in Table 3, do not have the same regulatory status in drinking water supplies that maximum contaminant levels have. The ground water quality standard for a contaminant is based upon the health-based ground water quality criterion, developed using the same risk assessment approaches and assumptions as the health-based maximum contaminant levels, and analytical considerations (practical quantitation level) similar to that used for maximum contaminant level development. However, availability of treatment methodology is not considered in ground water quality standard development. There are ground water quality standards for many more organic contaminants than there are maximum contaminant levels. In the absence of an established maximum contaminant level or a ground water quality standard, the Department has the ability to develop an interim specific criterion for a specific contaminant based upon the weight of evidence available regarding each contaminant’s carcinogenicity, toxicity, public welfare or organoleptic effects, as appropriate, for the

protection of the potable water use. In addition, where the Department believes that the existing specific criteria are no longer appropriate in light of current scientific information, the Department may develop new interim specific criteria. Interim specific criteria may be derived by the Department for any contaminant of concern, in accordance with the methodologies or risk assessment approach discussed in the regulation. Interim and interim specific ground water quality standards are used by the Department as enforceable standards. Where no specific or interim specific criterion exists (or published health based information is lacking) for a synthetic organic chemical, the interim generic criteria for carcinogenic and non-carcinogenic synthetic organic chemicals shall apply until an interim specific criterion has been established. Lists of ground water quality standards, specific criteria, interim specific criteria, interim generic criteria are presented in Table 3. For information on ground water quality standards, go to www.state.nj.us/dep/wmm/sgwqt/njac79-6.pdf.

3. If a chemical has no maximum contaminant level or ground water quality criterion, there may be existing risk assessment information that can be used to evaluate the chemical. Such information includes the USEPA Integrated Risk Information System database, which provides peer reviewed risk assessment data on many chemicals. The Integrated Risk Information System, prepared and maintained by the USEPA, is an electronic database containing information on human health effects that may result from exposure to various chemicals in the environment. Files on individual chemicals contain descriptive and quantitative information on oral reference doses and inhalation reference concentrations for chronic noncarcinogenic health effects and hazard identification, oral slope factors, and oral and inhalation unit risks for carcinogenic effects. The risk assessments in the Integrated Risk Information System represent a consensus opinion of USEPA health scientists representing the program offices including the Office of Research and Development. The consensus process involves interpreting the scientific literature applicable to health effects of a chemical and using established methodologies to develop values for oral reference dose, inhalation reference concentration, carcinogenic slope factor and unit risk. The products of this work, summarized in the Integrated Risk Information System and elaborated in chemical-specific support documents, have been subject to USEPA's peer review policy since its issuance in 1994. As new scientific information becomes available, USEPA will review it, as appropriate, and revise the Integrated Risk Information System files accordingly.

4. The policy exists of using 5 ppb for carcinogens and 50 ppb for noncarcinogens in drinking water for contaminants that have no maximum contaminant level. This policy is based on a preproposal published in the New Jersey Register in 1987 but seldom needs to be applied.

Contaminants in drinking water have been addressed through one of the above approaches for the pertinent water systems on a case-by-case basis. However, the recent studies by NJDEP-EOHSI and USGS-NJDEP-CDC show that the number of unregulated contaminants present in public water systems are too numerous to address under the current approaches. Health information needed to evaluate potential effects of exposure through drinking water may not be available for many of them. Many may be uncharacterized by-products of other compounds and, in addition, some may have no effect at all individually but when in the presence of other compounds may exert a deleterious effect.

2. The Source Water Assessment Program

In addition to the chemical-specific methods for controlling contaminants in drinking water, the Department uses the data developed for the Source Water Assessment Program to determine a particular drinking water source's susceptibility to contamination. This program has developed a methodology for regulators to target vulnerable systems in the state. The program determines vulnerability for both ground water and surface water systems.

The 1996 Amendments to the federal Safe Drinking Water Act (P.L. 104-182) require all states to establish and implement a Source Water Assessment Program for all public water systems. Complete information about the program is available on www.state.nj.us/dep/swap. A Source Water Assessment Program consists of the first three steps of a full Source Water Protection Program. The five steps are:

1. Delineate the source water protection area for ground water and surface water sources of public drinking water;
2. Inventory the significant potential sources of contamination within the delineated source water protection area;
3. Determine the public water system's susceptibility to contamination by sources inventoried within the source water protection area.
4. Contingency planning.
5. Protection plans.

Monitoring schedules outline the specific contaminants that have to be sampled and the frequency of sampling in public water systems. Monitoring schedules are based on a combination of federal requirements, state requirements, past chemical monitoring and past susceptibility assessment determinations made by the Department. The Source Water Assessments developed as part of this program will assist in determining the monitoring that each public water system will be required to perform.

New Jersey has a large number of public wells (approximately 6,000) and surface water intakes (approximately 60). There are also a large number of actual and potential contamination sources. In addition, land use has been intensive in New Jersey over the years, creating a wide range of non-point contaminant sources. Since not every contaminant in a source water protection area will reach a source, protection strategies may differ.

VI. How the Federal Government, Other States, and the European Union Address Unregulated Contaminants in Drinking Water

The following descriptions are presented for illustrative purposes only. This section is not meant as an exhaustive assessment of all activities of other agencies in this area.

1. USEPA

It has already been stated that currently, before a chemical can be considered for federal or state regulation, toxicity information that shows adverse or potentially adverse health effects is needed. However, there are a number of other strategies that USEPA is using in order to address the risk of unregulated chemicals to human health. The federal programs are generally information-based (such as the Right-To-Know program), incentive-based (such as providing companies with fiscal or regulatory incentives to using non-toxic chemicals in their manufacturing processes), or monitoring-based (such as the research studies being conducted in the Great Lakes region on persistent bioaccumulative toxics).

The regulatory mechanism that most clearly addresses unregulated contaminants in drinking water is the Unregulated Contaminant Monitoring Rule.

Unregulated Contaminant Monitoring Rule

The 1996 Amendments to the Safe Drinking Water Act requires the USEPA to establish criteria for a monitoring program for unregulated contaminants and to publish a list of contaminants to be monitored. The rule was published on September 17, 1999, and supplemented on March 2, 2000 and January 11, 2001. The data generated by the Unregulated Contaminant Monitoring Rule is be used to evaluate and prioritize contaminants on the Drinking Water Contaminant Candidate List (Table 4), a list of contaminants USEPA is considering for possible new drinking water standards.

Contaminants on the Contaminant Candidate List (Table 4) are divided into three groups based on priorities for regulation, need for further health research, and need for further occurrence data collection. The Unregulated Contaminant Monitoring Regulation requires USEPA to establish monitoring requirements for 30 contaminants in any 5-year cycle. Since many of the contaminants still have analytical methods under development, the success of the methods development efforts will dictate which contaminants will be monitored in the 5-year cycle. Currently, most of the unregulated contaminants with potential of occurring in drinking water are pesticides and microbes. In addition, every six years, USEPA will re-evaluate existing regulations to determine if modifications are necessary. In 2003, USEPA reported the results of its evaluation on the first five-year cycle. The agency finalized regulatory determinations for nine contaminants on the Contaminant Candidate List. The Agency determined that at this time it is not appropriate to develop regulations for acanthamoeba, aldrin, dieldrin, hexachlorobutadiene, manganese, metribuzin, naphthalene, sodium, and sulfate. Therefore, no new regulatory maximum contaminant levels will be set during the first five-year cycle of the Unregulated Contaminant Monitoring Rule. Among the contaminants being reviewed for possible future regulatory action are radon, methyl tert-butyl ether (MTBE) and perchlorate.

USEPA Guidelines for the Health Risk Assessment of Chemical Mixtures

To address concerns over health risks from multichemical exposures, the USEPA published the *Guidelines for the Health Risk Assessment of Chemical Mixtures* in 1986 (8), available at http://cfpub.epa.gov/ncea/raf/recordisplay.cfm?deid=20533. The Guidelines describe broad concepts related to mixture exposure and toxicity and includes few specific procedures. In 1989 USEPA published guidance for the Superfund program on hazardous waste that gave practical steps for conducting a mixtures risk assessment. Also in 1989, USEPA published the revised document on the use of Toxicity Equivalence Factors for characterizing health risks of the class of chemicals including the dibenzo-dioxins and dibenzofurans. In 1990, USEPA published a Technical Support Document to provide more detailed information on toxicity of whole mixtures and on toxicological interactions (e.g., synergism) between chemicals in a binary (two-chemical) mixture. The concept of toxicological similarity was also discussed. The Environmental Criteria and Assessment Office (now the National Center for Environmental Assessment) followed this with the development of a *Technical Support Document on Health Risk Assessment of Chemical Mixtures*. When the 1986 Guidelines were published, the Agency recognized that they would need to be updated as the science of chemical mixture assessment evolved. After an overview of the background and scope, the *Supplementary Guidance for Conducting Health Risk Assessment of Chemical Mixtures* (9), available at http://www.epa.gov/ord/archives/2001/august/htm/art_science_policy.htm, was released. This document puts forth the actual risk assessment paradigm for mixtures. This paradigm begins with problem formulation, then briefly discusses hazard identification, dose-response assessment, exposure, and risk characterization. The document is organized according to the type of data available to the risk assessor, ranging from data-rich to data-poor situations. Procedures are described for assessment using data on the mixture of concern, data on a toxicologically similar mixture, and data on the mixture component chemicals. The state of the science varies dramatically for these three approaches. The whole-mixture procedures are most advanced for assessing potential carcinogenic risk, mainly because of the long use of in vitro mutagenicity tests to indicate possible carcinogenicity. In vitro test procedures for noncancer endpoints are still in the pioneering stage. In contrast, the component-based procedures, particularly those that incorporate information on toxicological interactions, are most advanced for noncarcinogenic toxicity. No single approach is recommended in this supplementary guidance. Instead, guidance is given for the use of several approaches depending on the nature and quality of the data. An evaluation of the data may lead the user to decide that only a qualitative analysis should be performed. This generally occurs in cases where data quality is poor, inadequate quantitative data are available, data on a similar mixture cannot be classified as “sufficiently similar” to the mixture of concern, exposures cannot be characterized with confidence, or method-specific assumptions about the toxicological action of the mixture or of its components cannot be met. When this occurs, the risk assessor can still perform a qualitative assessment that characterizes the potential human health impacts from exposure to that mixture. Such a risk characterization should discuss each element of the risk assessment paradigm, including available information on the mixture itself, on its components, and on potential interactions among the components. Any information on fate and transport of the mixture that would affect its final composition at the time of exposure should be noted. The assessment of chemical mixtures is an area of active scientific investigation. As new information relevant to health risk from exposure to chemical mixtures becomes available, additional guidance documents will be published.

Persistent Bioaccumulative and Toxic (PBT) Chemical Strategy

The goal of this agency-wide, multimedia strategy, released in November 1998, is to identify and reduce risks to human health and the environment from current and future exposure to persistent, bioaccumulative pollutants. Persistent, bioaccumulative and toxic pollutants are chemicals that are toxic, persist in the environment, and bioaccumulate in food chains and, thus, pose risks to human health and ecosystems. The approach outlined in this strategy builds upon work initiated under the Great Lakes Binational Toxics Strategy and uses regulatory action where voluntary efforts are insufficient. The action plans will consider enforcement and compliance, international coordination, place-based remediation of existing persistent, bioaccumulative and toxic pollutant contamination, research, technology development and monitoring, community and sector-based projects, the use of outreach and public advisories, and opportunities to integrate efforts across chemicals.

Toxics Release Inventory Program

The Toxic Release Inventory is a right to-know-program dealing with toxic chemical emissions and waste from manufacturing and other facilities. It is a publicly available USEPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 and expanded by the Pollution Prevention Act of 1990. The program has provided a strong incentive for chemical users to reduce chemical waste, emissions, and use.

High Production Volume Chemical Testing Production

The USEPA, the Environmental Defense Fund (an environmental advocacy organization) and the American Chemistry Council entered into a voluntary agreement in 1999 to produce screening level data on 2,800 high production volume chemicals. Companies enter into consortia to provide this data. The program has generated a set of screening level data for most of the high production volume chemicals used in the US, and the USEPA has made this data available on their website.

2. Agency for Toxic Substances and Disease Registry

Chemical Mixtures Program

The Agency for Toxic Substances and Disease Registry has been mandated to determine the health impact of exposure to combinations of chemicals. Exposure to two or more chemicals occurs at numerous hazardous waste sites, sometimes by way of more than one exposure route. Meanwhile, the majority of current toxicological research focuses on the health effects of exposure to a single substance. In order to fulfill its mandate, the Agency for Toxic Substances and Disease Registry is engaged in a multi-faceted course of investigation into the human health effects of chemical mixtures, including: (1) identification of the mixtures of highest concern to public health, (2) estimation of the joint toxic action of these chemicals through assessment and laboratory methods, and (3) development of new methodologies for evaluating the health effects of mixtures.

To address the course of investigation, the agency develops *Interactions Profiles*. Similar to the agency Toxicological Profiles, these documents summarize the health effects caused by exposure to chemicals in a mixture. Other guidance the agency offers or plans to offer include: the development of *Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures,* which is designed to assist health assessors in determining the impact of chemical mixture exposure on public health; the development of *Minimal Risk Levels* for chemical mixtures, which is a paradigm using methods to derive health guidance values for mixtures such as chlorinated dibenzodioxins and polybrominated biphenyls; performance of *weight of evidence* analyses for combinations of chemicals, used to predict the influence of one chemical on the health effects of another chemical; and performance of laboratory studies in collaboration with other national agencies to validate weight of evidence analyses. More information on this program can be found at the agency's website, http://www.atsdr.cdc.gov/mixtures.html.

Among the specific objectives of the program are:

- Develop methods to evaluate toxicological interactions of chemical mixtures. Trichloroethylene, the most frequently found drinking water contaminant, is being studied in combination with chemicals such as vinyl chloride, arsenic and 1,2-dichloroethane that are found together in water.
- Test effects of metal mixtures using laboratory techniques. Simple mixtures of environmentally important chemicals such as arsenic, cadmium, chromium and mercury are being studied.
- Improve precision and reliability in toxicity assessment methods for mixtures. Dose-response relationships are being studied using mixtures of liver toxicants such as chloroform and trichloroethylene.
- Assess the absorption of toxic chemical mixtures through skin. Mixtures of chemicals such as polychlorinated biphenyls and pentachlorophenol are being studied in the presence of chemicals that are found together and can influence skin absorption rates.
- Develop new methods and protocols to estimate the toxicity of complex mixtures. Mixtures containing polycyclic aromatic hydrocarbons that are found in sediments of certain hazardous waste sites are being studied. Such methods, when fully developed and validated, may be useful to assess the toxicity associated with lifestyle and occupational exposures.

3. Great Lakes Region

The Great Lakes region has always been a centerpiece of evidence on the health and ecosystem impacts of toxic substances – from pesticides and eggshell thinning in eagles to polychlorinated biphenyls and cognitive disabilities in humans.

Great Lakes Water Quality Issues and the International Joint Commission

The United States-Canada International Joint Commission was established by the 1909 Border Waters Treaty. In the late 1990's the Commissions Science Advisory Board recognized the health and ecosystem impacts of pollution from persistent chemicals and called for a phase out of such chemicals in the region as the most effective way to protect the region from further impacts.

The Agreement, first signed in 1972 and renewed in 1978 and again in 1987 (http://www.on.ec.gc.ca/glwqa/glreport-e.html), expresses the commitment of Canada and the United States to restore and maintain the chemical, physical and biological integrity of the Great Lakes Basin Ecosystem and includes a number of objectives and guidelines to achieve these goals. The 1987 amendments aim to strengthen the programs, practices and technology described in the 1978 Agreement and to increase accountability for their implementation. Timetables are set for implementation of specific programs. The Agreement calls for the virtual elimination of persistent and bioaccumulative pollution in the region. Annexes address atmospheric deposition of toxic pollutants, contaminated sediments, groundwater, and nonpoint sources of pollution. Other annexes incorporate the development and implementation of remedial action plans for Areas of Concern and lakewide management plans to control critical pollutants.

4. California

In June 2003, the San Francisco City Council passed an ordinance making the precautionary principle the founding principle of environmental policy in that city (representing the first time the precautionary principle has been enacted into municipal law in the United States). The precautionary principle states that " when an activity raises threats of potential harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically." While not specifically focused on drinking water, the new policy seeks to reduce contamination by reducing the amount of hazardous or potentially hazardous chemicals released into the environment.

Similarly, in July 2003, the California legislature passed restrictions on the use of polybrominated diphenyl ethers (PBDE) as flame-retardants in commercial products. While toxicity studies are still underway, the legislature decided to ban the flame-retardant based on its accumulation in the breast milk and blood of pregnant women and in infants. This action represents the precautionary approach of removing the contaminant from the marketing stream in order to reduce its occurrence in the environment, and thereby reducing human exposure before hard evidence of adverse health effects are available.

California's Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986) (http://www.oehha.ca.gov/prop65.html) was enacted as a ballot initiative in November 1986. The Proposition was developed to protect California citizens' drinking water sources from chemicals known to cause cancer, birth defects or other reproductive harm, and to inform citizens about exposures to such chemicals. Proposition 65 requires the Governor to publish, at least annually, a list of chemicals known to the state to cause cancer or reproductive toxicity. This right-to-know law has reduced emissions of some toxics and has caused some phase-outs of chemicals from consumer products. The law also included a rapid risk assessment provision whereby hundreds of chemical risk assessments were performed in a two-year period of time.

5. Massachusetts

Massachusetts Toxics Use Reduction Act

Passed in 1989, the Toxics Use Reduction Act (http://www.turi.org/government/)is a far-reaching piece of chemicals legislation, which requires that manufacturing firms using more than 10,000 pounds per year of some 1,200 substances annually undertake a full materials accounting exercise (data from which are publicly available) and every two years undertake a comprehensive plan to identify and evaluate process and product alternatives that would reduce reliance on and waste from toxic chemicals. Massachusetts reports that, since 1990, the law has resulted in an 80% reduction in chemical emissions, a 57% reduction in chemical waste, and a 40% reduction in chemical use with an estimated net saving of $14 million. Companies pay a fee on chemicals that support the regulatory program as well as voluntary technical assistance, research and training centers.

6. New York

New York State Department of Health applies a generic drinking water maximum contaminant level for several types of "general organic chemicals". The rationale for doing this is explained in a 1987 summary: "Even though sufficient data do not exist to establish a chemical specific, toxicity-based criterion for each organic chemical contaminants found in drinking water, the presence of such contaminants in drinking water presents a health risk which although difficult to quantify should be minimized" (7).

For principal organic contaminants, the maximum contaminant level is 5 µg/L; for unspecified organic contaminants, the maximum contaminant level is 50 µg/L; and for total principal and unspecified organic contaminants, the maximum contaminant level is 100 µg/L. These values were generated after a review of the available toxicological information used to derive human health guideline levels for 200 organic chemicals (based on information published before 1978). The cumulative distribution of the guideline values was graphed and 50 µg/L was determined to be the level at which one third of the values were below. Similarly, 100 µg/L was adopted by multiplying 50 by two. It was similar to the median value of the graphed values (the median was 131 µg/L). It is unclear how New York established the value of 5 µg/L for the principal organic chemicals.

As defined in Part 5 of the NY Codes, Rules and Regulations (10 NYCRR Part 5), a principal organic contaminant means any organic chemical compound belonging to the following classes, except for trichloromethane (chloroform), dibromochloromethane, bromodichloromethane, tribromomethane (bromoform) and any other organic contaminant with a specific maximum contaminant level;

1. <u>Halogenated alkane</u>: Compound containing carbon (C), hydrogen (H) and halogen (X) where X = fluorine (F), chlorine (Cl), bromine (Br) and/or iodine (I), having the general formula CnHyXz, where y + z = 2n + 2; n, y and z are integer variables; n and z are equal to or greater than one and y is equal to or greater than zero.
2. <u>Halogenated ether</u>: Compound containing carbon (C), hydrogen (H), oxygen (O) and halogen X (where X = F, Cl, Br and/or I) having the general formula CnHyXzO, where y + z = 2n + 2; the oxygen is bonded to two carbons; n, y and z are integer variables; n is equal to or greater than two, y is equal to or greater than zero and z is equal to or greater than one.

3. Halobenzenes and substituted halobenzenes: Derivatives of benzene which have at least one halogen atom attached to the ring and which may or may not have straight or branched chain hydrocarbon, nitrogen or oxygen substituents.
4. Benzene and alkyl- or nitrogen-substituted benzenes: Benzene or a derivative of benzene, which has either an alkyl- and/or a nitrogen-substituent.
5. Substituted, unsaturated hydrocarbons: A straight or branched chain unsaturated hydrocarbon compound containing one of the following: halogen, aldehyde, nitrile, amide.
6. Halogenated non-aromatic cyclic hydrocarbons: A non-aromatic cyclic compound containing a halogen.

Unspecified organic contaminant means any organic chemical compound not otherwise specified. Chemicals may be exempted from the group if sufficient valid scientific information demonstrates that they do not pose a risk to human health, thereby reversing the United States convention of proving harm before regulating.

7. Washington

Washington State PBT Policy

In 1998, the Washington Department of Ecology announced a statewide phase out policy on Persistent, Bioaccumulative and Toxic (PBT) chemicals, with the goal of eliminating PBT pollution (http://www.ecy.wa.gov/programs/eap/pbt/pbtfaq.html). The program has designated nine persistent, bioaccumulative and toxic chemicals, and included 13 more in the "PBT Working List" of chemicals on which to focus in future action plans. Washington has chosen to initially focus on mercury, and has created a draft Action Plan (August 2002), which emphasizes outreach, education, monitoring, research, and voluntary initiatives. The next Action Plan will be on dioxin.

8. European Strategies for Addressing Unregulated Contaminants

There are several noteworthy activities that pertain to the regulation of chemicals in the environment in Europe. These are developed and implemented by various cooperative groups comprised of multiple European countries (i.e., European Union and the OSPAR Commission). The strategies are not necessarily geared to drinking water, but the approaches and issues are applicable to this discussion. For more information on the European Commission, visit http://www.europa.eu.int. For information on the OSPAR Commission, visit http://www.ospar.org. The strategies described here all rely on existing data availability on the chemicals. When data are not available, the chemicals are not included in the priority ranking schemes.

REACH Chemicals Policy

In October, 2003, the Commission of the European Communities published a final proposal for a regulation of the European Parliament and of the council concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), a.k.a. the "REACH Regulation". The primary purpose of this directive is the requirement that all "new" substances (as opposed to "existing" substances) used on the market in volumes of 10 kilograms or higher need to be tested and assessed for possible risks to human health and the environment before they are marketed. For higher volumes, more in-depth testing is required, with a focus on long-term and chronic effects. The justification for this policy is that it was felt by the authors that there is a general lack of publicly available knowledge about the properties and uses of existing substances and that the risk assessment process is slow and resource-intensive and does not allow the system to work efficiently and effectively. Under the former system, the public authorities are responsible for the assessment instead of the enterprises that produce, import or use the substances. Furthermore, current legislation requires only the manufacturers and importers of substances to provide information, but does not impose similar obligations on downstream users (industrial users and formulators). Thus, purport the authors, information on uses of substances is difficult to obtain and information about the exposure arising from downstream uses is generally scarce. Decisions on further testing of substances can only be taken via a lengthy committee procedure and can only be requested from industry after authorities have proven that a substance may present a serious risk. Without test results, however, it is almost impossible to provide such proof. Final risk assessments have therefore only been completed for a small number of substances.

In a nutshell, REACH consists of the following elements:

- Registration requires industry to obtain relevant information on their substances and to use that data to manage them safely.
- Evaluation provides confidence that industry is meeting its obligations and prevents unnecessary testing.
- Risks associated with uses of substances with properties of very high concern will be reviewed and, if they are adequately controlled, or if the socio-economic benefits outweigh the risks and there are no suitable alternative substitute substances or technologies, then the uses will be granted an Authorization.
- The Restrictions procedure provides a safety net to manage risks that have not been adequately addressed by another part of the Reach system.

One of the key benefits of REACH identified by the proponents is that by assessing the toxicity of substances and making information available more quickly, it has the potential to identify a hazard before damage occurs rather than waiting for monitoring to provide evidence of harm. Further, by providing data in a systematic manner, it enables risks to be assessed rigorously, allowing effective risk management measures to be identified. The availability of information on risks enables industry (chemical manufacturers and downstream users) to take voluntary action in response to stakeholder pressure and/or their own policies. It provides a basis for quicker regulatory action for the most hazardous substances.

The complete report can be accessed at http://europa.eu.int/commenviornment/chemicals/envhlthimpact.pdf.

European Prioritization Schemes: COMMPS and DYNAMEC

These two European rule-based schemes were designed to identify and prioritize substances that may pose risks to freshwater and marine environments and to human health via these exposure routes. They were not intended for drinking water prioritization but they do represent schemes for ranking large groups of chemicals, some of which have little or no background information available.

COMMPS (**co**mbined **m**onitoring-based and **m**odeling-based **p**riority **s**etting) is an automated risk-based assessment of chemicals using information on production volumes, use patterns, environmental distribution and biodegradation as input parameters. A high weight was given to substances that had monitoring exposure data. The list of 32 chemicals that were ultimately selected and recommended resulted from the 658 substances compiled and evaluated by this approach. Information on this program is available at http://europa.eu.int/comm/environment/docum/0047_en.htm.

DYNAMEC is defined as a "dynamic mechanism for selecting and prioritizing hazardous substances"(http://www.ospar.org/eng/html/welcome.html). This system was used by the OSPAR (Oslo and Paris) Commission for the protection of the Northeast Atlantic marine environment. One of the major goals of OSPAR is the identification, prioritization, monitoring and control of the emissions, discharges, and losses of hazardous substances reaching the Northeast Atlantic Ocean. The DYNAMEC system was developed to identify chemicals for action. Using three large European environmental databases, the substances were assessed as to their persistence, toxicity and ability to bioaccumulate. Additional chemicals, deemed to have an equivalent level of concern, are included through the "safety net" procedure. Fact sheets were developed on the chemicals, and 80 were selected for in-depth analysis (using production volume information and other similar data). The list of 80 substances was further reevaluated and prioritized into groups.

VII. Options for Enhancing New Jersey's Approach to Regulating Contaminants in Drinking Water

After numerous internal and external discussions on the subject, including deliberations among members of the Drinking Water Quality Institute, the Department feels that public comment is needed on the possible options for addressing unregulated drinking water contaminants. Therefore, a brief description of each of the options being considered is presented. They are:

1. Chemical-specific regulation of drinking water contaminants.
2. Intensive Site Remediation investigation of unregulated contaminant occurrence in ground water.
3. Regulation of classes of chemicals, by health end-point.
4. Regulation of classes of chemicals, by chemical property
5. Installation of water treatment technology to reduce levels of regulated and unregulated synthetic organic chemicals

1. Chemical-specific regulation of drinking water contaminants.

The chemical-specific approach to regulating drinking water contaminants is currently used in New Jersey. The general procedure is described in Section IV.2. of this discussion paper. The strategy for addressing unregulated contaminants under this approach follows the 3-step process described in Section V.1.. In short, this option represents the Department's current method of addressing contaminants in drinking water.

Economic Assessment:
Under the chemical-specific approach, contaminants would be identified using standard analytical techniques. For contaminants having available health information, analytical techniques and available treatment, the cost of developing a new maximum contaminant level would only involve Departmental staff time and review by the Drinking Water Quality Institute. Depending upon information available, the economic assessment varies, as described below.

- Analytical costs could range from as low as $20 for contaminants that are already target analytes in existing analytical methods to $200 for contaminants that are not detectable using an existing compliance method – a new method would need to be added to the analytical suite, but the method is established and available. Cost would be borne by the water supplies being monitored.
- Approximate costs for developing analytical methodologies for a compound where adequate health information is available: $500,000 per contaminant (based on information from laboratory studies and the NJDEP-EOHSI and NJDEP-USGS studies). Costs would be borne by the state.
- Approximate cost for developing health information for a contaminant where only an analytical method is available: $1 million to $10 million per contaminant (based on information from the Toms River Cancer Cluster study). Cost would be borne by the state. If appropriate toxicity information is available in the scientific literature, the costs would be much lower.
- Approximate cost for developing a maximum contaminant level for a compound having neither analytical method nor adequate health information: $1.5 million - $10.5 million per contaminant. Cost would be borne by the state.

Because the current chemical-specific approach for developing maximum contaminant levels relies on occurrence information from other programs and agencies using standard USEPA compliance methods, it is unlikely that the contaminants found in the studies (1, 2, 3) would be addressed soon or at all. Further, the prerequisite that a compound demonstrate adverse human health effects before being considered for regulation means that most of the compounds would probably not be addressed under this approach.

Advantages:

- Current method of setting standards is in alignment with the USEPA approach.
- Similar approach used for other standard-setting programs in the Department (e.g., Ground Water Quality Standards, Surface Water Quality Standards, and Soil Standards).
- USEPA-approved analytical methods are available for many of the contaminants that would be considered for regulation.

- Treatment technologies to reduce levels of contaminants are available.

Disadvantages:

- Current method may not be protective for unregulated contaminants.
- Does not fully address the potentially hundreds of synthetic organic chemicals that may be present in water supplies from hazardous waste sites.

2. **Intensive Site Remediation investigation of unregulated contaminant occurrence in ground water.**

This option requires the Site Remediation Program to greatly expand its program to better identify contaminants on site (including unregulated contaminants) and to determine the potential for contaminants to reach public water supplies. Such expansion might include research on analytical methods, preparation of standards for chemicals and even multi-year toxicological studies. The first step would involve plume assessment at sites near drinking water wells. The Source Water Assessment Program could be used to target water supplies that are susceptible to contamination. Preliminary information from this program shows that approximately 44% of New Jersey wells are highly susceptible to volatile organic chemical contamination due the presence of a source within their assessment areas.

As part of this option, any contaminants that were found to be migrating off the contaminated property would need to be identified and investigated with possible remediation provided for the site and any potentially impacted drinking water sources. The remediation that would be required at any drinking water source impacted by organic contaminants would likely be air-stripping or air-stripping with granular activated carbon treatment, as described in option #5.

This approach would require more detailed information about compounds disposed of at contaminated sites and may involve investigation of parent compounds from original manufacturers. In order for this approach to work effectively, chemical manufacturers and sources of contaminants to sites would need to make health and environmental information on their products more available. Taking this a step further, the tenets behind the European Union's REACH directive could be applied – companies that manufacture and market new chemicals should test them for human health and environmental effects before using them. While this would not address the issue of degradation products or chemical interactions in the environment, it would supply much needed information on chemicals that are used in the market before they reach the waste stream. A program that incorporates components of the Source Water Assessment Program to determine susceptibility with a chemicals policy at the manufacturing stage would greatly reduce human and environmental exposure to synthetic organic chemicals.

<u>Economic Assessment</u>

This approach would require significant Site Remediation Program staff resources to implement. It would be under the discretion of the current program to determine whether it has the staff and/or resources to conduct the additional work, which could be significant. Further, once it is determined that a contaminant has reached a public drinking water supply, the likely action taken would be to install treatment to reduce levels of the contaminant. Cost estimates would then be similar to those outlined in approach #5. However, under this approach, it would be easier to definitively identify the source(s) of the contamination and thereby direct the responsible parties to pay for the water treatment.

Advantages:

- This approach puts responsibility where it belongs- with the polluter (or public funds for addressing pollution where no responsible party is identified).
- This approach would limit activity to locations with known or suspected contamination problems.

Disadvantages:

- Significantly resource-intensive for both the Site Remediation Program and responsible parties.
- The nature of tentatively identified compounds (i.e., the fact that they are only "tentative" identifications) makes investigations difficult and subjective.
- Relationship between susceptibility and contamination has not been fully studied.
- Relationship between exposure and health effects might remain unresolved.

3. Regulate classes of chemicals, by health end-point.

The Department considered two general approaches involving regulating chemicals by generic classes. The approach described in this section involves regulating classes of chemicals according to their health end-points. For instance, one such group could be the "carcinogens." All chemical carcinogens, such as those on those classified as known, possible or probable human carcinogens by USEPA on its Integrated Risk Information System database (http://www.epa.gov/iris), the list developed by the International Agency for Research on Cancer (http://www.monographs.iarc.fr/monoeval/grlist.html), or the list generated by California's Proposition 65 (http://www.oehha.ca.gov/prop65.html) would be regulated at some level, for instance, at the level of analytical detection. Of the universe of chemicals known to be carcinogenic, only a fraction is known to occur in drinking water. However, only a fraction of these are included as a target analyte in drinking water methods. Therefore, even if these carcinogenic compounds were present in water, most would not be detected in a given water sample. For those carcinogens that are found with some frequency in drinking water, maximum contaminant levels have already been developed.

The USEPA's Integrated Risk Information System database has been described in Section IV.1. of this paper. California's Proposition 65 is described in Section VI.4..

Since 1969, the International Agency for Research on Cancer (IARC) has evaluated the carcinogenic risk of chemicals to humans and to produce monographs, or critical reviews, on individual chemicals. More than 900 chemicals have been evaluated to date. The objective of the IARC program is to prepare publish monographs and evaluations of evidence on the carcinogenicity of a wide range of human exposures to contaminants. This is accomplished with the help of international working groups of experts

IARC categorizes chemicals by their degree of evidence for carcinogenicity in humans and in experimental animals. These categories refer only to the strength of the evidence that an exposure is carcinogenic and not to the extent of its carcinogenic activity (potency) nor to the mechanisms involved. The categories used by IARC are as follows:
Group 1: The agent (mixture) is carcinogenic to humans.
Group 2 (two classifications):
Group 2A: The agent (mixture) is probably carcinogenic to humans.
Group 2B: The agent (mixture) is possibly carcinogenic to humans.
Group 3: The agent (mixture, or exposure circumstance) is not classifiable as to carcinogenicity in humans.
Group 4: The agent (mixture, exposure circumstance) is probably not carcinogenic to humans.

For a chemical to be judged a potential water contaminant, an analytical method must be available to detect it. For regulatory purposes, the compound must be detectable by a formal USEPA method. Using the IARC list as an example, of the 166 compounds listed, 67 are detectable using a current conventional USEPA analytical method. There are 31 different analytical methods for those 67 chemicals. Methods would need to be identified and standardized for the remaining 99 carcinogens. But there is more to the analytic issue than whether a suitable method exists. The issue of “detection limit” is significant. There are practical quantitation levels established for only these 67 compounds. See Section IV.2. of this paper for a description and discussion of practical quantitation levels. While analytical methods may exist for the remaining 99 (and there likely are methods available, given the fact that carcinogenicity tests have been run of these chemicals), standardization of the methods and detection limit issues have not been addressed. Clearly, analytical issues are significant and costly under this approach.

Another issue of concern is that of regulating chemicals at the detection limit. The method detection limit is the lowest concentration level at which an analyte can be measured by an analytical method with confidence that the analyte detected is greater than zero. However, accurate and reproducible quantitation might not be achievable at this level. The method detection limits for a given analytical method may vary among laboratories and instruments; further, conditions may vary day to day on the same instrument used by the same operator. Neither the Department nor USEPA regulate drinking water at the method detection limit, but instead use the practical quantitation limit, as described in option #1.

For identified chemicals classified as carcinogens, the health-based goal would become "zero" (USEPA approach) instead of the one in one million goal, the current requirement of the New Jersey Safe Drinking Water Act. This policy is based on the assumption that there is no threshold for carcinogenic effects, and that exposure to any dose, no matter how low, poses some risk. When this non-threshold assumption is made and a decision is made to set the health-based goal at zero, no quantitative risk assessment and slope factor development would be required. However, it must be noted that this quantitative risk assessment is actually only a minor part of the entire standard development process.

It should also be mentioned that USEPA currently recommends using threshold carcinogenicity assumptions for certain carcinogens (i.e., chloroform) if there is mechanistic evidence that the carcinogencity occurs through a threshold mechanism rather than using zero as the maximum contaminant level goal, which is a departure from previous policy. Therefore, the automatic assignment of zero as the health-based goal for a chemical carcinogen may not be appropriate in all cases.

Far more important than the lack of actual savings in effort required for standard development, this option may not actually result in an increase in public health protection. As shown by the results of the recent studies (1, 2, 3), most of the unregulated chemicals found in New Jersey drinking water supplies are unusual ones for which very little health effects information is available, and for which positive identification may not even be possible. Therefore, these chemicals would not appear on any list of potential carcinogens and would not be regulated under the proposed approach.

Economic Assessment

There are 31 different analytical methods for the 67 chemicals having analytical techniques. Assuming each new method adds approximately \$20 to \$200 to the cost of analyze one water sample for the 67 chemicals on the IARC list (31 methods), the total additional cost would be \$620 to \$6200 per water sample. In addition, several additional analytical methods would need to be devised and developed for those 99 contaminants on the IARC list that are not currently included in a conventional method. The development of a new analytical method costs approximately \$500,000 to \$1 million.

With this option, the savings in money and effort would be in the area of the health-based risk assessment. Once a contaminant is identified as a carcinogen, no further risk assessment would need be developed.

Advantages:

- Some progress would be made toward identifying the universe of carcinogens that are likely to occur in drinking water.
- There are existing lists of carcinogens that could be used as a starting point, so new lists need not be developed

Disadvantages:

- Some chemical-specific information is necessary to identify carcinogens
- The issues of “detection limit” and NJ-specific practical quantitation levels are not resolved.
- EPA approved analytical methods are not necessarily available for the broad range of chemicals identified as carcinogens.
- The approach would address chemicals that may not be of concern in drinking water while missing other chemicals that may be of concern.
- Applicability of drinking water standards to other standard-setting programs in the Department may be impacted.

4. Regulate classes of chemicals, by chemical property.

The second approach to regulating contaminants by class involves classifying the chemicals by chemical characteristics. This approach is already used in New Jersey, under the Ground Water Quality Standards guidance in the generation of Interim Generic Criteria for Synthetic Organic Chemicals (see Table 3 for the complete list of all ground water quality standards):

Contaminant	Water Quality Criteria
Synthetic organic contaminants with evidence of carcinogenicity and lacking specific or interim specific criteria	5 ug/l each 25 ug/l total
Synthetic organic contaminants lacking evidence of carcinogenicity and lacking specific or interim specific criteria	100 ug/l each 500 ug/l total

New York State derives several of their state-specific maximum contaminant levels and water quality by regulating certain classes of organic contaminants. The New York approach is described in Section VI.6. of this paper. For principal organic contaminants, the maximum contaminant level is 5 µg/L; for unspecified organic contaminants, the maximum contaminant level is 50 µg/L; and for total principal and unspecified organic contaminants, the maximum contaminant level is 100 µg/L. These values were generated after a review of the available toxicological information used to derive human health guideline levels for 200 organic chemicals (based on information published before 1978). The cumulative distribution of the guideline values was graphed and 50 µg/L was determined to be the level at which one third of the values were below. Similarly, 100 µg/L was adopted by multiplying 50 by two. It was similar to the median value of the graphed values (the median was 131 µg/L). Using the same approach but with current New Jersey maximum contaminant levels, the corresponding values would be 2 µg/L for unspecified and 6 µg/L for total. It is unclear how New York established the value of 5 µg/L for the principal organic chemicals, so it is impossible to draw an analysis.

Another way of addressing potentially large numbers of contaminants occurring at low levels when health information is lacking or unknown would be to add up their concentrations and compare this sum to a generic standard. This could apply to both target unregulated compounds as well as tentatively identified compounds. A threshold value could be established for targeted analytes and another value established for the tentatively identified compounds. Methodologies for developing these threshold values would need to incorporate any health information currently available on them.

Individual chemicals within a class may behave quite differently and may have great variation in their toxic effects, both quantitatively and qualitatively. Regulating them as classes within chemical categories ignores the potential differences among chemicals within the same class. However, this approach eliminates the toxicological evaluation that is currently performed on all regulated chemicals. By developing drinking water standards similar to the ground water interim generic criteria, many organic compounds would be captured and indirectly regulated.

Economic Assessment

Under this approach, unregulated contaminants would be identified using standard analytical techniques. For contaminants detected, the cost of applying a generic standard would involve Departmental staff time only.

Advantages:

- This approach would provide guidance for chemicals for which no maximum contaminant level has been developed and for chemicals not yet listed as target analytes in routine analytical methods.
- Another state has adopted a similar approach (New York).

Disadvantages:

- The toxicity of individual chemicals, based on chemical classification, vary too much to be addressed in this way.
- Some level of health information is still needed in order to classify the chemicals.

5. Installation of water treatment (e.g., granular activated carbon)

This proposed approach would be to install water treatment on drinking water supplies vulnerable to contamination by unregulated synthetic organic chemicals. In effect, this option calls for the development of a “treatment technique” drinking water standard in lieu of a chemical-specific maximum contaminant level. The approach would result in a proposal to amend the New Jersey Safe Drinking Water Act regulations to include a treatment technique (e.g., granular activated carbon) as a primary drinking water regulation to reduce levels of currently unregulated synthetic organic compounds. A primary drinking water regulation specifies either a maximum contaminant level for each contaminant of concern or allows the Department’s Commissioner to specify a treatment technique in instances where determining the level of the contaminant is not economically or technologically feasible. This strategy represents a proactive approach to protecting public health in the absence of little or no definitive scientific information on the contaminants being detected. This option asserts that given the uncertainty in the health information available for these contaminants, the current methods of addressing unregulated compounds cannot be applied. In order to develop a maximum contaminant level, a ground water quality standard or an interim ground water quality standard, some minimum amount of toxicity information is necessary. For many contaminants detected in the NJDEP-EOHSI and USGS- NJDEP -CDC studies, even basic toxicity information is lacking. Rather than wait for studies to be completed, this option proposes installation of treatment as a protective measure.

Further, this approach represents the likely action that would be taken if the other options are followed to their logical end-points. That is, the best available technology for removing many synthetic organic contaminants from drinking water is granular activated carbon. Most of the contaminants detected in the afore-mentioned government-funded studies were synthetic organic compounds. If the Department pursued the other options, the likely end result would be to install carbon treatment on numerous public water systems throughout the state.

Granular activated carbon (GAC) or a combination of air stripping (AS) with GAC would be the most likely acceptable treatment technology, although other technologies capable of treating organic contaminants would be considered as well. Carbon filters are very effective at reducing levels of some types of organic chemicals in drinking water, and will reduce levels of those contaminants of concern that are detected by current analytical methods used for compliance purposes. But carbon filters do have limitations and do not reduce levels of all contaminants from drinking water (e.g., lead, arsenic and mercury).

This approach would target drinking water systems that use ground water as source water. The intent is to eventually address all drinking water systems in the state, but it is recognized that this option would be done in a step-wise fashion. There are several ways of determining the "trigger" for action under this approach. One is to install water treatment on drinking water supplies already affected by organic chemical contamination. Water systems that currently have air-stripping due to a maximum contaminant level violation of a regulated organic contaminant would be targeted for water treatment using this approach. Preliminary assessments of Bureau of Safe Drinking Water data show that there are approximately 93 facilities serving 52 public community water supplies with air-stripping treatment technology. These are systems whose ground water has contained a level of a regulated volatile organic contaminant above the maximum contaminant level. Air-stripping reduces the levels to below the maximum contaminant level but may not be effective at reducing levels of semi-volatile and non-volatile organic contaminants. Granular activated carbon or a combination of air- stripping with granular activated carbon would be the likely acceptable treatment technologies under this approach. It would essentially eliminate the air-stripping-alone treatment technology as an acceptable option for removing organic contamination. Essentially, the presence of an elevated level of a regulated organic chemical would be used as the trigger for action. Studies have demonstrated that semi-volatile contaminants do not often occur in the absence of volatile contaminants as described in Section III.1. of this paper. By using the presence of volatile contamination, it is likely that most of the systems having semi-volatile contamination will be captured, as semi-volatile contamination in the absence of volatile contamination is rare. Therefore, it may appropriate to use contamination by regulated chemicals as a trigger for water treatment here, unless a better trigger can be established.

Another way to trigger action under this approach is to select systems by their vulnerability to organic chemical contamination. Using the Source Water Assessment Program data, 44% of drinking water wells in the state are considered highly vulnerable to volatile organic chemical contamination. There are no vulnerability assessments for semi-volatile chemicals as a class, however, no wells are considered highly vulnerable to pesticides, which are mostly semi-volatile organic chemicals. It is not known how many water systems these wells represent.

An important consideration in this approach would be the identification of contaminants to measure to determine treatment system efficiency. One possibility would be to use the regulated organic compounds.

Currently the Department regulations require treatment of the source of water if there is a violation of the maximum contaminant levels. However, the Safe Drinking Water Act does include a provision that allows the Commissioner to require the use of treatment techniques to reduce the level of contaminants which, in his judgement, may have adverse effects on human health, and where it is not economically or technologically feasible to ascertain the level of such contaminant (N.J.S.A. 58:12A-3). In this approach, it is acknowledged that it is neither economically or technologically feasible to ascertain the level of the unregulated contaminants in the water. As the contaminants may have adverse effects on human health, the Commissioner may require a treatment technique for water systems, as appropriate (i.e., systems that are already contaminated by volatile organic chemicals or that the Source Water Assessment Program designates as vulnerable).

Economic Assessment
Preliminary assessments of Bureau of Safe Drinking Water data show that there are approximately 93 facilities serving 52 public community water supplies with air-stripping treatment technology. These 52 water systems have an estimated total capacity of 136 million gallons per day. Economic information from one water purveyor, United Water – Toms River, indicates that the cost to install one carbon unit at a facility (approximately one million gallons per day capacity) is approximately $1 million. The annual operations and maintenance cost for the unit would be an additional $70,000. Therefore, the installation cost to implement this approach for ground water systems would be approximately $93 million.

Advantages:

- Proactive approach to protecting public health.
- Addresses ingestion as well as exposures from other potable water uses (i.e., inhalation, dermal absorption from showering, bathing, washing dishes, etc.).
- Regulated contaminants, when present, may be used to monitor efficacy of removal technology (i.e., granular activated carbon).

Disadvantages:

- Initial cost may be high.
- Need to define who/how to pay for the installation of the treatment.
- Efficacy of the water treatment will be difficult to monitor in instances where suitable certified analytical techniques are not available.
- Does not account for water system vulnerability (as proposed, only systems with contaminant exceedances will install carbon).
- The issue of how to relate this approach to surface water systems or to private wells is not fully understood.

VIII. Requested Input from Interested Parties

The Department is seeking input from interested parties on the approaches described. This discussion paper represents an early notice to the public of the options being considered by the Department to address the issue of unregulated contaminants in drinking water. The Department is interested in comments on these specific issues:

- Regulatory authority for the approaches.

- Practical feasibility of the various approaches.
- Cost versus health benefits assessments of the approaches.
- Limitations of the approaches.
- Anticipated benefits of the approaches.
- Anticipated effectiveness of the approaches described to protect public health
- Ways in which the effectiveness of the approaches could be improved and ways to measure their effectiveness.
- Compliance, enforcement and reporting requirements issues associated with the approaches.
- Financial burden associated with the implementation of the approaches.
- Suggestions regarding possible ways to fund the costs.
- Other options that can be considered to enable the Department to address the presence of unregulated organic contaminants in drinking water.
- Other concerns not reflected in the above issues.

VIIII. References

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Written comments regarding the above-listed strategies may be submitted until April 2, 2004 to:

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The Department recommends, but does not require, that comments be submitted on diskette as well as on paper. Please note that the Department can accept or use comments submitted in MacIntosh format only if submitted in MS-WORD format readable by Windows systems.