

# Analysis of Brownfields Cleanup Alternatives (ABCA) Report

Area of Concern 2 - Silver Recovery Wastewater System

USEPA Assistance ID No. BF97249207

Former Photech Imaging  
1000 Driving Park Avenue  
Rochester, New York

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## 1.0 ABCA EXECUTIVE SUMMARY

This report presents an evaluation of alternatives for the remediation of soil and groundwater impacts identified at the former Photech Imaging Systems, Inc. (Site) which is currently owned by the City of Rochester (City) and is located at 1000 Driving Park Avenue, Rochester, NY, as shown on Figure 1. The Site is comprised of 12.5 acres of land that included 15 buildings which were demolished in 2010. These buildings formerly housed various manufacturing, laboratory, office, and warehouse operations.

The City entered into the New York State Department of Environmental Conservation (NYSDEC) Environmental Restoration Program (ERP) to investigate and cleanup the Site, and the NYSDEC assigned ERP No. B00016 to the Site. The City has targeted Area of Concern #2 (AOC 2), the Silver Recovery Wastewater System and Vault Area for the remediation utilizing USEPA cleanup grant funds. AOC 2 contains a 12,000-gallon underground concrete vault utilized as part of the silver recovery wastewater system, a 3,000-gallon underground storage tank, and associated wastewater piping. In 2010 water within the silver recovery vault contained cadmium at concentrations which exceed Toxicity Characteristic Leaching Procedure (TCLP) regulatory levels resulting in the water to be disposed of as a D006 characteristic hazardous waste. Soil and groundwater in the vicinity of the AOC 2 is contaminated with heavy metals, with cadmium typically present in the highest concentrations. Cadmium has been detected in soil at concentrations which exceed NYSDEC Part 375 Commercial Soil Cleanup Objectives. Groundwater in a monitoring well near the silver recovery vault has also contained cadmium at concentration which exceeds its respective Class GA groundwater standard.

As part of the ABCA, a preliminary screening of applicable remedial methods and technologies was completed for soil and groundwater contamination in AOC 2, including:

- The No Action Alternative
- The Institutional Action Alternative
- The Soil/Liquid Removal and Disposal Alternative
- The In-Situ Treatment of Metals Impacted Groundwater Alternative
- The Ex-Situ Groundwater Treatment Alternative

The recommended alternative for AOC 2 is the Soil/Liquid Removal and Disposal Alternative combined with the In-situ Treatment of Metals Impacted Groundwater Alternative as deemed warranted.

## **2.0 INTRODUCTION AND BACKGROUND**

This Analysis of Brownfields Cleanup Alternatives (ABCA) report provides a summary of alternatives evaluated for Area of Concern No. 2 (AOC 2) identified as the Silver Recovery Wastewater System area associated with the former Photech Imaging parcel located at 1000 Driving Park Avenue located in the City of Rochester, Monroe County, New York (see Figure 1). Hereinafter, this parcel will be referred to as "the site." The alternatives were evaluated based on the data obtained during Phase I and Phase II Environmental Site Assessments (ESAs) and Design Phase Investigations conducted at the site.

### **Site Location and Description**

The former Photech Imaging Systems, Inc. property (site) is located at 1000 Driving Park Avenue in a commercial/industrial-zoned area in the northwest quadrant of the City of Rochester, Monroe County. The site is comprised of 12.5 acres of land that include a total of 15 buildings demolished in 2010 comprising approximately 108,000 square feet of space. These buildings formerly housed various manufacturing, laboratory, office, and warehouse operations. A series of below ground tunnels connect several buildings. Various underground (UST) and aboveground storage tanks (AST), a below ground silver recovery wastewater system and associated wastewater system piping were formerly used at this facility. Other features of the site include a former burn pit area, a retention pond basin, asphalt parking lots, and three wooden shed-like structures.

The site is located in an M-1 Industrial District. An M-1 Industrial District is designed to promote the retention and growth of employment opportunities by providing areas where a broad range of industrial uses may locate and where options for complementary uses exist. Permitted uses within an M-1 District included but are not limited to; Research Laboratories; Corporate Headquarters; Manufacturing & Light Industrial; Warehouses; Vehicle Repair & Sales, etc.

The site is currently bound by: Driving Park Avenue to the south; Holleder Industrial Park to the north; Rochester Distribution Unlimited, Inc. to the east; and Electronic Media Solutions, Inc. to the west. Directly to the south of Driving Park Avenue is the Delphi manufacturing facility. The Delphi property is currently listed in the Registry of Inactive Hazardous Waste Sites as a class 2. The Photech Site is approximately 1000 feet east of Mt. Read Boulevard and 2 miles east of Interstate Route 390. Please refer to Figures 1 and 2 for a site location and a site plan.

### **Site History**

The site was originally developed in 1948 for manufacturing photographic film and paper. Several different companies have owned and operated the facility at the site for photographic paper and film production since its construction in 1948. The most recent owner, Photech Imaging Systems, Inc., ceased operations and abandoned the facility in 1991. Large amounts of chemicals, wastes, and various supplies and materials were left "as-is" on-site when the facility was abandoned. In 1994, the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) performed a bulk waste and chemical removal action at the site. This work successfully removed bulk chemicals from the facility; however, tanks were not certified as "clean"; small containers of chemicals were left in some of the buildings; and residual chemicals remain in some process vessels and piping. Since the removal action, the buildings have been vandalized, with ceilings, walls, piping and equipment severely damaged. As a result, asbestos and chemical residues are suspected to be present in many interior areas of the buildings. Additionally, the roofs failed on several of the buildings and there

was a fire in 2004 in the former warehouse portion of the facility.

During 2010, the City of Rochester demolished all of the buildings at the site including the sub grade tunnels. The demolition work included abatement of asbestos containing materials and residual chemicals inside the buildings, Interim Remedial Measures (IRMs) of impacted soil areas, suspect building materials (e.g. concrete floors) were assessed for chemicals of concern and remediated prior to demolition, and confirmatory soil sampling beneath former building slabs and foundations to assist in delineating the extent of soil contamination was performed. These activities were completed as part of an approved Work Plan under the NYSDEC Environmental Restoration Program (ERP).

## **Remedial History**

### *Burn Pit Cleanup*

Anecdotal information exists regarding a reported 'cleanup' performed by the former owners sometime in the 1970's or 1980's. This cleanup reportedly involved the removal and off-site disposal of solid waste from the former retention pond and burn pit area located on the northeastern portion of the site.

### *1986 Site Audit*

An independent contractor completed a site audit in 1986. The audit included a detailed environmental inspection of the plant, a review of waste handling practices, and the completion of a limited number of soil borings, and limited groundwater sampling. The most significant findings of the 1986 audit included:

- The former underground wastewater silver recovery vault located adjacent to the Research and Development Building had not contributed to any soil or groundwater contamination in the immediate area;
- One or more of the underground fuel tanks leaked into the surrounding soil;
- The underground 500-gallon waste methanol tank piping had failed; and
- The facility waste handling practices required upgrading or modification to meet regulatory requirements.

### *Bulk Chemical and Waste Removal Projects*

After closing in 1991, the previous owner of the Photech facility did not perform a facility closure to remove and dispose of chemical material and wastes. As a result, the Photech site contained an assortment of abandoned oxidizers, reactive chemicals, flammable liquids, corrosives, poisons, and shock sensitive chemicals that were stored both inside and outside of facility buildings. Many of these chemical materials were stored in deteriorating containers and in unsafe conditions. Subsequent to the closing of the facility, the NYSDEC completed several small interim remedial measures such as removing and disposing of hazardous wastes and relocating chemical products (i.e. glycols) to a more secure interior staging area.

In 1994, the NYSDEC and the USEPA performed a bulk waste and chemical removal action at the site. A wide variety of hazardous wastes, process chemicals, and laboratory chemicals stored at the property were removed and shipped off-site for proper disposal. The contents of numerous drums and tanks stored on-site were emptied and/or removed from the site. This project successfully removed the bulk chemicals from the facility.

### *Interim Remedial Measures*

Several IRMs were conducted in conjunction with the completion of the SI project. The objective of the IRMs were to mitigate any potential human health and environmental risks related to documented environmental concerns previously identified at the site, including:

- Four aboveground storage tanks (ASTs):
  - A 10,000-gallon steel fuel oil AST
  - A 10,000-gallon steel virgin methanol AST
  - A 2,500-gallon steel virgin methanol AST
  - A 2,500-gallon steel waste methanol AST
- Two suspected underground structures:
  - A 500-gallon steel waste chemical tank
  - A concrete vault structure of unknown size
- Containment drum: A small drum container, partially buried, used to collect runoff and drainage from the chemical storage shed structure.

### **Site Contamination**

The City of Rochester completed a site investigation report (SI) to determine the nature and extent of any contamination by hazardous and regulated substances at the site.

#### *Summary of the Site Investigation – Site Wide*

The purpose of the SI was to define the nature and extent of any contamination resulting from previous activities at the site. The SI was conducted between November 1998 and May 2005. The field activities and findings of the investigation are described in the SI/RAR report. The following activities were conducted during the SI:

- Performed a Phase I site assessment in accordance with American Society for Testing and Materials (ASTM) E 1527-97. This assessment included several interviews with the former Plant Engineer for the Photech facility;
- Conducted an asbestos survey and sampling program inside the buildings. The sampling consisted of 26 wipe samples and 212 bulk samples for asbestos analyses;
- Conducted a building and equipment decontamination survey to assess residual chemical contamination inside the building. The sampling program consisted of 110 wipe samples and 32 bulk samples for chemical analysis;
- Cleaned, removed and disposed of four aboveground storage tanks (ASTs);
- Excavated and removed the buried spill containment drum from the former hazardous waste storage area;
- Installed forty (40) soil borings and ten (10) monitoring wells for analysis of soils and groundwater as well as physical properties of soil and hydrogeologic conditions;
- Sampled shallow subsurface soils (0-9" below ground surface) at seventeen (17) locations;

- Soil and groundwater sampling at ten monitoring well locations to determine whether the soil and groundwater contain contamination at levels of concern. Data from the investigation were compared to the following SCGs;
- Groundwater, drinking water, and surface water SCGs are based on NYSDEC “Ambient Water Quality Standards and Guidance Values” and Part 5 of the New York State Sanitary Code;
- XRF Field Screening and Confirmation Analytical Sampling completed by LaBella during the building decommissioning and demolition process, June through October 2010;
- Preliminary Design Phase Investigation AOC 2 – Silver Recovery Wastewater System completed by LaBella in April 2010;
- Preliminary Design Phase Investigation AOC 4 – Former Chemical Storage Shed completed by LaBella in October 2010; and
- Building 7 and Building 2 Interim Remedial Measures (IRM) Confirmation Samples collected by LaBella in September 20, 2010.

Based on the SI results, in comparison to the SCGs and potential public health and environmental exposure routes, certain media and areas of the site require remediation. These are summarized below. More complete information can be found in the SI report.

#### *Nature of Contamination*

As described in the SI/RAR report, numerous soil and groundwater samples were collected to characterize the nature and extent of contamination. As summarized in Table 1, the main categories of contaminants that exceed their SCGs are semi-volatile organic compounds (SVOCs), and inorganics (metals).

The SI/RAR, confirmation sampling conducted during the demolition of the buildings, and known history of the site, identified twelve areas of concern (AOCs). These areas are as follows:

- AOC 1 – Chemical Building 11
- AOC 2 – Silver Recovery Wastewater System
- AOC 3 – Eastern Portion of the Site
- AOC 4 – Miscellaneous Areas
- AOC 5 – Asbestos Containing Materials
- AOC 6 – Residual Chemicals Inside Building
- AOC 7 – Building 2 and 7 Waste Water
- AOC 8 – Building 7 Sump and Pit
- AOC 9 – Boiler House UST
- AOC 10 – Building 12 Waste Water
- AOC 11 – Waste Soil Piles
- AOC 12 – Suspect Dumping

SVOCs identified at the site include the following polycyclic aromatic hydrocarbons (PAHs) in soils: benzo(a)anthracene; chrysene; benzo(b)fluoranthene; benzo(k)fluoranthene; benzo(a)pyrene; and dibenz(a,h)anthracene. PAHs can be associated with waste oil, creosote (preservative for railroad ties, telephone poles and piers), stripped paint, incinerator ash, incomplete combustion of fossil fuels, and natural sources such as in petroleum and smoke from fires, etc.

Other contaminants detected on-site include very low levels of volatile organic compounds (VOCs) in soils and groundwater. No significant source of VOCs was detected on-site.

Inorganic elements (metals) identified at the site include: cadmium, chromium, lead, nickel, selenium, silver, and zinc. Cadmium and silver have been the two metals that have consistently been detected in soil samples collected and analyzed from AOC 2 and 7. Cadmium typically is detected at higher concentrations than silver. Therefore cadmium appears to be the chemical of concern that will guide the remedial action at AOC 2 and 7.

### **Area of Concern Selected for USEPA Remediation Grant**

The City of Rochester will target AOC 2 – Silver Recovery Wastewater System and Vault Area for the remediation under the USEPA Program. This section describes the findings of the investigation for all environmental media that were investigated associated with AOC 2 – Silver Recovery Wastewater System. The findings are presented by both areas of concern (AOCs) and by media.

#### *Extent of Contamination - AOC 2 - Silver Recovery Wastewater System*

The liquid contents of the underground concrete silver recovery vault have high enough levels of silver to be considered a characteristic hazardous waste. The integrity of the concrete silver recovery vault is suspect. Leakage from this silver recovery wastewater system appears to have resulted in releases to adjacent subsurface soil and groundwater. Some of the subsurface soil samples in proximity to the underground silver recovery vault contain concentrations of benzo(a)pyrene, cadmium, copper, nickel, selenium and silver that exceed SCGs. The highest site-wide concentrations of metals in soils are located adjacent to the silver recovery vault. These highest concentrations are as follows: cadmium at 6,320 parts per million (ppm) and silver 846 ppm.

Groundwater in the vicinity is contaminated with cadmium, chromium, silver, and selenium at concentrations that exceed SCGs. While the full extent of metals and SVOC contamination in this area has not been fully defined, the investigations to date have delineated the approximate extent of soil contamination in this area. Please refer to Figure 2 for the estimated extent of soil contamination.

## **3.0 OBJECTIVE**

The objective of this phase of the project is to evaluate the Technical Feasibility and Costs associated with different remedial alternatives for AOC 2 – Silver Recovery Wastewater System. In addition to evaluating the Technical Feasibility and Costs of different remedial alternatives, there is a need to evaluate the Technical Feasibility of remedial alternatives at the site as they relate to the physical site constraints, site-specific cleanup objectives, and future site use. In order to be considered technically feasible, remedial alternatives will have to satisfy the following criteria:

- Permanence – the ability to permanently reduce levels of site constituents of concern (COCs) to acceptable human health risk levels;
- Feasibility and Practicality – the ability to implement the remedial measure in an a manner that will allow unhindered use of the site;

- Time effectiveness – remedial measures will need to be implemented within potential redevelopment timelines; and
- Quantitative & Measurable – in order to achieve regulatory agency closure, the remedial measures selected for the site must result in a quantifiable and measurable source reductions and be protective of human health in order to support regulatory agency closure while leaving residual impacts to naturally attenuate.

Only remedial alternatives that meet the criteria listed above will be evaluated for cost effectiveness.

#### **4.0 EXTENT OF SOIL IMPAIRMENT (Phase II ESA Data/Assumptions)**

While the full extent of metals and SVOC contamination in this area has not been fully defined, the investigations to date have delineated the approximate extent of soil contamination in AOC 2. Additional design phase investigations will be completed to evaluate these data gaps prior to the implementation of any remedial action.

##### **4.1 Exposure Pathways**

This section describes the types of human exposures that may present added health risks to persons at or around the site. A more detailed discussion of the human exposure pathways can be found in Section 7.0 of the SI/RAR report.

An exposure pathway describes the means by which an individual may be exposed to contaminants originating from a site. An exposure pathway has five elements: [1] a contaminant source, [2] contaminant release and transport mechanisms, [3] a point of exposure, [4] a route of exposure, and [5] a receptor population.

The source of contamination is the location where contaminants were released to the environment (any waste disposal area or point of discharge). Contaminant release and transport mechanisms carry contaminants from the source to a point where receptors may be exposed. The exposure point is a location where actual or potential human contact with a contaminated medium may occur. The route of exposure is the manner in which a contaminant actually enters or contacts the body (e.g., ingestion, inhalation, or direct contact). The receptor population is the people who are, or may be, exposed to contaminants at a point of exposure.

An exposure pathway is complete when all five elements of an exposure pathway exist. An exposure pathway is considered a potential pathway when one or more of the elements currently does not exist, but could in the future.

There are no confirmed complete pathways that are known to exist either on-site or off-site at this time. Public water serves the area; therefore, ingestion of contaminated groundwater used for drinking water is unlikely. The following receptor populations potentially may be exposed to site contaminants in the future:

- Future site workers in contact with SVOCs and metals in shallow subsurface and subsurface soils during excavation/construction activities; and

- Future site workers and future building occupants in contact with SVOCs and metals from contaminated groundwater.

The primary potential pathways of exposure to site contaminants associated with AOC 2 include the following:

- Direct contact or incidental ingestion of contaminated soils;
- Inhalation of contaminated dust generated during construction activities; and
- Direct contact of contaminated groundwater during remedial actions.

Potential exposure pathways require remediation and/or engineering/institutional controls. Since it is planned that this property will be redeveloped, remediation and/or engineering/institutional controls will also be required to mitigate the potential future exposure pathways. Potential exposure during the remedial work will be managed with a Health and Safety Plan (HASP).

#### 4.2 Proposed Future Use of Site

The future use of the site is expected to be for commercial and/or light industrial purposes. A specific redevelopment plan for the site has not been finalized.

### 5.0 SELECTION OF CLEANUP GOALS

This section identifies the Standards, Criteria and Guidelines (SCGs) for the site. The SCGs identified are used in order to quantify the extent of contamination at the site that requires remedial work. These SCGs will be used to evaluate the effectiveness of the remedial actions and be used to determine if additional remedial actions are successful. The SCGs for soil and groundwater are provided below.

- In accordance with site-specific goals established by the NYSDEC Project Manager, this Work Plan will adhere to the Soil Cleanup Objectives (SCOs) in 6 NYCRR Part 375-6 Restricted Use Soil Cleanup Objectives for a Commercial Site and the Protection of Groundwater (cadmium and silver only).
- Groundwater contamination will be evaluated using NYSDEC *Technical and Operational Guidance Series 1.1.1: Ambient Water Quality Standards and Guidance Values and Groundwater Effluent Limitations* (TOGS 1.1.1) dated June 1998.
- All structures at the site have been demolished. As such, no soil gas sampling is anticipated. However, if soil gas sampling becomes necessary, evaluation of post-remedial soil gas sampling results will be based on provisions set forth in the Human Health Risk Assessment guidelines outlined in NYSDEC DER-10 and/or the New York State Department of Health (NYSDOH) *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* dated October 2006.

A copy of the NYCRR Part 375-6 Restricted Use Soil Cleanup Objectives for a Commercial Site plus the Protection of Groundwater Table 375-6.8(b), the NYSDEC TOGS 1.1.1 documents, and the NYSDOH *Guidance for Evaluating Soil Vapor Intrusion in the State of New York* are included in Appendix 1.

## 6.0 REMEDIAL OBJECTIVES

The following remedial goals are anticipated for AOC 2. The Remedial Goals for AOC 2 are as follows:

- 1.) remove and dispose of residual liquids, solids, and/or sludge located within the 3,000-gallon underground storage tank and 12,000-gallon underground concrete storage vault; remove and dispose all subsurface storage vessels and associated piping, remove and dispose of any soil impacts associated with the silver recovery wastewater system; and
- 2.) remove and dispose of as much impacted groundwater from the open excavation as possible to further reduce the contaminant mass associated with AOC 2.

The ultimate Remedial Goals for AOC 2 are to eliminate or reduce to the extent practicable:

- Exposures of persons at or around the site to metals in on-site soils and groundwater;
- The release of contaminants from soil into groundwater that may create exceedances of groundwater quality standards; and
- The release of contaminants from shallow subsurface soil into storm drainage systems through storm water erosion.

## 7.0 DETAILED ANALYSIS OF ALTERNATIVES – AOC 2

Remediation is required to develop the site consistent with the objectives of the City of Rochester. Although contaminant levels do not pose a significant threat to local residents, the environmental condition associated with AOC 2 presents a barrier to redevelopment. Alternatives were evaluated based on technical feasibility for the contaminant types and media, consistency with the remedial objectives, generation of regulated or hazardous wastes, risk to site workers and cost effectiveness.

### 7.1 Individual Analysis of Subsurface Soil Alternatives

Subsurface soil associated with AOC 2 includes all soil above the bedrock which is located at depths ranging from approximately 0 to 12 feet (ft) below ground surface (bgs). In addition, the top few feet of bedrock appears weathered and fractured, and may also be impacted with site contaminants.

#### 7.1.1 *Alternative 1 - No Action*

Under this alternative the impacted soil and groundwater from the Silver Recovery Wastewater System and Vault Area would remain as is and future site use and development would not be limited. In addition, remedial and monitoring activities as well as placement of institutional controls at the site are not implemented.

Applicability: This alternative is not protective of human health or the environment. Soil and groundwater samples collected from this area contained concentrations of SVOCs and metals above SCGs. With the exception of potential natural attenuation of some SVOCs and dispersion of metals, this alternative would not result in the reduction of contaminant toxicity, mobility or volume and therefore would not be in compliance with chemical-specific SCGs. Location-specific SCGs are met since the site is located within a commercial and industrial area and the contamination is not adversely impacting

human health or environmentally sensitive areas. Action-specific SCGs are not applicable under the No Action alternative.

There would be no increased short-term risks associated with the No Action alternative for the Silver Recovery Wastewater System and Vault Area since remedial activities are not implemented; however, long-term effectiveness and permanence would not be adequately monitored. Based on the findings of studies performed to date, it is anticipated that this alternative would not be acceptable to the community, NYSDEC, or NYSDOH and in relation to the anticipated planned future industrial redevelopment use of the site. Of the alternatives being considered, the No Action alternative for this area of concern is not feasible since remedial, institutional, monitoring, etc. activities will not be implemented. The costs for this alternative are summarized below.

Present Worth.....	\$ 0
Capital/Initial Cost .....	\$ 0
O&M/Annual Present Cost .....	\$ 0

### 7.1.2 Alternative 2 – Institutional Action

Under this alternative, institutional controls (deed restrictions, City Building Permit Flagging System, etc.) would be implemented, and a Soil Management Plan (SMP) (including HASP) would be developed. The SMP would include procedures for properly handling and disposing of impacted media (e.g., soil, etc.) in the Silver Recovery Wastewater System and Vault Area should this area be disturbed in the future.

Applicability: This alternative may be protective of human health and the environment. The institutional controls and SMP should decrease potential risks associated with the Silver Recovery Wastewater System and Vault Area. The concentration of SVOCs may decrease over time.

With the exception of possible decreases in the concentration of some SVOCs through natural attenuation processes, this alternative would not result in the reduction of contaminant toxicity, mobility or volume; and, therefore would not be in compliance with chemical-specific SCGs. Location-specific SCGs are met since the site is located within a commercial and industrial area and the contamination is not adversely impacting human health or environmentally sensitive areas. Action-specific SCGs are not applicable under the institutional action alternative since active remediation is not being conducted.

There would be no increased short-term risks associated with the institutional action alternative for the Silver Recovery Wastewater System and Vault Area at the site since remedial activities would not be implemented. This alternative should be effective in the long-term since procedures for future ground intrusive work would be in place however, since the source area is not being addressed, potential migration of groundwater contaminants is a concern. This alternative may not be a permanent remedy.

Based on the findings of studies performed to date, it is anticipated that this alternative may be acceptable to the community, NYSDEC, or NYSDOH due to the anticipated planned future industrial redevelopment of the site.

Of the alternatives being considered, the institutional action alternative for the Silver Recovery Wastewater System and Vault Area of the site is feasible. The costs for this alternative are summarized below and detailed in Table 2.

Present Worth.....	\$ 13,200
Capital/Initial Cost .....	\$ 13,200
O&M/Annual Present Cost .....	\$ 0

7.1.3 *Alternative 2 – Soil/Liquid Removal and Disposal*

Under this alternative, the institutional controls and SMP identified above would be implemented. However, active remediation would also be implemented. This alternative also presumes dewatering will be required to facilitate excavation and to evacuate contaminated groundwater, and that up to 40,000 gallons of water will require handling, temporary storage on-site for up to three months, analytical laboratory testing for characterization, and disposal to the public sanitary sewer system under a sewer use permit with Monroe County Pure Waters. Initially, all liquids and sediments in the silver recovery vault, silver recovery UST and associated piping for each will be pumped out, characterized and disposed of off-site. The silver recovery vault system may then be allowed to re-fill with groundwater. Additional liquids will then be removed from the silver recovery vault system and be disposed off-site in an effort to achieve groundwater cleanup objectives and/or asymptotic conditions. For the purposes of the cost estimate, it is assumed that approximately 30,000 gallons of liquid and sediments will be removed and subsequently disposed off-site as hazardous waste (i.e., due to cadmium and/or silver content).

Subsequent to removing and disposing liquids from the silver recovery vault, the silver recovery system (including recovery vault, silver recovery UST, underground vaults, and associated piping) will be removed, and soil that exceeds SCGs will be excavated and disposed off-site. X-Ray Fluorescence (XRF) equipment and an acceptable percentage of confirmatory analytical laboratory testing will be used during the soil removal work to determine the extent of soil excavation. The XRF equipment and an acceptable percentage of confirmatory analytical laboratory testing will also be used to document that the soil cleanup objectives are achieved. For the purpose of this evaluation, it is assumed that approximately 1,060 tons of soil will be removed from the silver recovery pit area, 150 tons of soil will be removed from the silver recovery vault area. As such, a total of approximately 1,210 tons of soil from the above areas will require disposal as hazardous waste. In addition, given that the silver wastewater structures appear to be placed at or near the top of weathered sedimentary bedrock it is anticipated that some weathered bedrock will be removed to complete the source removal action. As such, a total of approximately 250 tons of contaminated weathered bedrock will require disposal either as a hazardous waste or as a regulated solid waste. [Note: It is presumed that the soil removal will be from excavations that cover only a portion of the area shown as AOC 2 on Figure 2.]

Subsequent to removal of impacted soil and weathered bedrock, the areas would be backfilled. During backfilling of the silver recovery vault excavation, groundwater monitoring points would be installed. These groundwater monitoring points would be used to evaluate the concentrations of metals in groundwater in this area after removal of the source. In addition, the groundwater monitoring points will be constructed in a large enough diameter (e.g. 8-inches) to use as a possible recovery well or to add remedial agents.

Applicability: This alternative should be protective of human health and the environment. Soil concentrations that exceed SCGs would be removed and disposed of off-site.

This alternative would result in the reduction of the toxicity, mobility, and volume of contaminants in the soil. Therefore, this alternative would be in compliance with chemical-specific SCGs for soil. The removal of source area groundwater should reduce the volume of impacted groundwater. If it is determined that groundwater continues to exceed SCGs, it would be monitored by a long-term groundwater sampling program. Location-specific SCGs are met since the impacted soil would be removed from the site. Action-specific SCGs would be applicable during the removal of impacted soil (i.e., proper PPE, disposal of study derived waste, etc.).

There would be an increase in short-term risks associated with the soil removal work for this alternative as it relates to exposure of the workers conducting the remedial work. This alternative would be permanent in terms of soil remediation and effective in the long-term.

Based on the findings of studies performed to date, it is anticipated that this alternative may be acceptable to the community, NYSDEC, or NYSDOH, and for the anticipated planned future industrial redevelopment of the site.

Of the alternatives being considered, the soil/liquid removal and disposal alternative for AOC 2 is feasible. The costs for this alternative are summarized below and detailed in Table 3.

Present Worth.....	\$ 565,980
Capital/Initial Cost .....	\$ 565,980
O&M/Annual Present Cost .....	\$ 0

## 7.2 Individual Analysis of Groundwater Alternatives

This section evaluates potential alternatives to conduct post-soil removal groundwater remediation. The SI/RA work at the site included groundwater sampling rounds in 2000 and 2005. For AOC 2 this included sampling of Well-01, refer to Figure 3 for location. The results of this sampling indicated metals contamination of concern in the groundwater. The contamination was similar to the soil with cadmium and silver being the metals of highest concentration. The 2000 sampling (completed by BRG Environmental) results showed significant impact to groundwater for cadmium (40,000 ppb); however, turbid waters were noted in the sampling log. This groundwater sampling appears to have been completed by bailing and thus the elevated concentration of silver and cadmium may be impacted by turbidity. This assumption is supported by the water level in Well-01 in the 2000 sampling was noted to be at about 6.25-ft. below grade at the beginning of sampling and 3.5-ft. below grade at the end of sampling. This increasing water column would appear to show that the well was relatively ‘silted’ and the purging action loosened sediments.

The 2005 sampling by Day Environmental, Inc. was also completed via bailing; however, the concentration of cadmium was substantially lower (91.9 ppb). As part of the recent work at the Site, LaBella completed a round of groundwater sampling utilizing low-flow methodologies and this sampling only detected 8.45 ppb in Well-01. In addition to the sampling of Well-01, two wells were recently installed in the area of AOC 2 (MW-12 & MW-13) and sampled via low-flow methodologies. These samples did not detect cadmium above the reported laboratory detection limit. Figure 3 shows the location of these wells and the results of the sampling completed since 2000.

It should also be noted that each of these wells were installed as overburden/bedrock interface wells and the results were representative of dissolved phase groundwater concentrations (i.e., turbidity was not a factor), of the overburden groundwater and bedrock groundwater. As such, groundwater from the bedrock only, has not been evaluated.

Based on the above, it is unclear if the metals contamination in groundwater in AOC 2 identified in 2000 is due to turbidity of the water sample or a dissolved phase plume of cadmium impacted groundwater. The subsequent testing (2005 and 2010) would seem to indicate that the turbidity of the samples in 2000 resulted in biased high results for Cadmium.

Additionally the results may be more representative of the overburden groundwater in AOC 2 than the bedrock or weathered rock groundwater zone. In the event metals impacts to groundwater are limited to the overburden or shallow bedrock, these could be addressed with the overburden soil removal work recommended in Section 6.1.3.

The above indicates the need to further evaluate the groundwater after the overburden soil removal work and prior to final selection of a groundwater remediation strategy. The post removal groundwater monitoring recommended is provided below and included as the first cost for each alternative, since this is recommended as the next step, regardless of the groundwater remediation alternative.

#### *Post Excavation Groundwater Evaluation*

The post-excavation groundwater evaluation will be completed in order to evaluate the extent of any additional groundwater remedies that may be required. This evaluation will include the installation and sampling of 3 groundwater monitoring well pairs. Each pair would consist of a shallow and a deep monitoring well in order to evaluate differences in the overburden and bedrock interface; and bedrock groundwater. The shallow wells will be an overburden/bedrock interface and will be set approximately 3 feet into the top of the weathered bedrock. The deep wells will be dedicated rock wells set approximately 10-ft. into the bedrock. The deep wells would include a 'rock-socket' approximately 2-ft. into the top of bedrock in order to seal a casing into the rock and thus create a sampling interval separate from the overburden. Each of the wells would be sampled via low-flow methodologies (*USEPA Ground Water Issue, Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*) in order to obtain representative samples of dissolved phase metal concentrations. The sampling results would be utilized in order to determine the next applicable step. Figure 4 includes post-excavation groundwater monitoring locations along with the basic well construction information for each well pair.

Each of the groundwater remediation alternatives assumes that the above sampling would be conducted.

#### *7.2.1 Alternative 1 - No Action*

Under this alternative, no action would be conducted and the impacted groundwater regardless of the concentration would not be addressed. In addition, no additional institutional controls would be implemented.

Applicability: This alternative may not be protective of human health or the environment. With the exception of potential natural attenuation of some SVOCs and dispersion of metals, this alternative would not result in the reduction of contaminant toxicity, mobility or volume and therefore may not be in compliance with chemical-specific SCGs. Location-specific SCGs are met since the site is located within

a commercial and industrial area and the contamination is not adversely impacting human health or environmentally sensitive areas. Furthermore, the City of Rochester water supply is supplied by sources other than groundwater aquifers located within the City of Rochester and the City of Rochester has an ordinance that does not allow the use of groundwater for drinking water purposes. Action-specific SCGs are not applicable under the No Action alternative.

There would be no increased short-term risks associated with the No Action alternative for the Silver Recovery Wastewater System and Vault Area since remedial activities are not implemented; however, long-term effectiveness and permanence would not be adequately monitored. This alternative may not be acceptable to the community or in relation to the anticipated planned future industrial redevelopment use of the site. The costs for this alternative are summarized below and in Table 4.

Present Worth.....	\$ 52,020
Capital/Initial Cost .....	\$ 0
O&M/Annual Present Cost .....	\$ 0

*7.2.2 Alternative 2 – In-Situ Treatment of Metals Impacted Groundwater*

Under this alternative, an in-situ treatment of the metals in groundwater would be conducted. This alternative would include initially collecting representative samples of the groundwater within the treatment area from the wells installed as part of the post excavation groundwater monitoring. The post-excavation groundwater monitoring would also include evaluating additional parameters (e.g. alkalinity, hardness, anions, pH, metals {totals}, Eh, total organic carbon, dissolved organic carbon, etc.) in order to evaluate potential interferences with an in-situ application and to evaluate application or dosing rates. In addition, samples would also be submitted for bench-scale testing of at least one or more products to determine which in-situ application appears the best fit for the specific chemistry of this site.

For the purposes of this evaluation, it is assumed that the bench-scale testing would result in selection of EHC-M® containing controlled release organic carbon, zero-valent iron (ZVI), and a source of sulfate, offered by Adventus Americas, Inc. (Adventus). This product produces a metal-sulfide compound that precipitates out of the dissolved phase and sorbs strongly to soil particles. This essentially immobilizes the compound as it remains fixed to the soil matrix. Adventus’s technical summary of EHC-M® is included in Appendix 2. The in-situ application of the materials would be conducted by drilling a series of injection wells into the uppermost portion of the bedrock groundwater and the direct application of EHC-M® into the remedial excavation.

First, the EHC-M® will be applied to the area where the weathered bedrock will be removed/ripped during the remedial activities. The estimated weathered rock removal area is shown on Figure 5. A slurry of EHC-M® will be applied directly on top of the area where the weathered bedrock has been removed. Secondly, EHC-M® will be injected outside of the ripped rock area. Each injection well would require fracturing of the uppermost bedrock in order to deliver the EHC-M®. In order to effectively deliver enough product into the necessary treatment area/zone, it is estimated that hydraulic fracturing followed by EHC-M® injections would be completed at approximately 16 well locations, advanced on an approximate 10-ft by 10-ft grid. The proposed injection area is shown on Figure 5. The fracturing would consist of setting a temporary steel casing into the top of rock and coring an approximate 10-ft core of rock followed by injecting an EHC-M® and water mixture under pressure to fracture the upper rock layers while applying the amendment. The actual amount and necessary volume of EHC-M® including number of injection events required would be based on the post excavation groundwater testing and the bench scale test; however, for the purpose of this evaluation, it is assumed that only one injection event

would be necessary, since fracturing of the bedrock would increase the contact area. This assessment assumes 2 years of quarterly groundwater monitoring would be conducted for metals from the three of wells installed as part of the post excavation groundwater evaluation.

Applicability: This alternative would be protective of human health and the environment. The precipitation of the metals out of the dissolved phase and into an immobile compound would minimize the potential for migration of cadmium and other heavy metals from AOC 2. This alternative would result in the reduction of contaminant mobility; however, it would not reduce the amount of metals present. Location-specific SCGs would be met since the site is located within a commercial and industrial area and the contamination is not adversely impacting human health or environmentally sensitive areas.

Furthermore, the City of Rochester water supply is supplied by sources other than groundwater aquifers located within the City of Rochester and the City of Rochester has an ordinance that does not allow the use of groundwater for drinking water purposes.

Since the treatment would be conducted in-situ, there would only be a minimal increased short-term risk associated with the In-Situ Treatment alternative. This alternative would likely be acceptable to the community and in relation to the anticipated planned future industrial redevelopment use of the site. The costs for this alternative are summarized below and detailed in Table 5.

Present Worth.....	\$ 250,020
Capital/Initial Cost.....	\$ 46,000
O&M/Annual Present Cost.....	\$ 296,020

### 7.2.3 Alternative 3 – Ex-Situ Groundwater Treatment (Pump and Treat)

Under this alternative, the post excavation groundwater monitoring would be conducted and the results utilized to further evaluate the type of ex-situ treatment required. This alternative includes conducting pump tests on up to two of the groundwater monitoring wells installed as part of the post excavation groundwater monitoring. Specifically, one overburden and one bedrock well would each be tested (if warranted) in order to determine the approximate yield of the formation and in order to evaluate the necessary number of wells/location to obtain capture of AOC 2. In the event that both overburden and bedrock groundwater requires remediation, the pump test would likely include a combined test to evaluate the extent of communication between overburden and bedrock groundwater.

In addition, this alternative would include collecting representative samples of the groundwater to be submitted for bench-scale testing to evaluate ex-situ treatment options. The treatment option would depend on the post excavation groundwater samples; however, the options evaluated would include, but not be limited to: filtration (e.g., Forager™ Sponge), precipitation and ion exchange. In the event that groundwater concentrations are relatively low (approximately 1 to 2 ppm or below), filtration may be a potential option.

For the purpose of this evaluation, it is assumed that precipitation (via pH adjustment and coagulant addition if necessary) followed by filtration prior to discharge to the sanitary sewer would be the remedial treatment option. Based on the current information, it is assumed that two extraction wells with a combined flow rate of 5 gallons per minute would provide adequate capture of groundwater impacts to AOC 2. This assessment assumes that an equalization tank followed by a tank for chemical addition would be needed. The treated stream would be filtered prior to discharge to the sanitary sewer. A limited

description of a proposed groundwater pump and treat system is shown on Figure 6. While precipitation of metals is well proven, this would require routine maintenance/monitoring of the system as well as optimizing the process in order to effectively and consistently remove the metals. If necessary, recycling of the water into injection wells may also be considered with pH adjustment (adjust to slightly acidic) to further extract contaminants from the formation; however, at this time, this is not included in the scope/cost of this assessment. This assessment assumes the system will need to be operated for two years and that a total of three years of quarterly groundwater monitoring would be conducted for metals from the three of wells installed as part of the post excavation groundwater evaluation.

Applicability: This alternative would be protective of human health and the environment. Obtaining capture of the groundwater in AOC 2 and thus the removal of the metals followed by treatment (precipitation) and disposal would reduce contaminant toxicity, volume and mobility.

Location-specific SCGs would be met since the site is located within a commercial and industrial area and the contamination is not adversely impacting human health or environmentally sensitive areas. Since the treatment would be conducted ex-situ, there would be a minimal increased short-term risk associated with this alternative; however, this could be managed with a health and safety plan and proper site security. This alternative would likely be acceptable to the community and in relation to the anticipated planned future industrial redevelopment use of the site. The costs for this alternative are summarized below and detailed in Table 6.

Present Worth.....	\$ 288,600
Capital/Initial Cost.....	\$ 147,380
O&M/Annual Present Cost.....	\$ 435,980

## 8.0 RECOMMENDATION – AOC 2: SILVER RECOVERY WASTEWATER SYSTEM

Selecting the alternative that meets the objectives of the City of Rochester and is cost effective requires a land use plan for the site. Based on the findings, the current environmental conditions and the potential cost of remediation should not be considered a major barrier to site redevelopment. Based on the factors evaluated the following remedial alternative has been selected;

### Summary - Individual Analysis of Subsurface Soil Alternatives

- The No Action Alternative may not be protective of human health and the environment. In addition, the No Action alternative may not be acceptable to the community, NYSDEC or NYSDOH in-conjunction with redevelopment of the site.
- The Institutional Action Alternative should reduce exposure to the contaminants in this area since potential future ground intrusive work in this area would be conducted in accordance with a SMP. However, the Institutional Action alternative may not be acceptable to the community, NYSDEC or NYSDOH and may inhibit redevelopment of this portion of the site.

- The Soil/Liquid Removal and Disposal Alternative should be protective of human health and the environment. Although the soil/liquid removal and disposal alternative is more expensive than the other alternatives, the soil/liquid removal and disposal alternative is a permanent remedy, should be effective in the long-term, and has the potential to achieve groundwater cleanup objectives and/or asymptotic conditions. In addition, this alternative should be acceptable to the community, NYSDEC or NYSDOH in relation to site redevelopment.
- Obtaining capture of the groundwater in AOC 2 and thus the removal of the metals followed by treatment (precipitation) and disposal would reduce contaminant toxicity, volume and mobility.

### **Summary - Individual Analysis of Groundwater Alternatives**

- The No Action Alternative may not be protective of human health and the environment. In addition, the No Action alternative may not be acceptable to the community, NYSDEC or NYSDOH in-conjunction with redevelopment of the site.
- The In-Situ Treatment of Metals Impacted Groundwater Alternative would be protective of human health and the environment. The precipitation of the metals out of the dissolved phase and into an immobile compound would minimize the potential for migration of cadmium and other heavy metals from AOC 2. This alternative would likely be acceptable to the community, NYSDEC and NYSDOH in relation to the anticipated planned future industrial redevelopment use of the site.
- The Ex-Situ Groundwater Treatment Alternative would be protective of human health and the environment. Obtaining capture of the groundwater in AOC 2 and thus the removal of the metals followed by treatment (precipitation) and disposal would reduce contaminant toxicity, volume and mobility. Since the treatment would be conducted ex-situ, there would be a minimal increased short-term risk associated with this alternative; however, this could be managed with a health and safety plan and proper site security. This alternative would likely be acceptable to the community, NYSDEC and NYSDOH in relation to the anticipated planned future industrial redevelopment use of the site.

### **Recommendation**

The recommended alternative for AOC 2 (Silver Recovery Wastewater System and Vault area) is the Soil/Liquid Removal and Disposal Alternative combined with the In-situ Treatment of Metals Impacted Groundwater Alternative.

The actual area/volume of removal and cost of this alternative will depend on: 1) the extent and concentration of groundwater contamination at the silver recovery wastewater system and vault area to achieve groundwater cleanup objectives and/or asymptotic conditions; and 2) the results of field screening using XRF equipment and subsequent confirmatory soil sampling/testing.

**LaBELLA**

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# Tables

**TABLE 1**  
**Nature and Extent of Contamination**  
**Range of Sampling Dates (1999 - 2010)**

Shallow Subsurface Soil (0"-9" bgs)	Contaminant of Concern	Concentration Range (ppm)	SCG (ppm)	Frequency of Exceeding SCG
VOCs	Acetone	ND to 0.006 J	500	0 of 15
	Trichloroethene	ND to 0.003 J	200	0 of 15
SVOCs	Benzo(a)anthracene	ND to 2.4	5.6	0 of 16
	Chrysene	ND to 2.5	56	0 of 16
	Benzo(b)fluoranthene	ND to 1.7	5.6	0 of 16
	Benzo(k)fluoranthene	ND to 2.1	56	0 of 16
	Benzo(a)pyrene	ND to 2.3	1	2 of 16
	Dibenzo(a,h)anthracene	ND to 0.680	0.56	1 of 16
Metals	Cadmium	ND to 17.9	9.3	1 of 16
	Nickel	4.73 to 13.5	310	0 of 16
	Selenium	0.520 to 4.12	1500	0 of 16
	Silver	1.04 to 462	1500	0 of 16
	Zinc	18.6 to 255	10000	0 of 16
Subsurface Soil	Contaminant of Concern	Concentration Range (ppm)	SCG (ppm)	Frequency of Exceeding SCG
VOCs	Acetone	ND to 0.094	500	0 of 50
	1,2 Dichloroethane	ND to 0.030	200	0 of 50
	2-Butanone	ND to 0.075	NA	0 of 50
	Trichloroethene	ND to 0.018	200	0 of 50
SVOCs	Benzo(a)anthracene	ND to 10	5.6	1 of 66
	Chrysene	ND to 8.7	56	0 of 66
	Benzo(b)fluoranthene	ND to 5.2	5.6	0 of 66
	Benzo(k)fluoranthene	ND to 5.6	56	0 of 66
	Benzo(a)pyrene	ND to 7.9	1	1 of 66
	Ideno(1,2,3-cd)pyrene	ND to 4.5	5.6	0 of 66
	Dibenzo(a,h)anthracene	ND to 1.9	0.56	1 of 66
Metals	Arsenic	ND to 18.1	16	1 of 142
	Cadmium	ND to 6320	7.5	20 of 142
	Chromium	3.40 to 69.2	1500	1 of 142
	Lead	4.20 to 1300	1000	1 of 142
	Nickel	6.72 to 38.9	310	0 of 48
	Selenium	0.725 to 5.66	1500	0 of 142
	Silver	ND to 999	8.3	12 of 142
	Zinc	14.8 to 450	10000	0 of 48
Groundwater	Contaminant of Concern	Concentration Range (ppm)	SCG (ppm)	Frequency of Exceeding SCG
VOCs	1,1 Dichloroethene	ND to 0.030	5	2 to 26
	Trichloroethene	ND to 0.018	5	2 of 26
SVOCs	Benzo(a)anthracene	ND to 10	10	1 of 16
	Chrysene	ND to 8.7	0.002	1 of 16
	Benzo(b)fluoranthene	ND to 5.2	0.002	1 of 16
	Benzo(k)fluoranthene	ND to 5.6	0.002	1 of 16
	Benzo(a)pyrene	ND to 7.9	0.002	1 of 16
	Ideno(1,2,3-cd)pyrene	ND to 4.5	0.002	1 of 16
Metals	Arsenic	ND to 18.1	25	10 of 26
	Cadmium	ND to 6320	5	7 of 26
	Chromium	3.40 to 69.2	50	7 of 26
	Lead	4.20 to 1300	25	10 of 26
	Nickel	6.72 to 38.9	100	10 of 26
	Selenium	0.725 to 5.66	10	1 of 26
	Silver	ND to 999	50	4 of 26

**Note:**

VOCs denotes Volatile Organic Compounds

SVOCs denotes Semi-Volatile Organic compounds

ppm denotes parts per million

bgs denoted below the ground surface

ND denoted not detected above laboratory method detection limit

J denotes estimated value

SCG denotes Site Cleanup Goal

**TABLE 2**

**FORMER PHOTECH IMAGING SITE  
1000 DRIVING PARK AVENUE, ROCHESTER, NEW YORK**

**Area of Concern 2: Silver Recovery Vault Area  
Institutional Control Action Cost**

<b>Capital / Initial Cost</b>	
Deed Restrictions	\$ 5,000
Site Management Plan (including Health and Safety Plan)	\$ 6,000
20 % Contingency	\$ 2,200
Total Capital / Initial Costs	<u>\$ 13,200</u>
<b>Operation / Maintenance / Annual Cost</b>	\$ -
<b>Present Worth Cost</b>	
Present Worth Cost	\$ 13,200
<b>Total Present Worth Cost</b>	<u>\$ 13,200</u>

TABLE 3

FORMER PHOTECH IMAGING SITE  
1000 DRIVING PARK AVENUE, ROCHESTER, NEW YORK

Area of Concern 2: Silver Recovery Vault Area  
Soil / Liquid Removal and Disposal Cost

**Capital / Initial Cost**

Deed Restrictions	\$ 5,000
Site Management Plan (including Health and Safety Plan)	\$ 6,000
Soil / Liquid Removal Engineering Cost	\$ 40,000
Subcontractor Cost	\$ 13,200
Mobilization / Demobilization	\$ 3,150
Site Preparation	\$ 2,400
Permits	\$ 200
Dewatering	\$ 17,200
Liquid - Removal, Treatment, & Disposal (30,000 gal at \$1.25/gal)	\$ 37,500
Clean / Remove Silver Recovery Vault	\$ 7,700
Clean / Remove Silver Recovery UST	\$ 3,300
Clean / Remove Underground Piping	\$ 4,400
Clean / Remove Underground Water Vaults	\$ 3,300
Clean Soil Excavation (125 yds x \$6.50/yd)	\$ 750
Impacted Soil Excavation (800 yds x \$6.50 yd)	\$ 5,200
Rip Bedrock (100 yds x \$30/yd)	\$ 3,000
Disposal Characterization Testing	\$ 2,750
Soil & Ripped Bedrock - Transport and Disposal (1,460 tons x \$145/ton*)	\$ 211,700
Concrete - Transport and Disposal (150 tons x \$64/ton)	\$ 9,600
Backfill Material and Placement (900 yds x \$19.50/yd)	\$ 17,550
Backfill Clean Soil (125 yds x \$6/yd)	\$ 750
Confirmatory Soil Sampling	\$ 7,000
Oversight and Documentation	\$ 40,000
Reporting	\$ 30,000
20 % Contingency	\$ 94,330
<b>Total Capital / Initial Costs</b>	<b>\$ 565,980</b>

**Operation / Maintenance /Annual Cost**

\$ -

**Present Worth Cost**

Present Worth Cost	\$ 565,980
<b>Total Present Worth Cost</b>	<b>\$ 565,980</b>

Note:

\*Assumes TCLP D004 Hazardous Waste

**TABLE 4**

**FORMER PHOTECH IMAGING SITE  
1000 DRIVING PARK AVENUE, ROCHESTER, NEW YORK**

**Area of Concern 2: Silver Recovery Vault Area  
No Action - Metals Impacted Groundwater**

**Capital / Initial Cost**

Subcontractor Cost	
Mobilization / Demobilization	\$ 1,200
Permits (Hydrant)	\$ 500
Drill Rig and Crew	\$ 22,000
4" Steel Casing	\$ 800
Core Boxes	\$ 200
Well Materials	\$ 4,000
55-gallon Drums	\$ 1,000
Steam Cleaner Rental	\$ 600
Decon Pad	\$ 100
Well Installation Oversight	\$ 4,200
Well Development	\$ 2,250
Well Sampling	\$ 4,000
Documentation and Reporting	\$ 2,500
20 % Contingency	\$ 8,670
<b>Total Capital / Initial Costs</b>	<b>\$ 52,020</b>

**Operation / Maintenance / Annual Cost** \$ -

**Present Worth Cost**

Present Worth Cost	\$ 52,020
<b>Total Present Worth Cost</b>	<b>\$ 52,020</b>

TABLE 5

**FORMER PHOTECH IMAGING SITE  
1000 DRIVING PARK AVENUE, ROCHESTER, NEW YORK**

**Area of Concern 2: Silver Recovery Vault Area  
In-Situ Treatment of Metals Impacted Groundwater**

**Capital / Initial Cost**

Deed Restrictions	\$ 5,000
Site Management Plan (including Health and Safety Plan)	\$ 6,000

Well Installations

Subcontractor Cost	
Mobilization / Demobilization	\$ 1,200
Permits (Hydrant)	\$ 500
Drill Rig and Crew	\$ 22,000
4" Steel Casing	\$ 800
Core Boxes	\$ 200
Well Materials	\$ 4,000
55-gallon Drums	\$ 1,000
Steam Cleaner Rental	\$ 600
Decon Pad	\$ 100
Well Installation Oversight	\$ 4,200
Well Development	\$ 1,500
Well Sampling	\$ 4,500

Bedrock Fracturing and Injection Work

Subcontractor Cost	
Mobilization / Demobilization	\$ 4,500
Permits (Hydrant)	\$ 1,500
Drill Rig and Crew (Est. 20-days)	\$ 36,800
Temporary 4" Steel Casing (Est. 200 ft)	\$ 1,600
Disposable Materials	\$ 1,000
Injection Pump and Operator (Est. 20-days)	\$ 25,600
Fracking Equipment Rental (Est. 20-days)	\$ 24,000
EHC-M® Product (est. \$13/treated cubic yard)	\$ 11,250
Fracturing and Injection Oversight	\$ 25,500
Documentation and Reporting	\$ 25,000
20 % Contingency	\$ 41,670
<b>Total Capital / Initial Costs</b>	<b>\$ 250,020</b>

**Operation / Maintenance / Annual Cost**

Follow up Groundwater Monitoring (est. quarterly for 2 years)	\$ 36,000
Annual Report (2 yrs)	\$ 10,000
	<b>\$ 46,000</b>

**Present Worth Cost**

Present Worth Cost	\$ 250,020
<b>Total Present Worth Cost</b>	<b>\$ 296,020</b>

TABLE 6

**FORMER PHOTECH IMAGING SITE  
1000 DRIVING PARK AVENUE, ROCHESTER, NEW YORK**

**Area of Concern 2: Silver Recovery Vault Area  
Ex-Situ Treatment of Metals Impacted Groundwater (Pump and Treat)**

<b>Capital / Initial Cost</b>	
Deed Restrictions	\$ 5,000
Site Management Plan (including Health and Safety Plan)	\$ 6,000
<u>Well Installations</u>	
Subcontractor Cost	
Mobilization / Demobilization	\$ 1,200
Permits (Hydrant)	\$ 500
Drill Rig and Crew	\$ 22,000
4" Steel Casing	\$ 800
Core Boxes	\$ 200
Well Materials	\$ 4,000
55-gallon Drums	\$ 1,000
Steam Cleaner Rental	\$ 600
Decon Pad	\$ 100
Well Installation Oversight	\$ 4,200
Well Development	\$ 1,500
Well Sampling	\$ 4,500
<u>Extraction System Design</u>	
Pump Tests	\$ 3,500
Bench Scale Testing	\$ 9,500
Extraction Well Design	\$ 4,500
System Design and Chemical Dosing Estimates	\$ 17,500
<u>Extraction System Installation</u>	
Well Installation Subcontractor Cost	
Mobilization / Demobilization	\$ 3,500
Drill Rig and Crew (Est. 8-days)	\$ 15,400
6" Steel Casing	\$ 2,000
Well Materials	\$ 3,500
Pumps	\$ 6,000
Fracking Equipment Rental	\$ 36,000
System Installation Cost	
Mobilization / Demobilization	\$ 2,500
Trenching	\$ 4,500
Electrical Drop and Connections	\$ 6,500
System Automation/Connections	\$ 7,000
Extraction Piping and Sewer Discharge Connection	\$ 8,500
Equalization/pH Adjustment Tankage	\$ 2,000
Coagulation/Settlement Tankage	\$ 2,000
Filter System	\$ 3,500
System Enclosure	\$ 7,500
System Enclosure Pad	\$ 12,000
Mechanical System Connections	\$ 6,500
Oversight, Documentation and Reporting	\$ 25,000
20 % Contingency	\$ 48,100
<b>Total Capital / Initial Costs</b>	<b>\$ 288,600</b>
<b>Operation / Maintenance / Annual Cost</b>	
O&M On-Site Work	\$ 15,980
Chemicals (est. \$4,500 quarterly for 2 years)	\$ 36,000
Replacement Filters and Waste Disposal (\$1,000 quarterly)	\$ 8,000
Electrical (est. \$350/month on avg.)	\$ 8,400
Follow up Groundwater Monitoring (est. quarterly for 3 years)	\$ 54,000
Reporting (2 yrs on system and 1 year for groundwater only)	\$ 25,000
	<b>\$ 147,380</b>
<b>Present Worth Cost</b>	
Present Worth Cost	\$ 288,600
<b>Total Present Worth Cost</b>	<b>\$ 435,980</b>

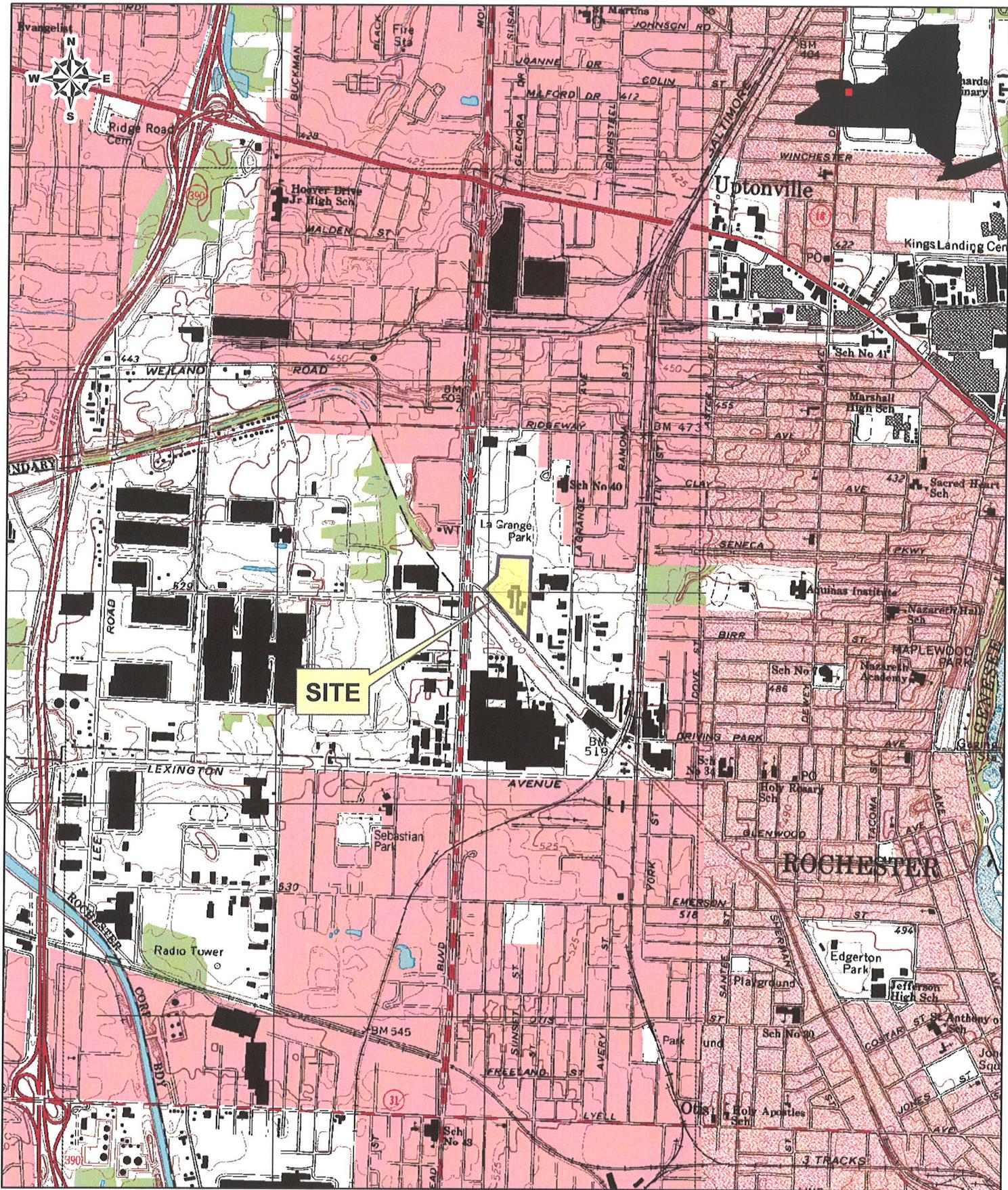
**LABELLA**

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Rochester, New York 14614

# Figures



PROJECT/DRAWING NUMBER

**209288**

**FIGURE 1**

DRAWING TITLE

**SITE LOCATION WITH USGS  
7.5 MINUTE TOPO MAP  
ROCHESTER WEST QUAD  
1:24,000**

ISSUED FOR

REVIEW	DESIGNED BY	RCN
	DRAWN BY	RCN
DATE 9/11/2009	REVIEWED BY	DEP

PROJECT CLIENT

CITY OF ROCHESTER DEQ

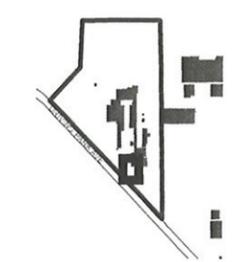
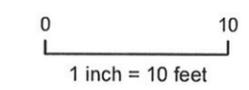
FORMER PHOTECH  
IMAGING FACILITY  
1,000 DRIVING PARK AVENUE  
ROCHESTER, NY

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CITY OF ROCHESTER  
FORMER PHOTECH SITE  
1000 DRIVING PARK BLVD  
ROCHESTER, NEW YORK

ANALYSIS OF BROWNFIELD  
CLEANUP ALTERNATIVES  
AREA OF CONCERN 2  
SILVER RECOVERY  
WASTEWATER SYSTEM  
EXCAVATION LIMITS



[ 209288 ]  
[ FIGURE 2 ]

**NYSDEC SOIL CLEANUP OBJECTIVES**

Contaminant	Units	NYSDEC DER 6 NYCRR Part 375-6.8(b) Restricted Use Soil Cleanup Objective for a Commercial Property	NYSDEC DER 6 NYCRR Part 375-6.8(b) Restricted Use Soil Cleanup Objective for the Protection of Groundwater
Silver		1500	8.3
Cadmium	mg/kg	9.3	7.5

**Note:**  
Sample Location  
Cadmium Concentrations (mg/kg)  
Silver Concentrations (ppm)  
Cd: 2.14  
Ag: 3.88

**Underground Water Service Vault**

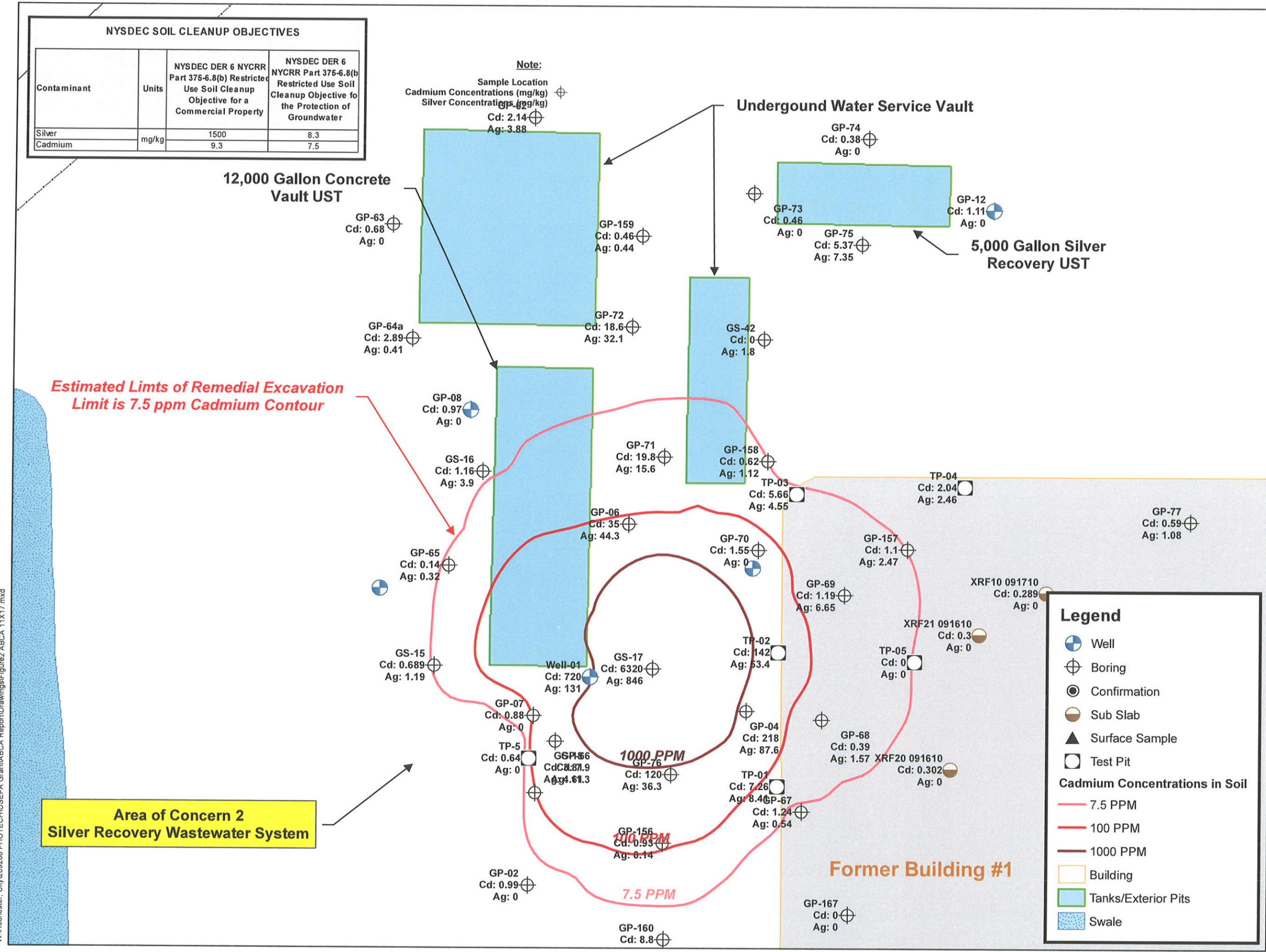
**12,000 Gallon Concrete Vault UST**

**5,000 Gallon Silver Recovery UST**

*Estimated Limits of Remedial Excavation  
Limit is 7.5 ppm Cadmium Contour*

**Area of Concern 2  
Silver Recovery Wastewater System**

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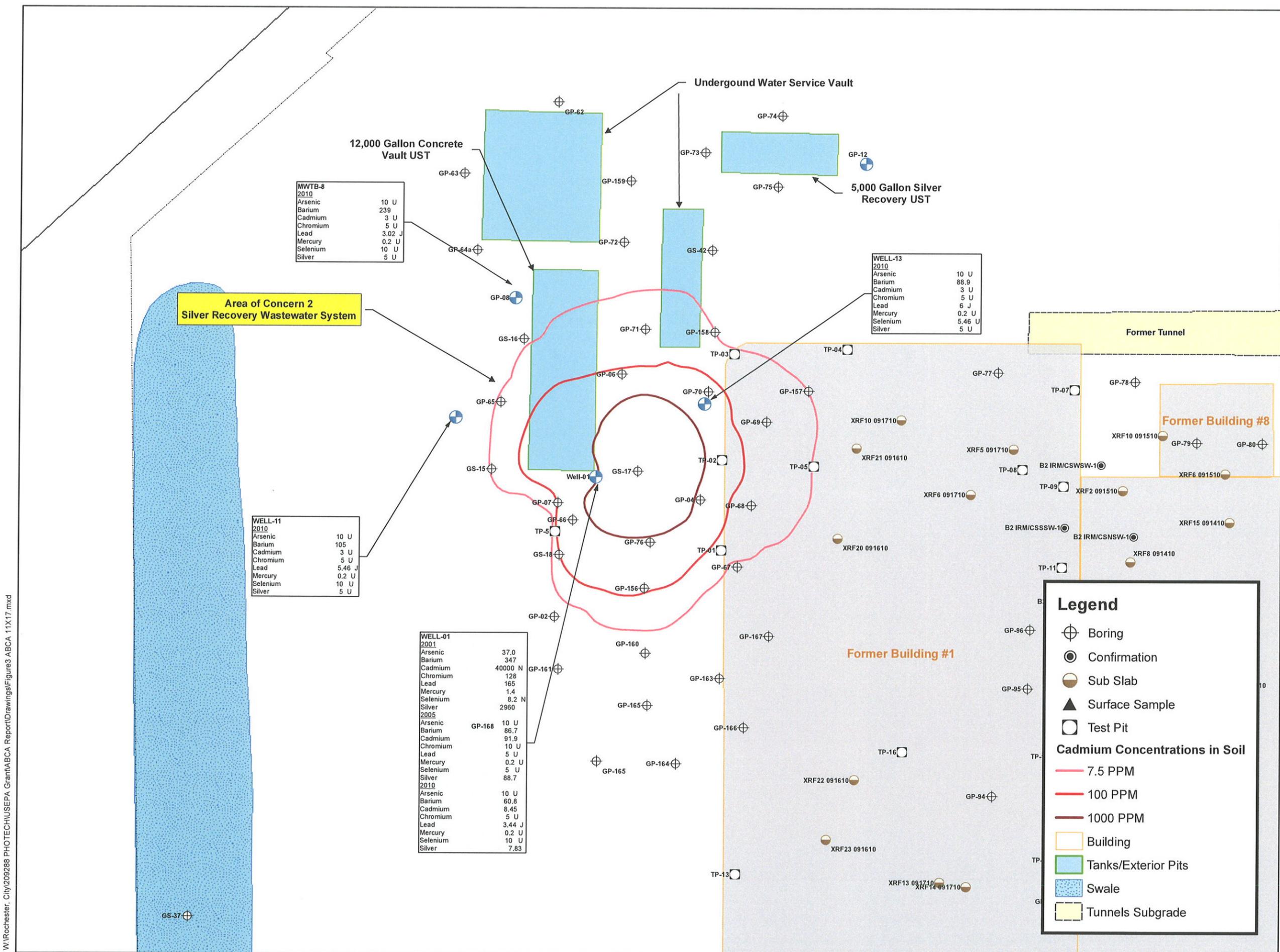


CITY OF ROCHESTER

FORMER PHOTECH SITE  
1000 DRIVING PARK BLVD  
ROCHESTER, NEW YORK

ANALYSIS OF BROWNFIELD  
CLEANUP ALTERNATIVES

AREA OF CONCERN 2  
SILVER RECOVERY  
WASTEWATER SYSTEM  
SAMPLE RESULTS



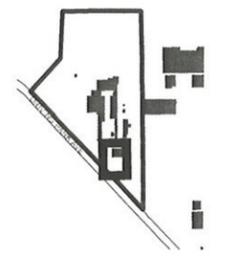
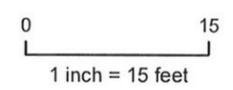
**Legend**

- ⊕ Boring
- ⊙ Confirmation
- Sub Slab
- ▲ Surface Sample
- Test Pit

**Cadmium Concentrations in Soil**

- 7.5 PPM
- 100 PPM
- 1000 PPM

- Building
- Tanks/Exterior Pits
- Swale
- Tunnels Subgrade

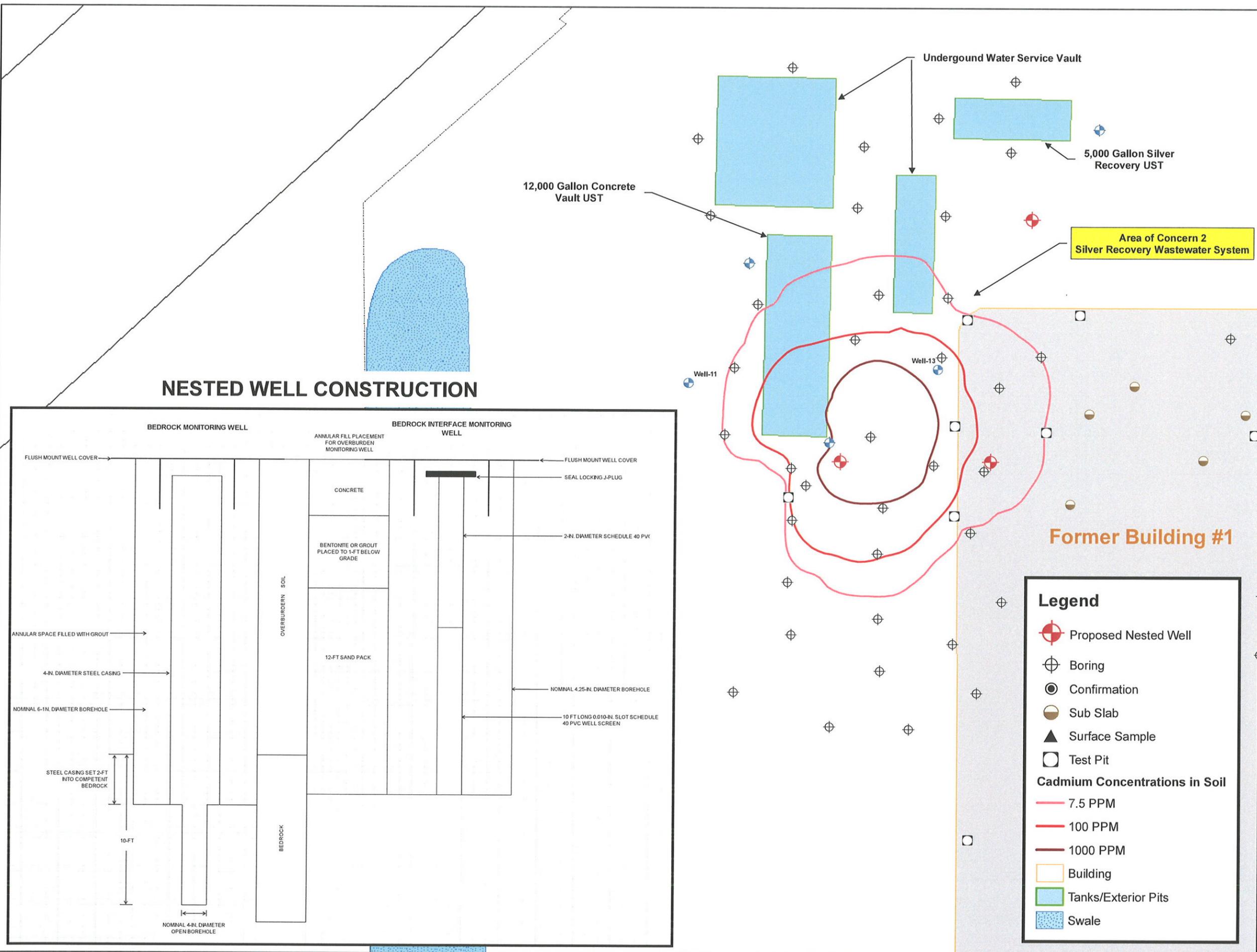


[ 209288 ]  
[ FIGURE 3 ]

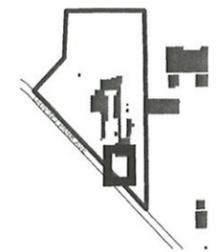
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ROCHESTER, NEW YORK

ANALYSIS OF BROWNFIELD  
CLEANUP ALTERNATIVES

AREA OF CONCERN 2  
SILVER RECOVERY  
WASTEWATER SYSTEM  
PROPOSED LOCATIONS  
OF NESTED GROUNDWATER  
WELLS



0 15  
1 inch = 15 feet



[ 209288 ]  
[ FIGURE 4 ]

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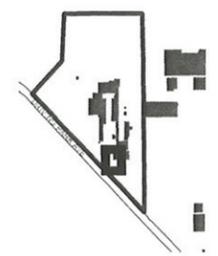
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ROCHESTER, NEW YORK

ANALYSIS OF BROWNFIELD  
CLEANUP ALTERNATIVES

AREA OF CONCERN 2  
SILVER RECOVERY  
WASTEWATER SYSTEM  
PROPOSED INJECTION GRID  
GROUNDWATER REMEDIAL  
ALTERNATIVE NO. 2

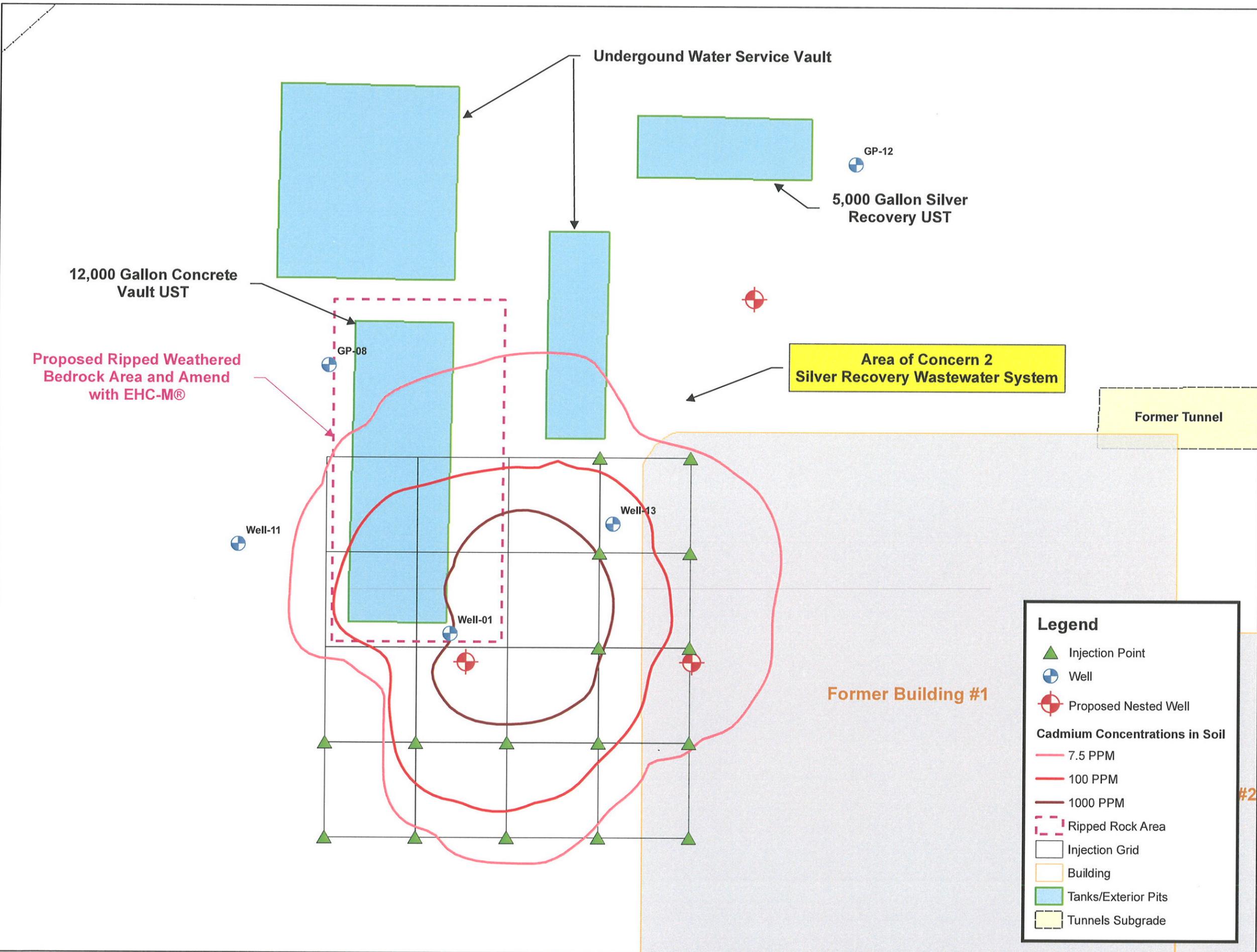


0 10  
1 inch = 10 feet



[ 209288 ]  
[ FIGURE 5 ]

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**Legend**

- ▲ Injection Point
- Well
- ⊕ Proposed Nested Well

**Cadmium Concentrations in Soil**

- 7.5 PPM
- 100 PPM
- 1000 PPM

- - - Ripped Rock Area
- Injection Grid
- Building
- Tanks/Exterior Pits
- Tunnels Subgrade

**CITY OF ROCHESTER**

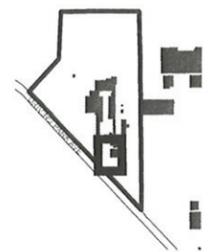
**FORMER PHOTECH SITE**  
1000 DRIVING PARK BLVD  
ROCHESTER, NEW YORK

**ANALYSIS OF BROWNFIELD  
CLEANUP ALTERNATIVES**

**AREA OF CONCERN 2  
SILVER RECOVERY  
WASTEWATER SYSTEM  
PROPOSED GROUNDWATER  
PUMP AND TREAT  
ALTERNATIVE NO. 3**

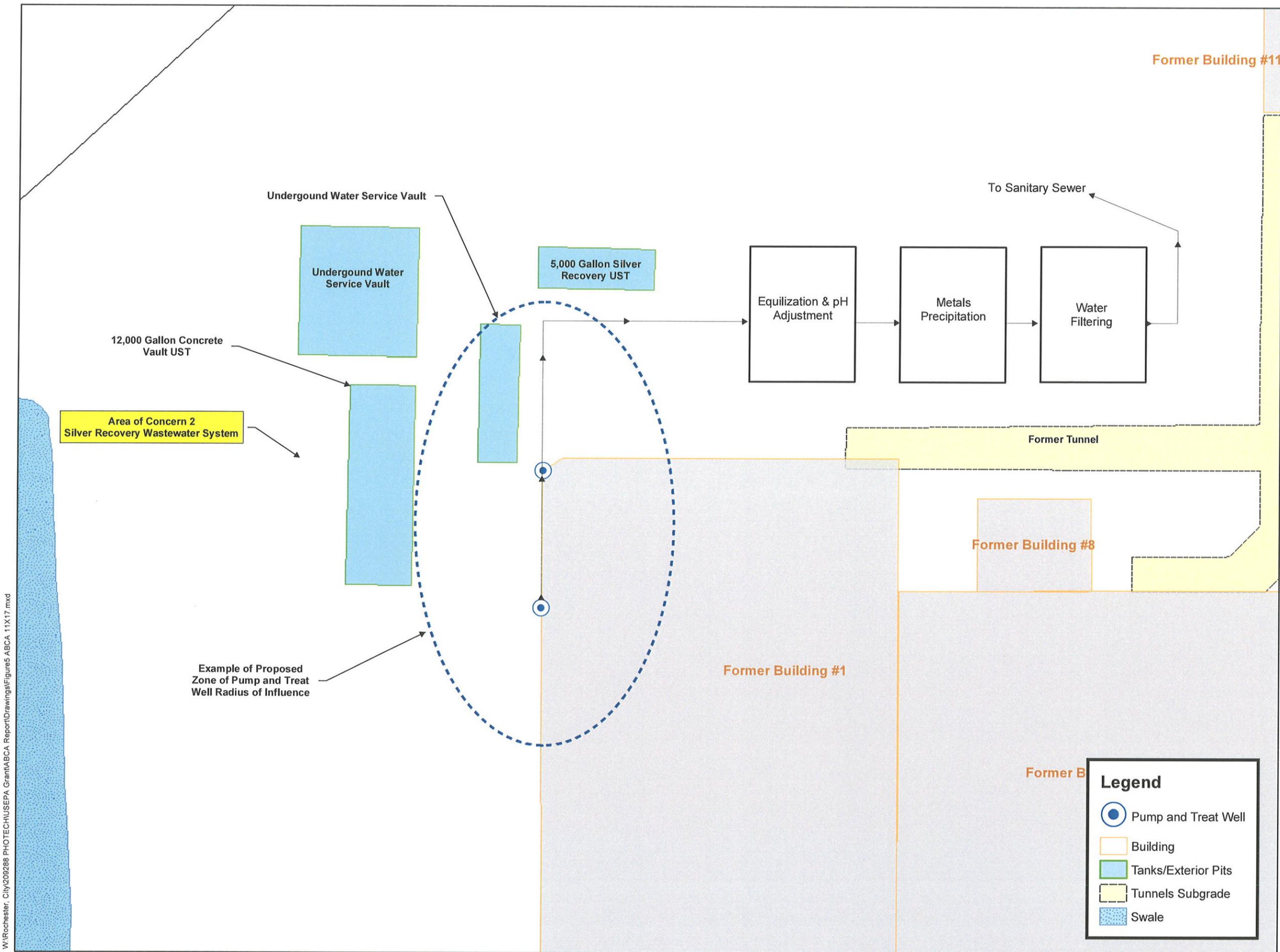


0 15  
1 inch = 15 feet



[ 209288 ]

[ FIGURE 6 ]



**Legend**

- Pump and Treat Well
- Building
- Tanks/Exterior Pits
- Tunnels Subgrade
- Swale

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**LaBELLA**

LaBella Associates, P.C.

300 State Street

Rochester, New York 14614

# Appendix 1



Department of Environmental Conservation

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**Division of Environmental Remediation**

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**6 NYCRR PART 375**  
Environmental Remediation Programs  
Subparts 375-1 to 375- 4 & 375-6

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Effective December 14, 2006

**New York State Department of Environmental Conservation**

## (b) Restricted use soil cleanup objectives.

**Table 375-6.8(b): Restricted Use Soil Cleanup Objectives**

Contaminant	CAS Number	Protection of Public Health				Protection of Ecological Resources	Protection of Ground-water
		Residential	Restricted-Residential	Commercial	Industrial		
<b>Metals</b>							
Arsenic	7440-38-2	16 <sup>f</sup>	16 <sup>f</sup>	16 <sup>f</sup>	16 <sup>f</sup>	13 <sup>f</sup>	16 <sup>f</sup>
Barium	7440-39-3	350 <sup>f</sup>	400	400	10,000 <sup>d</sup>	433	820
Beryllium	7440-41-7	14	72	590	2,700	10	47
Cadmium	7440-43-9	2.5 <sup>f</sup>	4.3	9.3	60	4	7.5
Chromium, hexavalent <sup>h</sup>	18540-29-9	22	110	400	800	1 <sup>e</sup>	19
Chromium, trivalent <sup>h</sup>	16065-83-1	36	180	1,500	6,800	41	NS
Copper	7440-50-8	270	270	270	10,000 <sup>d</sup>	50	1,720
Total Cyanide <sup>h</sup>		27	27	27	10,000 <sup>d</sup>	NS	40
Lead	7439-92-1	400	400	1,000	3,900	63 <sup>f</sup>	450
Manganese	7439-96-5	2,000 <sup>f</sup>	2,000 <sup>f</sup>	10,000 <sup>d</sup>	10,000 <sup>d</sup>	1600 <sup>f</sup>	2,000 <sup>f</sup>
Total Mercury		0.81 <sup>j</sup>	0.81 <sup>j</sup>	2.8 <sup>j</sup>	5.7 <sup>j</sup>	0.18 <sup>f</sup>	0.73
Nickel	7440-02-0	140	310	310	10,000 <sup>d</sup>	30	130
Selenium	7782-49-2	36	180	1,500	6,800	3.9 <sup>f</sup>	4 <sup>f</sup>
Silver	7440-22-4	36	180	1,500	6,800	2	8.3
Zinc	7440-66-6	2200	10,000 <sup>d</sup>	10,000 <sup>d</sup>	10,000 <sup>d</sup>	109 <sup>f</sup>	2,480
<b>PCBs/Pesticides</b>							
2,4,5-TP Acid (Silvex)	93-72-1	58	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	3.8
4,4'-DDE	72-55-9	1.8	8.9	62	120	0.0033 <sup>e</sup>	17
4,4'-DDT	50-29-3	1.7	7.9	47	94	0.0033 <sup>e</sup>	136
4,4'-DDD	72-54-8	2.6	13	92	180	0.0033 <sup>e</sup>	14
Aldrin	309-00-2	0.019	0.097	0.68	1.4	0.14	0.19
alpha-BHC	319-84-6	0.097	0.48	3.4	6.8	0.04 <sup>g</sup>	0.02
beta-BHC	319-85-7	0.072	0.36	3	14	0.6	0.09
Chlordane (alpha)	5103-71-9	0.91	4.2	24	47	1.3	2.9

**Table 375-6.8(b): Restricted Use Soil Cleanup Objectives**

Contaminant	CAS Number	Protection of Public Health				Protection of Ecological Resources	Protection of Ground-water
		Residential	Restricted-Residential	Commercial	Industrial		
delta-BHC	319-86-8	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	0.04 <sup>g</sup>	0.25
Dibenzofuran	132-64-9	14	59	350	1,000 <sup>c</sup>	NS	210
Dieldrin	60-57-1	0.039	0.2	1.4	2.8	0.006	0.1
Endosulfan I	959-98-8	4.8 <sup>i</sup>	24 <sup>i</sup>	200 <sup>i</sup>	920 <sup>i</sup>	NS	102
Endosulfan II	33213-65-9	4.8 <sup>i</sup>	24 <sup>i</sup>	200 <sup>i</sup>	920 <sup>i</sup>	NS	102
Endosulfan sulfate	1031-07-8	4.8 <sup>i</sup>	24 <sup>i</sup>	200 <sup>i</sup>	920 <sup>i</sup>	NS	1,000 <sup>c</sup>
Endrin	72-20-8	2.2	11	89	410	0.014	0.06
Heptachlor	76-44-8	0.42	2.1	15	29	0.14	0.38
Lindane	58-89-9	0.28	1.3	9.2	23	6	0.1
Polychlorinated biphenyls	1336-36-3	1	1	1	25	1	3.2
<b>Semivolatiles</b>							
Acenaphthene	83-32-9	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	20	98
Acenaphthylene	208-96-8	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	107
Anthracene	120-12-7	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	1,000 <sup>c</sup>
Benz(a)anthracene	56-55-3	1 <sup>f</sup>	1 <sup>f</sup>	5.6	11	NS	1 <sup>f</sup>
Benzo(a)pyrene	50-32-8	1 <sup>f</sup>	1 <sup>f</sup>	1 <sup>f</sup>	1.1	2.6	22
Benzo(b)fluoranthene	205-99-2	1 <sup>f</sup>	1 <sup>f</sup>	5.6	11	NS	1.7
Benzo(g,h,i)perylene	191-24-2	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	1,000 <sup>c</sup>
Benzo(k)fluoranthene	207-08-9	1	3.9	56	110	NS	1.7
Chrysene	218-01-9	1 <sup>f</sup>	3.9	56	110	NS	1 <sup>f</sup>
Dibenz(a,h)anthracene	53-70-3	0.33 <sup>e</sup>	0.33 <sup>e</sup>	0.56	1.1	NS	1,000 <sup>c</sup>
Fluoranthene	206-44-0	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	1,000 <sup>c</sup>
Fluorene	86-73-7	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	30	386
Indeno(1,2,3-cd)pyrene	193-39-5	0.5 <sup>f</sup>	0.5 <sup>f</sup>	5.6	11	NS	8.2
m-Cresol	108-39-4	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.33 <sup>e</sup>
Naphthalene	91-20-3	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	12

**Table 375-6.8(b): Restricted Use Soil Cleanup Objectives**

Contaminant	CAS Number	Protection of Public Health				Protection of Ecological Resources	Protection of Ground-water
		Residential	Restricted-Residential	Commercial	Industrial		
o-Cresol	95-48-7	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.33 <sup>e</sup>
p-Cresol	106-44-5	34	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.33 <sup>e</sup>
Pentachlorophenol	87-86-5	2.4	6.7	6.7	55	0.8 <sup>e</sup>	0.8 <sup>e</sup>
Phenanthrene	85-01-8	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	1,000 <sup>c</sup>
Phenol	108-95-2	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	30	0.33 <sup>e</sup>
Pyrene	129-00-0	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	1,000 <sup>c</sup>
<b>Volatiles</b>							
1,1,1-Trichloroethane	71-55-6	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.68
1,1-Dichloroethane	75-34-3	19	26	240	480	NS	0.27
1,1-Dichloroethene	75-35-4	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.33
1,2-Dichlorobenzene	95-50-1	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	1.1
1,2-Dichloroethane	107-06-2	2.3	3.1	30	60	10	0.02 <sup>f</sup>
cis-1,2-Dichloroethene	156-59-2	59	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.25
trans-1,2-Dichloroethene	156-60-5	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.19
1,3-Dichlorobenzene	541-73-1	17	49	280	560	NS	2.4
1,4-Dichlorobenzene	106-46-7	9.8	13	130	250	20	1.8
1,4-Dioxane	123-91-1	9.8	13	130	250	0.1 <sup>e</sup>	0.1 <sup>e</sup>
Acetone	67-64-1	100 <sup>a</sup>	100 <sup>b</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	2.2	0.05
Benzene	71-43-2	2.9	4.8	44	89	70	0.06
Butylbenzene	104-51-8	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	12
Carbon tetrachloride	56-23-5	1.4	2.4	22	44	NS	0.76
Chlorobenzene	108-90-7	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	40	1.1
Chloroform	67-66-3	10	49	350	700	12	0.37
Ethylbenzene	100-41-4	30	41	390	780	NS	1
Hexachlorobenzene	118-74-1	0.33 <sup>e</sup>	1.2	6	12	NS	3.2
Methyl ethyl ketone	78-93-3	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	100 <sup>a</sup>	0.12

**Table 375-6.8(b): Restricted Use Soil Cleanup Objectives**

Contaminant	CAS Number	Protection of Public Health				Protection of Ecological Resources	Protection of Ground-water
		Residential	Restricted-Residential	Commercial	Industrial		
Methyl tert-butyl ether	1634-04-4	62	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	0.93
Methylene chloride	75-09-2	51	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	12	0.05
n-Propylbenzene	103-65-1	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	3.9
sec-Butylbenzene	135-98-8	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	11
tert-Butylbenzene	98-06-6	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	NS	5.9
Tetrachloroethene	127-18-4	5.5	19	150	300	2	1.3
Toluene	108-88-3	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	36	0.7
Trichloroethene	79-01-6	10	21	200	400	2	0.47
1,2,4-Trimethylbenzene	95-63-6	47	52	190	380	NS	3.6
1,3,5- Trimethylbenzene	108-67-8	47	52	190	380	NS	8.4
Vinyl chloride	75-01-4	0.21	0.9	13	27	NS	0.02
Xylene (mixed)	1330-20-7	100 <sup>a</sup>	100 <sup>a</sup>	500 <sup>b</sup>	1,000 <sup>c</sup>	0.26	1.6

All soil cleanup objectives (SCOs) are in parts per million (ppm).

NS=Not specified. See Technical Support Document (TSD).

**Footnotes**

<sup>a</sup> The SCOs for residential, restricted-residential and ecological resources use were capped at a maximum value of 100 ppm. See TSD section 9.3.

<sup>b</sup> The SCOs for commercial use were capped at a maximum value of 500 ppm. See TSD section 9.3.

<sup>c</sup> The SCOs for industrial use and the protection of groundwater were capped at a maximum value of 1000 ppm. See TSD section 9.3.

<sup>d</sup> The SCOs for metals were capped at a maximum value of 10,000 ppm. See TSD section 9.3.

<sup>e</sup> For constituents where the calculated SCO was lower than the contract required quantitation limit (CRQL), the CRQL is used as the SCO value.

<sup>f</sup> For constituents where the calculated SCO was lower than the rural soil background concentration as determined by the Department and Department of Health rural soil survey, the rural soil background concentration is used as the Track 2 SCO value for this use of the site.

<sup>g</sup> This SCO is derived from data on mixed isomers of BHC.

<sup>h</sup> The SCO for this specific compound (or family of compounds) is considered to be met if the analysis for the total species of this contaminant is below the specific SCO.

<sup>i</sup> This SCO is for the sum of endosulfan I, endosulfan II, and endosulfan sulfate.

<sup>j</sup> This SCO is the lower of the values for mercury (elemental) or mercury (inorganic salts). See TSD Table 5.6-1.

# MEMORANDUM

**\*\*\* NOTICE \*\*\***

This document has been developed to provide Department staff with guidance on how to ensure compliance with statutory and regulatory requirements, including case law interpretations, and to provide consistent treatment of similar situations. This document may also be used by the public to gain technical guidance and insight regarding how the department staff may analyze an issue and factors in their consideration of particular facts and circumstances. This guidance document is not a fixed rule under the State Administrative Procedure Act section 102(2)(a)(i). Furthermore, nothing set forth herein prevents staff from varying from this guidance as the specific facts and circumstances may dictate, provided staff's actions comply with applicable statutory and regulatory requirements. This document does not create any enforceable rights for the benefit of any party.

Previous Date: October 22, 1993

Reissued Date: JUNE 1998

TO: Bureau Directors, Regional Water Engineers, Section Chiefs

SUBJECT: Division of Water Technical and Operational Guidance Series (1.1.1)

AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES  
AND GROUNDWATER EFFLUENT LIMITATIONS

(Originator - John Zambrano/Scott Stoner)

## **PURPOSE**

The primary purpose of this document is to provide a compilation of ambient water quality guidance values and groundwater effluent limitations for use where there are no standards (in 6 NYCRR 703.5) or regulatory effluent limitations (in 703.6). For the convenience of the reader, the standards in 703.5 and groundwater effluent limitations in 703.6 are included in this document. The values in this document (guidance and regulatory) are used in Department programs, including the SPDES permit program.

## **DISCUSSION**

This document combines and revises the previous editions of TOGS 1.1.1 (ambient values) and 1.1.2 (groundwater effluent limitations). The main reason for the revision is to include revised and added ambient standards and effluent limitations resulting from the amendments to 6 NYCRR Parts 700 - 706, effective March 12, 1998. Ambient guidance values are also added for over 100 substances, largely based on the application of the Principal Organic Contaminant (POC) value to surface waters classified as sources of water supply.

## **GUIDANCE**

This TOGS presents Division of Water ambient water quality standards and guidance values and groundwater effluent limitations. The authority for these values is derived from Article 17 of the Environmental Conservation Law and 6 NYCRR Parts 700-706, Water Quality Regulations.

This TOGS is divided into two Parts. Part I describes and lists ambient standards and guidance values. Part II describes and lists groundwater effluent limitations.

Although the reader may be tempted to turn immediately to the tables containing the ambient or effluent values, the following cautionary note is important: Many substances for which there are standards, guidance values and effluent limitations are not individually listed or identified in the tables, but are included as part of "group" entries such as "Principal Organic Contaminant." A careful reading of the text of Parts I and II is needed to ensure proper use of this document.

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**PART I AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES**

Ambient water quality standards and guidance values for toxic and non-conventional pollutants are presented in Table 1. This Table includes all of the Division's numerical standards and guidance values established as of the date of this document except standards for coliforms and dissolved oxygen. The reader is referred to Part 703 for the excepted numerical standards and for the Department's narrative water quality standards.

Section A of this Part provides an explanation of ambient water quality standards and guidance values in the format of the column headings in Table 1. Section B, relying on the background of Section A, provides a procedure to help determine whether or not there is a standard or guidance value for a particular substance. Included in this section are instructions on determining the applicability of the POC general groundwater standard to specific substances. Section C provides guidance on certain aspects of development, interpretation and use of standards and guidance values.

**A. EXPLANATION OF AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES**

Ambient water quality standards and guidance values are presented in Table 1. Table 1 includes columns for "Substance (CAS No.)," "Water Classes," "Standard," "Guidance Value," "Type" and "Basis Code." This section describes these terms. Standards and guidance values are described first to facilitate understanding.

1. Standard and Guidance Value

Standards and guidance values are ambient water quality values that are set to protect the state's waters. They both are derived according to scientific procedures that are in regulation (6 NYCRR Part 702).

A standard is a value that has been promulgated and placed into regulation. The standards for the surface water and groundwater classes are extracted from Part 703 of Title 6. Surface water and groundwater standards were last revised effective March 12, 1998.

A guidance value may be used where a standard for a substance or group of substances has not been established for a particular water class and type of value (section 702.15). All guidance values as of the date of this document are listed in Table 1 of this TOGS.

Standards and guidance values are the maximum allowable concentration in units of ug/L, unless otherwise indicated. Where standards or guidance values are expressed as a function of hardness, hardness is in units of parts per million (ppm), expressed as calcium carbonate, and the resulting value is in ug/L. Also, in such hardness functions, the term "exp" represents the base e exponential function.

"ND" means a non-detectable concentration by the approved analytical methods referenced in section 700.3.

The "general organic guidance value," described in 702.15, is misunderstood by some. This value does not automatically apply in the absence of a standard or specific guidance value. For this value to be applied to an individual substance, the Department must determine that certain toxicological data requirements have been met. As of the date of this TOGS, the only substances for which the Division has made this determination are listed in Table 1.

2. Substance (CAS No.)

The substance or group of substances (entry) for which a standard or guidance value has been derived is presented in this column in alphabetical order. The Chemical Abstract Service Registry (CAS) Number(s) are given, where applicable, to provide positive identification. Because a substance may be known by names other than the one used in this document, identification of the CAS number can be useful for locating the substance. An index of CAS numbers is provided at the end of the document.

Group entries fit into one of three categories, as described below. For each such entry, a Remark will indicate whether the standard(s) or guidance value(s) apply to the sum of the substances or to each substance individually.

Interpretation of Group Entries

- a. Where the entry consists of two or more specific substances, with or without CAS Numbers (e.g.: Aldrin and Dieldrin), the entry includes only the specific substances listed.
- b. Where the entry is the name of a group of substances, with CAS numbers listed (e.g.: Dichlorotoluenes), the entry includes only those substances for which the CAS Numbers are listed.
- c. Where the entry is the name of a group of substances, without CAS Numbers (e.g.: Principal organic contaminant), the entry includes all substances that belong to the group, unless otherwise noted. The specific substances in the group may not be listed in the entry or the index. A determination of the specific substances encompassed by the standard(s) or guidance value(s), therefore, may be necessary.

The principal organic contaminant (POC) standard for groundwater is the largest and most complex of this third type of group entry. It is a general standard that applies individually to a virtually unlimited number of substances in six chemical classes. Because of the importance of this general groundwater standard, instructions for determining its applicability to specific substances are included in Section C, below.

3. Water Classes and Type

Standards and guidance values are developed for specific classes of fresh and saline surface waters and fresh groundwaters for protection of the best uses assigned to each class. Best uses are described in Part 701. Standards and guidance values are further designated as to "Type." Values for protection of sources of drinking water are designated Health (Water Source) and noted by H(W.S). Similarly, values for protection of human consumers of fish are designated as Health (Fish Consumption) and noted by H(FC). Values for protection of aquatic life from chronic effects are designated Aquatic (Chronic) and noted as A(C). Values for protection of aquatic life from acute effects are designated Aquatic (Acute) and noted as A(A). Values for protection of wildlife are designated as Wildlife and noted as W. Values for protection from aesthetic considerations are designated as Aesthetic and noted as E. Designation of the Type of value determines the applicability of section 702.15, which concerns derivation of guidance values.

A summary description of best usage protections, water classes and type of values related to toxic pollutants is presented below. The groupings of Water Classes and Type presented for the summary description are those that frequently appear in Table 1. A complete description of the water classifications is provided in Part 701.

<u>Water Classes</u>	<u>Type</u>	<u>Protection For</u>
A, A-S, AA, AA-S	H(W.S)	Source of Drinking Water (surface water)
GA	H(W.S)	Source of Drinking Water (groundwater)
A, A-S, AA, AA-S, B, C, D	H(FC)	Human Consumption of Fish (fresh waters)
SA, SB, SC, I, SD	H(FC)	Human Consumption of Fish (saline waters)
A, A-S, AA, AA-S, B, C	A(C)	Fish Propagation (fresh waters)
A, A-S, AA, AA-S, B, C, D	A(A)	Fish Survival (fresh waters)
SA, SB, SC, I	A(C)	Fish Propagation (saline waters)
SA, SB, SC, I, SD	A(A)	Fish Survival (saline waters)
A, A-S, AA, AA-S, B, C, D	W	Wildlife Protection (fresh waters)
SA, SB, SC, I, SD	W	Wildlife Protection (saline waters)
A, A-S, AA, AA-S, B, C, D, GA	E	Aesthetic (fresh waters)
SA, SB, SC, I, SD	E	Aesthetic (saline waters)

For many substances, more than one Type of value will be listed for a specific water class. In these situations, all values apply and may be used to derive the most stringent limitations.

#### 4. Basis Code

The letters in this column designate the specific procedure used to derive the standard or guidance value. The key to the letter designations is provided in Table 2.

#### B. HOW TO LOCATE AMBIENT STANDARD OR GUIDANCE VALUE

This section contains instructions on how to determine whether the Division has an ambient standard or guidance value for a substance. As described above, many substances with standards or guidance values are included in "group" entries but not individually identified, or are listed by a different name. Therefore, the absence of a specific entry for a substance name does not necessarily mean that there is no standard or guidance value. The procedures below should assist the user, but are not guaranteed. The user may want to contact the Division's Standards and Special Studies Section before assuming that there is no standard or guidance value for a particular substance.

##### 1. Recommended Procedure for Determining if Standard or Guidance Value Exists

- Step 1. Look up substance by name(s) in Table 1. If found, confirm identity by CAS number, if listed. If substance is not found, go to Step 2.
- Step 2. Using CAS number and the CAS number index, determine the entry name and location of the substance. If CAS number is not in index, go to Step 3.
- Step 3. Entries for metals and some other substances, e.g., nitrate, do not contain CAS numbers. The entry for a metal includes all forms of the metal, metallic and in compounds, unless otherwise specified. The nitrate entry includes all compounds containing nitrate. There is no entry for "sodium nitrate" for instance, but there are entries for sodium and for nitrate. Therefore, look in Table 1 for the components of a metallic or ionic compound. If not found, go to Step 4.
- Step 4. Determine whether the substance is included in any of the groups listed below that has a standard or guidance value listed for the water class(es) of interest. Detailed instructions for determining the applicability of the principal organic contaminant (POC) groundwater standard are provided below.

Alkyl diphenyl oxide sulfonates  
Aminomethylene phosphonic acid salts  
Aryltriazoles  
Boric acid, Borates and Metaborates  
Chlorinated dibenzo-p-dioxins and Chlorinated dibenzofurans  
Foaming agents

Gross alpha radiation  
Gross beta radiation  
Isothiazolones, total  
Linear alkyl benzene sulfonates (LAS)  
Methylbenz(a)anthracenes  
Phenolic compounds (total phenols)  
Phenols, total chlorinated  
Phenols, total unchlorinated  
Polybrominated biphenyls  
Polychlorinated biphenyls  
Principal organic contaminant  
Quaternary ammonium compounds  
Sulfides, total

##### 2. Determination of Applicability of POC Groundwater Standard to Individual Substances

The POC standard for groundwater (Table 1) is a general standard that applies individually to an unlimited number of substances in six chemical classes. Some, but by no means all of the individual POCs are listed in Table 1. Consequently, the applicability of this standard to specific substances must be determined.

The POC standard was originally developed by the New York State Department of Health (DOH) for drinking water. The definitions of the six POC classes (6 NYCRR section 700.1 and Table 4 of this TOGS), obtained from the DOH regulations, are definitive for the first two classes, but require interpretation for the others. Furthermore, some substances that meet the definition of a particular POC class may not be regulated by the POC standard because they have a more stringent specific standard. It is, therefore, important to follow sequentially the steps below for determining the applicability of the POC groundwater standard.

It should be noted that the POC applies as a general standard only to groundwater.

The recommended procedure consists of five steps. These steps must be followed in sequential order to avoid making an incorrect determination. They include reference to three tables within this TOGS, the use of definitions for two POC classes, and how to obtain assistance.

- Step 1. Check Table 1 of this TOGS. If the substance is listed in Table 1 as having either a specific groundwater standard (POC or other) or groundwater guidance value, that listed value applies and the reader should not go further. If not, go on to Step 2.
- Step 2. Check Table 3 of this TOGS, which is a partial list of substances to which the POC groundwater standard does not apply. If the substance is listed in Table 3, the standard does not apply and the reader should not go further. If the substance is not in Table 3, go

on to Step 3.

- Step 3. Compare the substance with the definitions of POC classes 1 and 2, below. If it meets either of these definitions, the POC groundwater standard applies and the reader should not go further. If it does not meet either definition, or if the reader is uncertain whether it does, go on to Step 4.

Definitions of POC Classes 1 and 2:

Class 1 - Halogenated alkane\*: 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  $C_nH_yX_z$ , 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.

Class 2 - Halogenated ether: Compound containing carbon (C), hydrogen (H), oxygen (O) and halogen (X) (where X = F, Cl, Br and/or I) having the general formula  $C_nH_yX_zO$ , 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.

- Step 4. Although the definitions of the remaining classes are in regulation and reproduced in Table 4, determinations beyond this point involve interpretations, including chemical comparisons with previously determined substances. The user, therefore, should contact the Standards and Special Studies Section (Scott Stoner (518-485-5824) or John Zambrano (518-457-6997)) for assistance. They will make the determination, consulting with the DOH as needed. Provision of the CAS number and structure of the substance will facilitate the determination.

\*Note: This definition does not mention the specific exclusions listed in the definition in regulation (6 NYCRR 700.1 and Table 4) because those excluded substances are listed in Table 1 of this TOGS and thus covered by Step 1 of this procedure

C. DEVELOPMENT, INTERPRETATION AND USE OF AMBIENT STANDARDS AND GUIDANCE VALUES

1. Development of Standards and Guidance Values

Guidance values are developed as needed with priorities primarily reflecting greater expected or observed occurrence in the environment and greater toxicity. Most requests for development of guidance values originate through the use and

discharge information that is generated through the State Pollutant Discharge Elimination System (SPDES) permit program. Standards are proposed for rule making with similar priority considerations.

As stated previously, a guidance value may be utilized where a standard has not been adopted for a substance. Guidance values that have been developed for surface waters and groundwaters are presented in Table 1. If a substance is judged to pose a threat to the environment and if no standard or guidance value is presented in Table 1 for that substance and water class, a request for development of a guidance value should be made to the Standards and Special Studies Section.

2. Analytical Methods

Section 700.3 provides the analytical requirements to determine compliance with water quality standards and guidance values. These regulations include specific analytical references and also refer to "...other methods approved by the department..." The Division of Water maintains a compilation of methods approved by the department in a separate Technical and Operational Guidance Series (TOGS) document.

There are a number of water quality standards and guidance values for which there is no approved analytical procedure. Use of these values should be accompanied by the identification of an acceptable analytical method.

3. SPDES Effluent Limits

Ambient water quality standards and guidance values are used to derive water quality-based effluent limitations for SPDES permits. Instruction for the derivation of these limitations is provided in separate TOGS documents. There are, however, a number of topics that warrant discussion here.

a. Hydrologic Flow Base and Averaging Period

The derivation of water quality based effluent limitations from ambient water quality standards or guidance values requires selection of a receiving water flow and the specification of an averaging period for the effluent limitation. Their selection will be a function of the variability of the receiving water flow and effluent load and the time period associated with the critical adverse effect. In general, standards and guidance values that are based on adverse effects that develop over time periods greater than a month will receive effluent limitations based on the minimum average 30 consecutive day receiving water flow with a one-in-ten year occurrence (MA30CD/10) and calculated as a monthly average. Values based on shorter-term adverse effects will generally receive effluent limitations based on MA7CD/10 flow and calculated as a daily maximum. Specific determinations, however, are made at the time of permit issuance.

b. Chemical Forms

Standards and guidance values apply to all forms of the substances unless otherwise specified.

Certain ambient standards and guidance values apply to a specific toxic form rather than all forms of the substance. Changes in the form of a substance can occur in the receiving water. As a result, the form of the substance that is specified as an effluent limitation may differ from the form of the ambient standard or guidance value.

c. Groundwater Effluent Limitations

Groundwater effluent limitations are discussed in Part II of this document.

d. Total of Organic Chemicals

Subparagraph 702.16(b)(3) of the water quality regulations specifies, for the purpose of deriving effluent limitations for surface water, an ambient value of 100 ug/L for the total of organic substances having a standard or guidance value established pursuant to the human-health methodologies. The substances included in this total are all of the organic substances listed in Table 1 of this TOGS that have a H(WS) standard or guidance value less than 100 ug/L for surface water.

Table 1

NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Acenaphthene (83-32-9)	A, A-S, AA, AA-S, B, C		5.3	A(C)	
	A, A-S, AA, AA-S, B, C, D		48	A(A)	
	SA, SB, SC, I		6.6	A(C)	
	SA, SB, SC, I, SD		60	A(A)	
	A, A-S, AA, AA-S GA	20	20	E E	U U
Acetone (67-64-1)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Acrolein (107-02-8)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Acrylamide (79-06-1)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Acrylic acid (79-10-7)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Acrylonitrile (107-13-1)	A, A-S, AA, AA-S		0.07	H(WS)	A
	GA	*		H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Alachlor (15972-60-8)	A, A-S, AA, AA-S	0.5		H(WS)	A
	GA	0.5		H(WS)	A
Aldicarb (116-06-3)	A, A-S, AA, AA-S	7		H(WS)	B
	GA	*		H(WS)	
Remark:	* Refer to entry for "Aldicarb and Methomyl."				
Aldicarb and Methomyl (116-06-3;16752-77-5)	GA	0.35*		H(WS)	F
Remark:	* Applies to the sum of these substances.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Aldicarb sulfone (1646-88-4)	A, A-S, AA, AA-S		2*	H(WS)	G
	GA		2*	H(WS)	G
Remark:	* This substance did not receive a review beyond determining the existence of a Specific MCL. A more in-depth review, currently underway, could lead to a more (but not less) stringent guidance value.				
Aldicarb sulfoxide (1646-87-3)	A, A-S, AA, AA-S		4*	H(WS)	G
	GA		4*	H(WS)	G
Remark:	* This substance did not receive a review beyond determining the existence of a Specific MCL. A more in-depth review, currently underway, could lead to a more (but not less) stringent guidance value.				
Aldrin (309-00-2)	A, A-S, AA, AA-S		0.002	H(WS)	A
	GA	ND		H(WS)	
	A, A-S, AA, AA-S, B, C, D	*		H(FC)	
	SA, SB, SC, SD	*		H(FC)	
Remark:	* Refer to entry for "Aldrin and Dieldrin."				
Aldrin and Dieldrin (309-00-2; 60-57-1)	A, A-S, AA, AA-S, B, C, D	0.001*		H(FC)	
	SA, SB, SC, SD	0.001*		H(FC)	
			0.001*	H(FC)	
Remark:	* Applies to the sum of these substances.				
Alkyl dimethyl benzyl ammonium chloride (68391-01-5)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
	A, A-S, AA, AA-S, B, C	*		A(C)	
Remark:	* Refer to entry for "Quaternary ammonium compounds."				
Alkyl diphenyl oxide sulfonates (CAS No. Not Applicable)	A, A-S, AA, AA-S		50*	H(WS)	Z
	GA		50*	H(WS)	Z
Remark:	* Applies to each alkyl diphenyl oxide sulfonate individually.				
Allyl chloride (107-05-1)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Aluminum, ionic (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	100*		A(C)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Ametryn (834-12-8)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA	50		H(WS)	J

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
4-Aminobiphenyl (92-67-1)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Aminocresols (95-84-1; 2835-95-2; 2835-99-6)	A, A-S, AA, AA-S	*		E	
	GA	*		E	
	A, A-S, AA, AA-S, B, C	**		E	
	D	**		E	
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)." ** Refer to entry for "Phenols, total unchlorinated."				
Aminomethylene phosphonic acid salts (CAS No. Not Applicable)	A, A-S, AA, AA-S		50*	H(WS)	Z
	GA		50*	H(WS)	Z
Remark:	* Applies to each aminomethylene phosphonic acid salt individually.				
Aminopyridines (462-08-8; 504-24-5; 504-29-0; 26445-05-6)	A, A-S, AA, AA-S		1*	H(WS)	B
	GA		1*	H(WS)	B
Remark:	* Values listed apply to sum of these substances.				
3-Aminotoluene (108-44-1)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Aminotoluene (106-49-0)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Ammonia and Ammonium (7664-41-7; CAS No. Not Applicable)	A, A-S, AA, AA-S	2,000*		H(WS)	H
	GA	2,000*		H(WS)	H
	A, A-S, AA, AA-S, B, C	**		A(C)	
	D	**		A(A)	

Remarks: \* NH<sub>3</sub> + NH<sub>4</sub><sup>+</sup> as N.  
 \*\* Un-ionized ammonia as NH<sub>3</sub>; tables below provide the standard in ug/L at varying pH and temperature for different classes and specifications. Linear interpolation between the listed pH values and temperatures is applicable.

Classes A, A-S, AA, AA-S, B, C with the (T) or (TS) Specification

pH	0°C	5°C	10°C	15°-30°C
6.50	0.7	0.9	1.3	1.9
6.75	1.2	1.7	2.3	3.3
7.00	2.1	2.9	4.2	5.9
7.25	3.7	5.2	7.4	11
7.50	6.6	9.3	13	19
7.75	11	15	22	31
8.0-9.0	13	18	25	35

Classes A, A-S, AA, AA-S, B, C without the (T) or (TS) Specification

pH	0°C	5°C	10°C	15°C	20°-30°C
6.50	0.7	0.9	1.3	1.9	2.6
6.75	1.2	1.7	2.3	3.3	4.7
7.00	2.1	2.9	4.2	5.9	8.3
7.25	3.7	5.2	7.4	11	15
7.50	6.6	9.3	13	19	26
7.75	11	15	22	31	43
8.0-9.0	13	18	25	35	50

Class D

pH	0°C	5°C	10°C	15°C	20°C	25°-30°C
6.50	9.1	13	18	26	36	51
6.75	15	21	30	42	59	84
7.00	23	33	46	66	93	131
7.25	34	48	68	95	140	190
7.50	45	64	91	130	180	260
7.75	56	80	110	160	220	320
8.0-9.0	65	92	130	180	260	370

Table 1 (Continued)

NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

Total Ammonia (mg/L NH <sub>3</sub> )							
Classes A, A-S, AA, AA-S, B, C with the (T) or (TS) Specification							
pH	0°C	5°C	10°C	15°C	20°C	25°C	30°C
6.50	2.5	2.4	2.2	2.2	1.5	1.0	.73
6.75	2.5	2.4	2.2	2.2	1.5	1.0	.73
7.00	2.5	2.4	2.2	2.2	1.5	1.0	.74
7.25	2.5	2.4	2.2	2.2	1.5	1.0	.74
7.50	2.5	2.4	2.2	2.2	1.5	1.1	.74
7.75	2.3	2.2	2.1	2.0	1.4	.99	.71
8.00	1.5	1.4	1.4	1.3	.93	.66	.47
8.25	.87	.82	.78	.76	.54	.39	.28
8.50	.49	.47	.45	.44	.32	.23	.17
8.75	.28	.27	.26	.27	.19	.15	.11
9.00	.16	.16	.16	.16	.13	.10	.08

Classes A, A-S, AA, AA-S, B, C without the (T) or (TS) Specification

pH	0°C	5°C	10°C	15°C	20°C	25°C	30°C
6.50	2.5	2.4	2.2	2.2	2.1	1.5	1.0
6.75	2.5	2.4	2.2	2.2	2.1	1.5	1.0
7.00	2.5	2.4	2.2	2.2	2.1	1.5	1.0
7.25	2.5	2.4	2.2	2.2	2.1	1.5	1.1
7.50	2.5	2.4	2.2	2.2	2.1	1.5	1.1
7.75	2.3	2.2	2.1	2.0	1.9	1.4	1.0
8.00	1.5	1.4	1.3	1.3	1.3	.93	.67
8.25	.87	.82	.78	.76	.76	.54	.40
8.50	.49	.47	.45	.44	.45	.33	.25
8.75	.28	.27	.26	.27	.27	.21	.16
9.00	.16	.16	.16	.16	.17	.14	.11

Class D

pH	0°C	5°C	10°C	15°C	20°C	25°C	30°C
6.50	35	33	31	30	29	29	20
6.75	32	30	28	27	27	26	19
7.00	28	26	25	24	23	23	16
7.25	23	22	20	20	19	19	14
7.50	17	16	16	15	15	15	10
7.75	12	11	11	11	10	10	7.3
8.00	8.0	7.5	7.1	6.9	6.8	6.8	4.9
8.25	4.5	4.2	4.1	4.0	3.9	4.0	2.9
8.50	2.6	2.4	2.3	2.3	2.3	2.4	1.8
8.75	1.4	1.4	1.3	1.4	1.4	1.5	1.1
9.00	.86	.83	.83	.86	.91	1.0	.82

This table provides total ammonia concentrations that will contain the un-ionized ammonia concentration at the level of the standard at the respective pH and temperatures based on relationships established in USEPA 1985, Ambient Water Quality Criteria for Ammonia - 1984. Office of Water, Criteria & Standards Division, Washington, D.C. 20460. EPA 440/5-85-001. January 1985. (Cited, Thurston, R.V., R.C. Russo, and K. Emerson. 1979. Aqueous ammonia equilibrium - tabulation of percent un-ionized ammonia. EPA Ecol. Res. Ser. EPA-600/3-79-091. Environmental Research Laboratory, U.S. Environmental Protection Agency, Duluth, MN: 427 p.)

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE	
Aniline (62-53-3)	A, A-S, AA, AA-S	5		H(WS)	I	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
Anthracene (120-12-7)	A, A-S, AA, AA-S			H(WS)	Z	
	GA			H(WS)	Z	
	A, A-S, AA, AA-S, B, C			3.8	A(C)	
	A, A-S, AA, AA-S, B, C, D			35	A(A)	
Antimony (CAS No. Not Applicable)	A, A-S, AA, AA-S	3		H(WS)	B	
	GA	3		H(WS)	B	
Arsenic (CAS No. Not Applicable)	A, A-S, AA, AA-S	50		H(WS)	G	
	GA	25		H(WS)	F	
	A, A-S, AA, AA-S, B, C	150*		A(C)		
	A, A-S, AA, AA-S, B, C, D	340*		A(A)		
	SA, SB, SC	63*		A(C)		
	I		36*	A(C)		
	SD	120*		A(A)		
Remark: * Dissolved arsenic form.						
Aryltriazoles (CAS No. Not Applicable)	A, A-S, AA, AA-S		50*	H(WS)	Z	
	GA		50*	H(WS)	Z	
Remark: * Applies to each aryltriazole individually.						
Asbestos (CAS No. Not Applicable)	A, A-S, AA, AA-S			H(WS)	G	
	GA			H(WS)	G	
Remark: * 7,000,000 fibers (longer than 10 um)/L.						
Atrazine (1912-24-9)	A, A-S, AA, AA-S	7.5		3*	H(WS)	G
	GA			H(WS)	F	
Azinphosmethyl (86-50-0)	A, A-S, AA, AA-S	4.4		0.07	H(WS)	A
	GA			H(WS)	F	
	A, A-S, AA, AA-S, B, C			0.005*	A(C)	
	SA, SB, SC			0.01	A(C)	
	I			0.01	A(C)	
Remark: * For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).						
Azobenzene (103-33-3)	A, A-S, AA, AA-S			0.5	H(WS)	A
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
Barium (CAS No. Not Applicable)	A, A-S, AA, AA-S	1,000		H(WS)	G	
	GA	1,000		H(WS)	F	

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE		
Benfenin (1861-40-1)	GA	35		H(WS)	F		
Benz(a)anthracene (56-55-3)	A, A-S, AA, AA-S			0.002	H(WS)	A	
	GA			0.002	H(WS)	A	
	A, A-S, AA, AA-S, B, C			0.03	A(C)		
	A, A-S, AA, AA-S, B, C, D			0.23	A(A)		
Benzene (71-43-2)	A, A-S, AA, AA-S	1			H(WS)	A	
	GA			1	H(WS)	A	
	A, A-S, AA, AA-S, B, C, D			10	H(FC)	A	
	SA, SB, SC, I, SD			10	H(FC)	A	
	A, A-S, AA, AA-S, B, C				210	A(C)	
	A, A-S, AA, AA-S, B, C, D				760	A(A)	
	SA, SB, SC, I				190	A(C)	
SA, SB, SC, I, SD		670	A(A)				
Benzidine (92-87-5)	A, A-S, AA, AA-S			0.02	H(WS)	A	
	GA				H(WS)	J	
	A, A-S, AA, AA-S, B, C			0.1**	A(C)		
	D			0.1**	A(A)		
Remarks: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance. ** For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).							
Benzisothiazole (271-61-4)	A, A-S, AA, AA-S			50	H(WS)	Z	
	GA			50	H(WS)	Z	
Benzo(b)fluoranthene (205-99-2)	A, A-S, AA, AA-S			0.002	H(WS)	A	
	GA			0.002	H(WS)	A	
Benzo(k)fluoranthene (207-08-9)	A, A-S, AA, AA-S			0.002	H(WS)	A	
	GA			0.002	H(WS)	A	
Benzo(a)pyrene (50-32-8)	A, A-S, AA, AA-S	ND		0.002	H(WS)	A	
	GA			0.002	H(WS)	F	
	A, A-S, AA, AA-S, B, C, D			0.0012	H(FC)		
	SA, SB, SC, I, SD			$6 \times 10^{-4}$	H(FC)		
Beryllium (CAS No. Not Applicable)	A, A-S, AA, AA-S			3	H(WS)	B	
	GA			3	H(WS)	B	
	A, A-S, AA, AA-S, B, C			*	A(C)		
Remarks: * 11 ug/L, when hardness is less than or equal to 75 ppm; 1,100 ug/L when hardness is greater than 75 ppm. * For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c). Aquatic Type standards apply to acid-soluble form.							

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
1,1'-Biphenyl (92-52-4)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Bis(2-chloroethoxy)methane (111-91-1)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Bis(2-chloroethyl)ether (111-44-4)	A, A-S, AA, AA-S GA	1.0	0.03	H(WS) H(WS)	A F
Bis(chloromethyl)ether (542-88-1)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Bis(2-chloro-1-methylethyl)ether (108-60-1)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Bis(2-ethylhexyl)phthalate (117-81-7)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C	5 5 0.6		H(WS) H(WS) A(C)	A A
Boric acid, Borates & Metaborates (CAS No. Not Applicable)	A, A-S, AA, AA-S GA		125* 125*	H(WS) H(WS)	B B
Remarks:	* Applies as boron equivalents. Values listed apply to the sum of these substances.				
Boron (CAS No. Not Applicable)	GA A, A-S, AA, AA-S, B, C SA, SB, SC I	1,000 10,000* 1,000		H(WS) A(C) A(C) A(C)	H
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic standard if so determined under 702.15 (c). Aquatic Type standards and guidance value apply to acid-soluble form.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Bromacil (314-40-9)	GA	4.4		H(WS)	F
Bromide (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	2,000 2,000		H(WS) H(WS)	B B
Bromobenzene (108-86-1)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Bromochloromethane (74-97-5)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Bromodichloromethane (75-27-4)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Bromoform (75-25-2)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Bromomethane (74-83-9)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Butachlor (23184-66-9)	GA	3.5		H(WS)	F
cis-2-Butenal (15798-64-8)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
trans-2-Butenal (123-73-9)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
cis-2-Butenenitrile (1190-76-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
trans-2-Butenenitrile (627-26-9)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Butoxyethoxyethanol (112-34-5)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA			H(WS)	Z
Butoxypropanol (5131-66-8)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA			H(WS)	Z
Butylate (2008-41-5)	A, A-S, AA, AA-S	50	50	H(WS)	Z
	GA			H(WS)	J
n-Butylbenzene (104-51-8)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
sec-Butylbenzene (135-98-8)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
tert-Butylbenzene (98-06-6)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Butyl benzyl phthalate (85-68-7)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA			H(WS)	Z
Butyl isopropyl phthalate (CAS No. Not Applicable)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA			H(WS)	Z

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Cadmium (CAS No. Not Applicable)	A, A-S, AA, AA-S	5	2.7	H(WS)	B,G
	GA	5		H(WS)	B,G
	SA, SB, SC, I, SD			H(FC)	
	A, A-S, AA, AA-S, B, C	*		A(C)	
	A, A-S, AA, AA-S, B, C, D	**		A(A)	
	SA, SB, SC, I	7.7		A(C)	
	SD	21	A(A)		
Remarks:	* (0.85) exp(0.7852 [ln (ppm hardness)] - 2.715)				
	** (0.85) exp(1.128 [ln (ppm hardness)] - 3.6867)				
	Aquatic Type standards apply to dissolved form.				
Captan (133-08-2)	GA	18		H(WS)	F
Carbaryl (63-25-2)	GA	29		H(WS)	F
Carbofuran (1563-66-2)	A, A-S, AA, AA-S	15	15	H(WS)	B
	GA			H(WS)	B
	A, A-S, AA, AA-S, B, C	1.0*		A(C)	
	D	10*		A(A)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
Carbon tetrachloride (56-23-5)	A, A-S, AA, AA-S	5	0.4	H(WS)	A
	GA			H(WS)	F
Carboxin (5234-68-4)	A, A-S, AA, AA-S	50		H(WS)	Z
	GA			H(WS)	J
Chloramben (CAS No. Not Applicable)	A, A-S, AA, AA-S	50*	50*	H(WS)	Z
	GA			H(WS)	J
Remark:	* Includes: related forms that convert to the organic acid upon acidification to a pH of 2 or less; and esters of the organic acid.				
Chloranil (118-75-2)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chlordane (57-74-9)	A, A-S, AA, AA-S	0.05		H(WS)	A
	GA	0.05		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$2 \times 10^{-5}$		H(FC)	A
	SA, SB, SC, I, SD	$2 \times 10^{-5}$		H(FC)	A
Chloride (CAS No. Not Applicable)	A, A-S, AA, AA-S	250,000		H(WS)	H
	GA	250,000		H(WS)	H

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Chlorinated dibenzo-p-dioxins and Chlorinated dibenzofurans (CAS No. Not Applicable)	A, A-S, AA, AA-S	7 x 10 <sup>-7*</sup>		H(WS)	A
	GA	7 x 10 <sup>-7*</sup>		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	6 x 10 <sup>-10*</sup>		H(FC)	A
	SA, SB, SC, I, SD	6 x 10 <sup>-10*</sup>		H(FC)	A
	A, A-S, AA, AA-S, B, C, D	3.1 x 10 <sup>-9**</sup>		W	
	SA, SB, SC, I, SD	3.1 x 10 <sup>-9**</sup>		W	
Remarks: *	Value is for the total of the chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans that are listed in the table below as equivalents of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).				
	The 2,3,7,8-TCDD equivalent for a congener for the H(WS) standards is obtained by multiplying the concentration of that congener by its Toxicity Equivalency Factor (TEF) from the table below. The 2,3,7,8-TCDD equivalent for a congener for the H(FC) standards is obtained by multiplying the concentration of that congener by its TEF and its Bioaccumulation Equivalency Factor (BEF) from the table below.				
	** Applies only to 2,3,7,8-TCDD				
	<u>CONGENER</u>	<u>TEF</u>	<u>BEF</u>		
	2,3,7,8-Tetrachlorodibenzo-p-dioxin	1	1		
	1,2,3,7,8-Pentachlorodibenzo-p-dioxin	0.5	0.9		
	1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	0.1	0.3		
	1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	0.1	0.1		
	1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	0.1	0.1		
	1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	0.01	0.05		
	Octachlorodibenzo-p-dioxin	0.001	0.01		
	2,3,7,8-Tetrachlorodibenzofuran	0.1	0.8		
	1,2,3,7,8-Pentachlorodibenzofuran	0.05	0.2		
	2,3,4,7,8-Pentachlorodibenzofuran	0.5	1.6		
	1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.08		
	1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.2		
	2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.7		
	1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.6		
	1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01		
	1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.4		
	Octachlorodibenzofuran	0.001	0.02		
Chlorine, Total Residual (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	5		A(C)	
	D	19		A(A)	
	SA, SB, SC, I	7.5		A(C)	
	SD	13		A(A)	
2-Chloroaniline (95-51-2)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
3-Chloroaniline (108-42-9)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Chloroaniline (106-47-8)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chlorobenzene (108-90-7)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
	A, A-S, AA, AA-S, B, C, D	400		H(FC)	B
	SA, SB, SC, I, SD	400		H(FC)	B
	A, A-S, AA, AA-S, B, C	5		A(C)	
	SA, SB, SC, I		5	A(C)	
	A, A-S, AA, AA-S	20		E	U
	D	50		E	V
	SD		50	E	V
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Chlorobenzotrifluoride (98-56-6)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1-Chlorobutane (109-69-3)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chloroethane (75-00-3)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chloroform (67-66-3)	A, A-S, AA, AA-S	7		H(WS)	A
	GA	7		H(WS)	A

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Chloromethyl methyl ether (107-30-2)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2-Chloronaphthalene (91-58-7)	A, A-S, AA, AA-S GA	10	10	E E	U U
2-Chloronitrobenzene (88-73-3)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Chloronitrobenzene (121-73-3)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Chloronitrobenzene (100-00-5)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chloroprene (126-99-8)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chlorothalonil (1897-45-6)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
2-Chlorotoluene (95-49-8)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Chlorotoluene (108-41-8)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Chlorotoluene (106-43-4)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Chloro-o-toluidine (95-69-2)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
5-Chloro-o-toluidine (95-79-4)	A, A-S, AA, AA-S GA	*	0.7	H(WS) H(WS)	A J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Chloro-1,1,1-trifluoropropane (460-35-5)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Chromium (CAS No. Not Applicable)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C A, A-S, AA, AA-S, B, C, D	50 50 * **		H(WS) H(WS) A(C) A(A)	G G
Remarks:	* $(0.86) \exp(0.819 [\ln (\text{ppm hardness})] + 0.6848)$ ** $(0.316) \exp(0.819 [\ln (\text{ppm hardness})] + 3.7256)$ Aquatic Type standards apply to dissolved form and do not include hexavalent chromium.				
Chromium (hexavalent) (CAS No. Not Applicable)	GA A, A-S, AA, AA-S, B, C A, A-S, AA, AA-S, B, C, D SA, SB, SC I SD	50 11* 16* 54**  1,200**		H(WS) A(C) A(A) A(C) A(C) A(A)	F
Remarks:	* Applies to dissolved form. ** Applies to acid-soluble form.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Chrysene (218-01-9)	A, A-S, AA, AA-S		0.002	H(WS)	A
	GA		0.002	H(WS)	A
Cobalt (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	5*	110	A(C)	A(A)
	D				
Remark: *	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c). Aquatic Type standards and guidance value apply to acid-soluble form.				
Copper (CAS No. Not Applicable)	A, A-S, AA, AA-S	200		H(WS)	H
	GA	200		H(WS)	H
	A, A-S, AA, AA-S, B, C	*		A(C)	
	A, A-S, AA, AA-S, B, C, D	**		A(A)	
	SA, SB, SC, I	***		A(C)	
	SA, SB, SC, I, SD	****		A(A)	
Remarks: *	(0.96) exp(0.8545 [ln (ppm hardness)] - 1.702)				
***	(0.96) exp(0.9422 [ln (ppm hardness)] - 1.7)				
****	Standard is 3.4 ug/L except in New York/New Jersey Harbor where it is 5.6 ug/L.				
	Standard is 4.8 ug/L except in New York/New Jersey Harbor where it is 7.9 ug/L.				
	Aquatic Type standards apply to dissolved form.				
Cyanide (CAS No. Not Applicable)	A, A-S, AA, AA-S	200		H(WS)	H
	GA	200		H(WS)	H
	A, A-S, AA-S, B, C, D	9,000		H(FC)	B
	SA, SB, SC, I, SD	9,000		H(FC)	B
	A, A-S, AA, AA-S, B, C	5.2*		A(C)	
	A, A-S, AA, AA-S, B, C, D	22*		A(A)	
	SA, SB, SC	1.0*	1.0*	A(C)	
	I SD	1.0*		A(A)	
Remark: *	As free cyanide: the sum of HCN and CN <sup>-</sup> expressed as CN.				
Cyanogen bromide (506-68-3)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Cyanogen chloride (506-77-4)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Dalapon (CAS No. Not Applicable)	A, A-S, AA, AA-S		50*	H(WS)	Z
	GA			H(WS)	J
Remark: *	Includes: related forms that convert to the organic acid upon acidification to a pH of 2 or less; and esters of the organic acid.				
p,p'-DDD (72-54-8)	A, A-S, AA, AA-S	0.3		H(WS)	A
	GA	0.3		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$8 \times 10^{-5}$		H(FC)	A
	SA, SB, SC, I, SD	$8 \times 10^{-5}$		H(FC)	A
	A, A-S, AA, AA-S, B, C, D	*		W	
	SA, SB, SC, I, SD	*		W	
Remark: *	Refer to entry for "p,p'-DDT."				
p,p'-DDE (72-55-9)	A, A-S, AA, AA-S	0.2		H(WS)	A
	GA	0.2		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$7 \times 10^{-6}$		H(FC)	A
	SA, SB, SC, I, SD	$7 \times 10^{-6}$		H(FC)	A
	A, A-S, AA, AA-S, B, C, D	*		W	
	SA, SB, SC, I, SD	*		W	
Remark: *	Refer to entry for "p,p'-DDT."				
p,p'-DDT (50-29-3)	A, A-S, AA, AA-S	0.2		H(WS)	A
	GA	0.2		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$1 \times 10^{-5}$		H(FC)	A
	SA, SB, SC, I, SD	$1 \times 10^{-5}$		H(FC)	A
	A, A-S, AA, AA-S, B, C, D	$1.1 \times 10^{-5*}$		W	
	SA, SB, SC, I, SD	$1.1 \times 10^{-5*}$		W	
Remark: *	Applies to the sum of p,p'-DDD, p,p'-DDE and p,p'-DDT				
Dechlorane Plus (13560-89-9)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Demeton (8065-48-3; 298-03-3; 126-75-0)	A, A-S, AA, AA-S, B, C	0.1*		A(C)	
	SA, SB, SC	0.1	0.1	A(C)	
	I			A(C)	
Remark: *	Standards and guidance value apply to the sum of these substances. For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Diazinon (333-41-5)	GA	0.7		H(WS)	F
	A, A-S, AA, AA-S, B, C	0.08*		A(C)	
Remark: *	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE	
1,2-Dibromobenzene (583-53-9)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
1,3-Dibromobenzene (108-36-1)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
1,4-Dibromobenzene (106-37-6)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
Dibromochloromethane (124-48-1)	A, A-S, AA, AA-S			50	H(WS)	Z
	GA			50	H(WS)	Z
1,2-Dibromo-3-chloropropane (96-12-8)	A, A-S, AA, AA-S	0.04	0.04	H(WS)	A	
	GA			H(WS)	A	
Dibromodichloromethane (594-18-3)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
Dibromomethane (74-95-3)	A, A-S, AA, AA-S	**	5*	H(WS)	I	
	GA			H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,2-Dibromo-3-nitropropionamide and Dibromoacetonitrile (10222-01-2; 3252-43-5)	A, A-S, AA, AA-S	50	50*	H(WS)	Z	
	GA			H(WS)	Z	
	A, A-S, AA, AA-S, B, C			20	A(C)	
	D			50	A(A)	
Remarks:	Values listed apply to the sum of these substances, except as noted below. * Applies to 2,2-dibromo-3-nitropropionamide only.					
Di-n-butyl phthalate (84-74-2)	A, A-S, AA, AA-S	50		H(WS)	Z	
	GA			H(WS)	J	
Dicamba (1918-00-9)	GA	0.44		H(WS)	F	

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE	
Dichlorobenzenes (95-50-1;541-73-1;106-46-7)	A, A-S, AA, AA-S	3*		H(WS)	A	
	GA	3*		H(WS)	A	
	A, A-S, AA, AA-S, B, C	5**		A(C)		
	SA, SB, SC, I		5**	A(C)		
	A, A-S, AA, AA-S	20***/30****		E	U	
	D	50**		E	V	
	SD		50**	E	V	
Remarks:	* Applies to each isomer (1,2-, 1,3- and 1,4-dichlorobenzene) individually. ** Applies to the sum of 1,2-, 1,3- and 1,4-dichlorobenzene *** Applies to 1,3-dichlorobenzene only. **** Applies to 1,4-dichlorobenzene only. For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).					
3,3'-Dichlorobenzidine (91-94-1)	A, A-S, AA, AA-S	**		5*	H(WS)	I
	GA			H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
3,4-Dichlorobenzotrifluoride (328-84-7)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
cis-1,4-Dichloro-2-butene (1476-11-5)	A, A-S, AA, AA-S	**		5*	H(WS)	I
	GA			H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
trans-1,4-Dichloro-2-butene (110-57-6)	A, A-S, AA, AA-S	**		5*	H(WS)	I
	GA			H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
Dichlorodifluoromethane (75-71-8)	A, A-S, AA, AA-S	**		5*	H(WS)	I
	GA			H(WS)	J	
Remark:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE	
1,1-Dichloroethane (75-34-3)	A, A-S, AA, AA-S	5		H(WS)	I	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
1,2-Dichloroethane (107-06-2)	A, A-S, AA, AA-S	0.6		H(WS)	A	
	GA			H(WS)	A	
1,1-Dichloroethene (75-35-4)	A, A-S, AA, AA-S		0.7	H(WS)	A	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
cis-1,2-Dichloroethene (156-59-2)	A, A-S, AA, AA-S	5		H(WS)	I	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
trans-1,2-Dichloroethene (156-60-5)	A, A-S, AA, AA-S	5		H(WS)	I	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
Dichlorofluoromethane (75-43-4)	A, A-S, AA, AA-S	5		H(WS)	I	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
2,4-Dichlorophenol (120-83-2)	A, A-S, AA, AA-S	****	5*****	H(WS)	I	
	GA			H(WS)	J	
	A, A-S, AA, AA-S			0.3*	E	U
	GA			**	E	
	A, A-S, AA, AA-S, B, C, D			***	E	
Remarks: * Also see entry for "Phenolic compounds (total phenols)." ** Refer to entry for "Phenolic compounds (total phenols)." *** Refer to entry for "Phenols, total chlorinated." **** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance. ***** This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.						
2,4-Dichlorophenoxyacetic acid (94-75-7)	A, A-S, AA, AA-S	50		H(WS)	G	
	GA			H(WS)	G	
1,1-Dichloropropane (78-99-9)	A, A-S, AA, AA-S	5		H(WS)	I	
	GA			H(WS)	J	
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
1,2-Dichloropropane (78-87-5)	A, A-S, AA, AA-S	1		H(WS)	A
	GA			H(WS)	A
1,3-Dichloropropane (142-28-9)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,2-Dichloropropane (594-20-7)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
1,1-Dichloropropene (563-66-6)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
1,3-Dichloropropene (542-75-6)	A, A-S, AA, AA-S	0.4*		H(WS)	A
	GA			H(WS)	A
Remark: * Applies to the sum of cis- and trans-1,3-dichloropropene, CAS Nos. 10061-01-5 and 10061-02-6, respectively.					
2,3-Dichlorotoluene (32768-54-0)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,4-Dichlorotoluene (95-73-8)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,5-Dichlorotoluene (19398-61-9)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,6-Dichlorotoluene (118-69-4)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
3,4-Dichlorotoluene (95-75-0)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3,5-Dichlorotoluene (25186-47-4)	A, A-S, AA, AA-S	5		H(WS)	I
	GA			H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Dieldrin (60-57-1)	A, A-S, AA, AA-S	0.004		H(WS)	A
	GA	0.004		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$6 \times 10^{-7}$		H(FC)	A
	SA, SB, SC, I, SD	$6 \times 10^{-7}$		H(FC)	A
	A, A-S, AA, AA-S, B, C	0.056		A(C)	
	A, A-S, AA, AA-S, B, C, D	0.24		A(A)	
Di(2-ethylhexyl)adipate (103-23-1)	A, A-S, AA, AA-S	20		H(WS)	A
	GA	20		H(WS)	A
Diethyl phthalate (84-66-2)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
1,2-Difluoro-1,1,2,2-tetrachloroethane (76-12-0)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,2-Diisopropylbenzene (577-55-9)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,3-Diisopropylbenzene (99-62-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
1,4-Diisopropylbenzene (100-18-5)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
N,N-Dimethylaniline (121-69-7)	A, A-S, AA, AA-S	1		H(WS)	A
	GA	1		H(WS)	A
2,3-Dimethylaniline (87-59-2)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,4-Dimethylaniline (95-68-1)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,5-Dimethylaniline (95-78-3)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,6-Dimethylaniline (87-62-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3,4-Dimethylaniline (95-64-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
3,5-Dimethylaniline (108-69-0)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3,3'-Dimethylbenzidine (119-93-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4,4'-Dimethylbiphenyl (538-39-6)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4,4'-Dimethyldiphenylmethane (4957-14-6)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Dimethylformamide (68-12-2)	A, A-S, AA, AA-S	GA	50	H(WS)	Z
			50	H(WS)	Z
alpha, alpha-Dimethyl phenethylamine (122-09-8)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,4-Dimethylphenol (105-67-9)	A, A-S, AA, AA-S	GA	50	H(WS)	Z
			50	H(WS)	Z
	A, A-S, AA, AA-S, B, C, D	1,000	H(FC)	B	
	SA, SB, SC, I, SD	1,000	H(FC)	B	
	A, A-S, AA, AA-S	*		E	
	GA	*		E	
	B, C, D	**		E	
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)."				
	** Refer to entry for "Phenols, total unchlorinated."				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE	
Dimethyl phthalate (131-11-3)	A, A-S, AA, AA-S	GA	50	H(WS)	Z	
			50	H(WS)	Z	
Dimethyl tetrachloroterephthalate (1861-32-1)	A, A-S, AA, AA-S	GA	50	H(WS)	Z	
			50	H(WS)	J	
1,3-Dinitrobenzene (99-65-0)	A, A-S, AA, AA-S	GA	**	5*	H(WS)	I
				H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.					
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,4-Dinitrophenol (51-28-5)	A, A-S, AA, AA-S	GA	10	H(WS)	B	
			10	H(WS)	B	
	A, A-S, AA, AA-S, B, C, D	400	H(FC)	B		
	SA, SB, SC, I, SD	400	H(FC)	B		
	A, A-S, AA, AA-S	*		E		
	GA	*		E		
	B, C, D	**		E		
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)."					
	** Refer to entry for "Phenols, total unchlorinated."					
2,3-Dinitrotoluene (602-01-7)	A, A-S, AA, AA-S	GA	**	5*	H(WS)	I
				H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.					
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,4-Dinitrotoluene (121-14-2)	A, A-S, AA, AA-S	GA	**	5*	H(WS)	I
				H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.					
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,5-Dinitrotoluene (619-15-8)	A, A-S, AA, AA-S	GA	**	5*	H(WS)	I
				H(WS)	J	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.					
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,6-Dinitrotoluene (606-20-2)	A, A-S, AA, AA-S	GA	*	0.07	H(WS)	A
				H(WS)	J	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
3,4-Dinitrotoluene (610-39-9)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3,5-Dinitrotoluene (618-85-9)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Di-n-octyl phthalate (117-84-0)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Dinoseb (88-85-7)	A, A-S, AA, AA-S GA B, C, D	* * **		E E E	
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)." ** Refer to entry for "Phenols, total unchlorinated."				
Diphenamid (957-51-7)	A, A-S, AA, AA-S GA	50	50	H(WS) H(WS)	Z J
Diphenylamine (122-39-4)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Diphenylhydrazines (122-66-7; 530-50-7)	A, A-S, AA, AA-S GA	ND**	0.05*	H(WS) H(WS)	A F
Remarks:	* Applies to 1,2-diphenylhydrazine (CAS No. 122-66-7) only. ** Applies to the sum of 1,1- and 1,2-diphenylhydrazine (CAS Nos. 530-50-7 and 122-66-7, respectively).				
Diquat (2764-72-9)	A, A-S, AA, AA-S GA	20* 20*		H(WS) H(WS)	B B
Remark:	* Applies to the concentration of diquat ion whether free or as an undissociated salt.				
Disulfoton (298-04-4)	GA	*		H(WS)	
Remark:	* Refer to entry for "Phorate and Disulfoton."				

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Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Dodecylguanidine acetate and Dodecylguanidine hydrochloride (2439-10-3; 13590-97-1)	A, A-S, AA, AA-S GA		50* 50*	H(WS) H(WS)	B B
Remark:	* Applies to sum of these substances.				
Dyphylline (479-18-5)	A, A-S, AA, AA-S GA	50	50	H(WS) H(WS)	B B
Endosulfan (115-29-7)	A, A-S, AA, AA-S, B, C D SA, SB, SC I SD	0.009 0.22* 0.001  0.034	0.001	A(C) A(A) A(C) A(C) A(A)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (d).				
Endothall (145-73-3)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Endrin (72-20-8)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C, D SA, SB, SC, SD I A, A-S, AA, AA-S, B, C A, A-S, AA, AA-S, B, C, D	0.2 ND 0.002 0.002  0.036 0.086	0.002	H(WS) H(WS) H(FC) H(FC) H(FC) A(C) A(A)	G F
Endrin aldehyde (7421-93-4)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Endrin ketone (53494-70-5)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Ethylbenzene (100-41-4)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C A, A-S, AA, AA-S, B, C, D SA, SB, SC, I SA, SB, SC, I, SD	5 *  17 4.5 41		H(WS) H(WS) A(C) A(A) A(C) A(A)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

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Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Ethylene chlorohydrin (107-07-3)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Ethylene dibromide (106-93-4)	A, A-S, AA, AA-S		$6 \times 10^{-4}$	H(WS)	A
	GA		$6 \times 10^{-4}$	H(WS)	A
Ethylene glycol (107-21-1)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
	A, A-S, AA, AA-S, B, C		500,000	A(C)	
	D		1,000,000	A(A)	
Ethylene oxide (75-21-8)	A, A-S, AA, AA-S		0.05	H(WS)	A
	GA		0.05	H(WS)	A
Ethylenethiourea (96-45-7)	GA	ND		H(WS)	F
Ferbam (14484-64-1)	GA	4.2		H(WS)	F
Fluometuron (2164-17-2)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA	50		H(WS)	J
Fluoranthene (206-44-0)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Fluorene (86-73-7)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
	A, A-S, AA, AA-S, B, C		0.54	A(C)	
	A, A-S, AA, AA-S, B, C, D		4.8	A(A)	
	SA, SB, SC, I		2.5	A(C)	
	SA, SB, SC, I, SD		23	A(A)	
Fluoride (CAS No. Not Applicable)	A, A-S, AA, AA-S	1,500		H(WS)	H
	GA	1,500		H(WS)	F
	A, A-S, AA, AA-S, B, C	*		A(C)	
	D	**		A(A)	
Remarks:	* (0.02) exp(0.907 [ln (ppm hardness)] + 7.394)				
	** (0.1) exp(0.907 [ln (ppm hardness)] + 7.394)				
	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
Foaming agents (CAS No. Not Applicable)	GA	500*		E	U
Remark:	* Determined as methylene blue active substances (MBAS) or by other tests as specified by the Commissioner.				
Folpet (133-07-3)	GA	50		H(WS)	J
Glyphosate (1071-83-6)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Gross alpha radiation (CAS No. Not Applicable)	A, A-S, AA, AA-S	*		H(WS)	G
	GA	*		H(WS)	G
Remark:	* 15 picocuries per liter, excluding radon and uranium.				
Gross beta radiation (CAS No. Not Applicable)	A, AA	*		H(WS)	H
	A-S, AA-S	*		H(WS)	H
	GA	*		H(WS)	H
Remark:	* 1,000 picocuries per liter, excluding strontium-90 and alpha emitters.				
Guaifenesin (93-14-1)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Heptachlor (76-44-8)	A, A-S, AA, AA-S	0.04		H(WS)	A
	GA	0.04		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$2 \times 10^{-4}$		H(FC)	A
	SA, SB, SC, I, SD	$2 \times 10^{-4}$		H(FC)	A
Heptachlor epoxide (1024-57-3)	A, A-S, AA, AA-S	0.03		H(WS)	A
	GA	0.03		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$3 \times 10^{-4}$		H(FC)	A
	SA, SB, SC, I, SD	$3 \times 10^{-4}$		H(FC)	A
Hexachlorobenzene (118-74-1)	A, A-S, AA, AA-S	0.04		H(WS)	A
	GA	0.04		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	$3 \times 10^{-5}$		H(FC)	A
	SA, SB, SC, I, SD	$3 \times 10^{-5}$		H(FC)	A
Hexachlorobutadiene (87-68-3)	A, A-S, AA, AA-S	0.5		H(WS)	B
	GA	0.5		H(WS)	B
	A, A-S, AA, AA-S, B, C, D	0.01		H(FC)	B
	SA, SB, SC, I, SD	0.01		H(FC)	B
	A, A-S, AA, AA-S, B, C	$10^*$		A(C)	
	D	$10^*$		A(A)	
	SA, SB, SC	0.3	0.3	A(C)	
	I SD	3.0		A(A)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
alpha-Hexachlorocyclohexane (319-84-6)	A, A-S, AA, AA-S	0.01		H(WS)	A
	GA	0.01		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	0.002		H(FC)	A
	SA, SB, SC, I, SD	0.002		H(FC)	A
beta-Hexachlorocyclohexane (319-85-7)	A, A-S, AA, AA-S	0.04		H(WS)	A
	GA	0.04		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	0.007		H(FC)	A
	SA, SB, SC, I, SD	0.007		H(FC)	A

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
delta-Hexachlorocyclohexane (319-86-8)	A, A-S, AA, AA-S	0.04		H(WS)	A
	GA	0.04		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	0.008		H(FC)	A
	SA, SB, SC, I, SD	0.008		H(FC)	A
epsilon-Hexachlorocyclohexane (6108-10-7)	A, A-S, AA, AA-S	0.04		H(WS)	A
	GA	0.04		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	0.008		H(FC)	A
	SA, SB, SC, I, SD	0.008		H(FC)	A
gamma-Hexachlorocyclohexane (58-89-9)	A, A-S, AA, AA-S	0.05		H(WS)	A
	GA	0.05		H(WS)	A
	A, A-S, AA, AA-S, B, C, D	0.008		H(FC)	A
	SA, SB, SC, I, SD	0.008		H(FC)	A
	A, A-S, AA, AA-S, B, C, D	0.95		A(A)	
Hexachlorocyclopentadiene (77-47-4)	A, A-S, AA, AA-S		5***	H(WS)	I
	GA			H(WS)	J
	A, A-S, AA, AA-S, B, C	0.45**		A(C)	
	D	4.5**		A(A)	
	SA, SB, SC	0.07	0.07	A(C)	
	I			A(C)	
	SD	0.7		A(A)	
A, A-S, AA, AA-S	1.0		E	U	
Remarks: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
**	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
***	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
Hexachloroethane (67-72-1)	A, A-S, AA, AA-S	5		H(WS)	A, I
	GA			H(WS)	J
	A, A-S, AA, AA-S, B, C, D	0.6		H(FC)	A
	SA, SB, SC, I, SD	0.6		H(FC)	A
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Hexachlorophene (70-30-4)	A, A-S, AA, AA-S		5****	H(WS)	I
	GA			H(WS)	J
	A, A-S, AA, AA-S	*		E	
	GA	**		E	
	B, C, D	***		E	
Remarks: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
**	Refer to entry for "Phenolic compounds (total phenols)."				
***	Refer to entry for "Phenols, total chlorinated."				
****	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Hexachloropropene (1888-71-7)	A, A-S, AA, AA-S		5*	H(WS)	I
	GA	**		H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance..				
2-Hexanone (591-78-6)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Hexazinone (51235-04-2)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA	50		H(WS)	J
Hydrazine (302-01-2)	A, A-S, AA, AA-S, B, C	*		A(C)	
	D	**		A(A)	
Remarks: *	5 ug/L at less than 50 ppm hardness and 10 ug/L at greater than or equal to 50 ppm hardness.				
**	50 ug/L at less than 50 ppm hardness and 100 ug/L at greater than or equal to 50 ppm hardness.				
	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
Hydrogen sulfide (7783-06-4)	A, A-S, AA, AA-S, B, C	2.0*		A(C)	
	SA, SB, SC	2.0		A(C)	
	I		2.0	A(C)	
	A, A-S, AA, AA-S		**	E	
	GA		**	E	
Remarks: *	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
**	Refer to entry for "Sulfides, total."				
	Aquatic Type standards and guidance value apply to undissociated form.				
Hydroquinone (123-31-9)	A, A-S, AA, AA-S, B, C	2.2**		A(C)	
	D	4.4**		A(A)	
	A, A-S, AA, AA-S	*		E	
	GA	*		E	
	B, C, D	***		E	
Remarks: *	Refer to entry for "Phenolic compounds (total phenols)."				
**	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
***	Refer to entry for "Phenols, total unchlorinated."				
1-Hydroxyethylidene- 1,1-diphosphonic acid (2809-21-4)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
2-(2-Hydroxy-3,5-di-tert-pentylphenyl)-benzotriazole (25973-55-1)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
	A, A-S, AA, AA-S	*		E	
	GA	**		E	
	B, C, D			E	
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)."				
	** Refer to entry for "Phenols, total unchlorinated."				
Indeno (1,2,3-cd) pyrene (193-39-5)	A, A-S, AA, AA-S		0.002	H(WS)	A
	GA		0.002	H(WS)	A
Iron (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	300**		A(C)	
	D	300**		A(A)	
	A, A-S, AA, AA-S	300		E	G
	GA	300*		E	F
Remarks:	* Also see standard for "Iron and Manganese."				
	** For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
Iron and Manganese (CAS No. Not Applicable)	GA	500*		E	F
Remark:	* Applies to the sum of these substances; also see individual standards for "Iron" and "Manganese."				
Isodecyl diphenyl phosphate (29761-21-5)	A, A-S, AA, AA-S, B, C	1.7*		A(C)	
	D	22*		A(A)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
Isodrin (465-73-6)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Isophorone (78-59-1)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
Isopropalin (33820-53-0)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Isopropylbenzene (98-82-8)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
	A, A-S, AA, AA-S, B, C		2.6	A(C)	
	A, A-S, AA, AA-S, B, C, D		23	A(A)	
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2-Isopropyltoluene (527-84-4)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Isopropyltoluene (535-77-3)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Isopropyltoluene (99-87-6)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Isothiazolones, total (isothiazolinones) (includes 5-chloro-2-methyl-4-isothiazolin-3-one & 2-methyl-4-isothiazolin-3-one) (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	1*		A(C)	
	D	10*		A(A)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d). Standards apply to the sum of these substances.				
Kepone (143-50-0)	GA	ND		H(WS)	F
Lead (CAS No. Not Applicable)	A, A-S, AA, AA-S	50		H(WS)	G
	GA	25		H(WS)	F
	A, A-S, AA, AA-S, B, C	*		A(C)	
	A, A-S, AA, AA-S, B, C, D	**		A(A)	
	SA, SB, SC, I	8		A(C)	
	SA, SB, SC, I, SD	204		A(A)	
Remarks:	* $\{1.46203 - [\ln(\text{hardness}) (0.145712)]\} \exp \{1.273 [\ln(\text{hardness})] - 4.297\}$				
	** $\{1.46203 - [\ln(\text{hardness}) (0.145712)]\} \exp \{1.273 [\ln(\text{hardness})] - 1.052\}$ Aquatic Type standards apply to dissolved form.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Linear alkyl benzene sulfonates (LAS) (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	40*		A(C)	
Remarks:	* LAS with side chains greater than 13 carbons only; applies to the sum of these substances. * For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Magnesium (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	35,000	35,000	H(WS) H(WS)	B B
Malathion (121-75-5)	GA A, A-S, AA, AA-S, B, C SA, SB, SC I	7.0 0.1* 0.1		H(WS) A(C) A(C) A(C)	F
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Mancozeb (8018-01-7)	GA	1.8		H(WS)	F
Maneb (12427-38-2)	GA	1.8		H(WS)	F
Manganese (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	300 300*		E E	G F
Remark:	* Also see entry for "Iron and Manganese."				
Mercaptobenzothiazole (149-30-4)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Mercury (CAS No. Not Applicable)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD A, A-S, AA, AA-S, B, C A, A-S, AA, AA-S, B, C, D A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD	0.7 0.7 $7 \times 10^{-4}$ * $7 \times 10^{-4}$ * 0.77* 1.4* 0.0026* 0.0026*		H(WS) H(WS) H(FC) H(FC) A(C) A(A) W W	B B B B
Remark:	* Applies to dissolved form.				
Methacrylic acid (79-41-4)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Methacrylonitrile (126-98-7)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Methomyl (16752-77-5)	GA	*		H(WS)	
Remark:	* Refer to entry for "Aldicarb and Methomyl."				
Methoxychlor (72-43-5)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C SA, SB, SC I	35 35 0.03* 0.03		H(WS) H(WS) A(C) A(C) A(C)	H F
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
(1-Methoxyethyl) benzene (4013-34-7)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
(2-Methoxyethyl) benzene (3558-60-9)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
N-Methylaniline (100-61-8)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Methylbenz(a)anthracenes (CAS No. Not Applicable)	A, A-S, AA, AA-S GA		0.002* 0.002*	H(WS) H(WS)	A A
Remark:	* Applies to the sum of these substances.				
Methyl chloride (74-87-3)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2-Methyl-4-chlorophenoxyacetic acid (94-74-6)	GA	0.44		H(WS)	F
4,4'-Methylene-bis-(2-chloroaniline) (101-14-4)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
4,4'-Methylene-bis-(N-methyl)- aniline (1807-55-2)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4,4'-Methylene-bis-(N,N'-dimethyl)- aniline (101-81-1)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Methylene bithiocyanate (6317-18-6)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C	1.0*	50 50	H(WS) H(WS) A(C)	Z Z
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Methylene chloride (75-09-2)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD	5 *		H(WS) H(WS) H(FC) H(FC)	I J A A
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-(1-Methylethoxy)-1-butanol (31800-69-8)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
2-Methylethyl-1,3-dioxolane (126-39-6)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Methyl ethyl ketone (78-93-3)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
Methyl iodide (74-88-4)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Methyl methacrylate (80-62-6)	GA	50		H(WS)	J

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
2-Methylnaphthalene (91-57-6)	A, A-S, AA, AA-S, B, C A, A-S, AA, AA-S, B, C, D SA, SB, SC, I SA, SB, SC, I, SD		4.7 42 4.2 38	A(C) A(A) A(C) A(A)	
Methyl parathion (298-00-0)	GA A, A-S, AA, AA-S, B, C	*		H(WS) A(C)	
Remark:	* Refer to entry for "Parathion and Methyl parathion."				
alpha-Methylstyrene (98-83-9)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2-Methylstyrene (611-15-4)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Methylstyrene (100-80-1)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Methylstyrene (622-97-9)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Metribuzin (21087-64-9)	A, A-S, AA, AA-S GA		50	H(WS) H(WS)	Z J
Mirex (2385-85-5)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD A, A-S, AA, AA-S, B, C D SA, SB, SC I SD	0.03 0.03 $1 \times 10^{-6}$ $1 \times 10^{-6}$ 0.001* 0.001* 0.001		H(WS) H(WS) H(FC) H(FC) A(C) A(A) A(C) A(C) A(C) A(A)	A A A A
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).				
Nabam (142-59-6)	GA	1.8		H(WS)	F

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Naphthalene (91-20-3)	A, A-S, AA, AA-S, B, C		13	A(C)	
	A, A-S, AA, AA-S, B, C, D		110	A(A)	
	SA, SB, SC, I		16	A(C)	
	SA, SB, SC, I, SD		140	A(A)	
	A, A-S, AA, AA-S GA	10	10	E E	U U
Niacinamide (98-92-0)	A, A-S, AA, AA-S	500		H(WS)	B
	GA		500	H(WS)	B
Nickel (CAS No. Not Applicable)	A, A-S, AA, AA-S	100		H(WS)	B
	GA	100		H(WS)	B
	A, A-S, AA, AA-S, B, C	*		A(C)	
	A, A-S, AA, AA-S, B, C, D	**		A(A)	
	SA, SB, SC, I	8.2		A(C)	
	SA, SB, SC, I, SD	74		A(A)	
Remarks:	* (0.997) exp (0.846 [ln (hardness)] + 0.0584) ** (0.998) exp (0.846 [ln (hardness)] + 2.255) Aquatic Type standards apply to dissolved form.				
Nitralin (4726-14-1)	GA	35		H(WS)	F
Nitrate (expressed as N) (CAS No. Not Applicable)	A, A-S, AA, AA-S	10,000*		H(WS)	G
	GA	10,000*		H(WS)	G
Remark:	* Also see entry for "Nitrate and Nitrite."				
Nitrate and Nitrite (expressed as N) (CAS No. Not Applicable)	A, A-S, AA, AA-S	10,000*		H(WS)	G
	GA	10,000*		H(WS)	G
Remark:	* Applies to the sum of these substances; also see individual standards for "Nitrate" and "Nitrite."				
Nitrilotriacetic acid (CAS No. Not Applicable)	A, A-S, AA, AA-S	3*		H(WS)	A
	GA	3*		H(WS)	A
	A, A-S, AA, AA-S, B, C	5,000**		A(C)	
Remarks:	* Includes related forms that convert to nitrilotriacetic acid upon acidification to a pH of 2.3 or less. ** Applies to nitrilotriacetate. ** For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Nitrite (expressed as N) (CAS No. Not Applicable)	A, A-S, AA, AA-S	1,000*		H(WS)	G
	GA	1,000*		H(WS)	G
	A, A-S, AA, AA-S, B, C	**		A(C)	
Remarks:	* Also see entry for "Nitrate and Nitrite." ** Standard is 100 ug/L for warm water fishery waters and 20 ug/L for cold water fishery waters. ** For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
2-Nitroaniline (88-74-4)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Nitroaniline (99-09-2)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Nitroaniline (100-01-6)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Nitrobenzene (98-95-3)	A, A-S, AA, AA-S	0.4		H(WS)	A
	GA	0.4		H(WS)	A
	A, A-S, AA, AA-S	30		E	U
N-Nitrosodiphenylamine (86-30-6)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
2-Nitrotoluene (88-72-2)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
3-Nitrotoluene (99-08-1)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
4-Nitrotoluene (99-99-0)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
5-Nitro-o-toluidine (99-55-8)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Octachlorostyrene (29082-74-4)	A, A-S, AA, AA-S	0.2	6 x 10 <sup>-6</sup>	H(WS)	B
	GA			H(WS)	B
	A, A-S, AA, AA-S, B, C, D			H(FC)	B
	SA, SB, SC, I, SD			H(FC)	B
Oxamyl (23135-22-0)	A, A-S, AA, AA-S	50	50	H(WS)	Z
	GA			H(WS)	J
Paraquat (4685-14-7)	GA	3.0		H(WS)	F
Parathion (56-38-2)	GA	*		H(WS)	
	A, A-S, AA, AA-S, B, C	*		A(C)	
	A, A-S, AA, AA-S, B, C, D	0.065		A(A)	
Remark:	* Refer to entry for "Parathion and Methyl parathion."				
Parathion and Methyl parathion (56-38-2; 298-00-0)	GA	1.5*		H(WS)	F
	A, A-S, AA, AA-S, B, C	0.008**		A(C)	
Remarks:	* Applies to the sum of these substances.				
	** Applies to the sum of these substances. For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Pendimethalin (40487-42-1)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Pentachlorobenzene (608-93-5)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Pentachloroethane (76-01-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
	** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Pentachloronitrobenzene (82-68-8)	GA	ND		H(WS)	F
Pentachlorophenol (87-86-5)	A, A-S, AA, AA-S, B, C	*		A(C)	
	A, A-S, AA, AA-S, B, C, D	**		A(A)	
	A, A-S, AA, AA-S	***		E	
	GA	***		E	
	B, C, D	****		E	
Remarks:	* exp [1.005 (pH) - 5.134]				
	** exp [1.005 (pH) - 4.869]				
	*** Refer to entry for "Phenolic compounds (total phenols)."				
	**** Refer to entry for "Phenols, total chlorinated."				
Phenanthrene (85-01-8)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
	A, A-S, AA, AA-S, B, C		5.0	A(C)	
	A, A-S, AA, AA-S, B, C, D		45	A(A)	
	SA, SB, SC, I		1.5	A(C)	
	SA, SB, SC, I, SD		14	A(A)	
Phenol (108-95-2)	A, A-S, AA, AA-S	*		E	
	GA	*		E	
	B, C, D	**		E	
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)."				
	** Refer to entry for "Phenols, total unchlorinated."				
Phenolic compounds (total phenols) (CAS No. Not Applicable)	A, A-S, AA, AA-S	1*		E	U
	GA	1*		E	U
Remark:	* Applies to the sum of these substances.				
Phenols, total chlorinated (CAS No. Not Applicable)	A, A-S, AA, AA-S	*		E	
	GA	*		E	
	A, A-S, AA, AA-S, B, C, D	1.0**		E	V
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)."				
	** Applies to the sum of these substances.				
Phenols, total unchlorinated (CAS No. Not Applicable)	A, A-S, AA, AA-S	*		E	
	GA	*		E	
A, A-S, AA, AA-S, B, C, D	5.0**		E	V	
Remarks:	* Refer to entry for "Phenolic compounds (total phenols)."				
	** Applies to the sum of these substances.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
1,2-Phenylenediamine (95-54-5)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,3-Phenylenediamine (108-45-2)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,4-Phenylenediamine (106-50-3)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Phenyl ether (101-84-8)	A, A-S, AA, AA-S GA	10	10	E E	U U
Phenylhydrazine (100-63-0)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Phenylpropanolamine (14838-15-4)	A, A-S, AA, AA-S GA		50 50	H(WS) H(WS)	Z Z
3-Phenyl-1-propene (637-50-3)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
cis-1-Phenyl-1-propene (766-90-5)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
trans-1-Phenyl-1-propene (873-66-5)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Phorate (298-02-2)	GA	*		H(WS)	
Remark:	* Refer to entry for "Phorate and Disulfoton."				
Phorate and Disulfoton (298-02-2; 298-04-4)	GA	ND*		H(WS)	F
Remark:	* Applies to sum of these substances.				
Phosphorus (CAS No. Not Applicable)	A, A-S, AA, AA-S, B		20*	**	**
Remarks:	* Applies only where the letter "P" (ponds, lakes and reservoirs) appears in the Water Index Number, excluding Lake Champlain. The department is considering site-specific values for Lake Champlain and for Lake Ontario and Lake Erie, both of which do not have the letter "P" designation. ** Based on aesthetic effects for primary and secondary contact recreation.				
Picloram (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	50*	50*	H(WS) H(WS)	Z J
Remark:	* Includes: related forms that convert to the organic acid upon acidification to a pH of 2 or less; and esters of the organic acid.				
Polybrominated biphenyls (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. Value applies to each congener individually. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to each congener individually.				
Polychlorinated biphenyls (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	0.09* 0.09*		H(WS) H(WS)	A A
	A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD	1 x 10 <sup>-6*</sup> 1 x 10 <sup>-6*</sup>		H(FC) H(FC)	A A
	A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD	1.2 x 10 <sup>-4*</sup> 1.2 x 10 <sup>-4*</sup>		W W	
Remark:	* Applies to the sum of these substances.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Principal organic contaminant (CAS No. Not Applicable)	GA	5		H(WS)	J
Remarks: This standard applies to any and every individual substance, whether listed in this Table or not, that is in one of the principal organic contaminant classes as defined in 6 NYCRR 700.1 <i>except</i> any substance that has a H(WS) Type standard for class GA waters (other than 5 ug/L with Basis Code J) listed elsewhere in this Table.					
For the convenience of the reader, the principal organic contaminant standard of 5 ug/L (Basis Code J), is listed in this Table for some (but not all) substances regulated by this standard.					
A less stringent guidance value for an individual substance may be substituted for this standard if so determined by the Commissioner of the New York State Department of Health.					
Prometon (1610-18-0)	A, A-S, AA, AA-S GA	50	50	H(WS) H(WS)	Z J
Propachlor (1918-16-7)	GA	35		H(WS)	F
Propanil (709-98-8)	GA	7.0		H(WS)	F
Propazine (139-40-2)	GA	16		H(WS)	F
Propham (122-42-9)	A, A-S, AA, AA-S GA	50	50	H(WS) H(WS)	Z J
n-Propylbenzene (103-65-1)	A, A-S, AA, AA-S GA	5		H(WS) H(WS)	I J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
Pyrene (129-00-0)	A, A-S, AA, AA-S GA		50	H(WS) H(WS)	Z Z
	A, A-S, AA, AA-S, B, C		4.6	A(C)	
	A, A-S, AA, AA-S, B, C, D		42	A(A)	
Pyridine (110-86-1)	A, A-S, AA, AA-S GA		50	H(WS) H(WS)	Z Z
Quaternary ammonium compounds (including dimethyl benzyl ammonium chloride & dimethyl ethyl benzyl ammonium chloride) (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	10*		A(C)	
Remarks: * Applies to the sum of these substances. * For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Radium 226 (CAS No. Not Applicable)	A, AA A-S, AA-S GA	*	*	H(WS) H(WS) H(WS)	H H H
Remark: * 3 picocuries per liter; also see entry for "Radium 226 and Radium 228."					
Radium 226 and Radium 228 (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	*	*	H(WS) H(WS)	G G
Remark: * 5 picocuries per liter; Applies to the sum of these substances.					
Radium 228 (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	*	*	H(WS) H(WS)	
Remark: * Refer to entry for "Radium 226 and Radium 228."					
Selenium (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	10	10	H(WS) H(WS)	G G
	A, A-S, AA, AA-S, B, C	4.6*		A(C)	
Remark: * Aquatic Type standard applies to dissolved form.					
Silver (CAS No. Not Applicable)	A, A-S, AA, AA-S GA	50	50	H(WS) H(WS)	G F
	A, A-S, AA, AA-S, B, C	0.1*		A(C)	
	D	**		A(A)	
	SD	2.3		A(A)	
Remarks: * Applies to ionic silver. ** exp (1.72 [ln (ppm hardness)] - 6.52) Standards for D and SD Classes apply to acid-soluble form. For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).					
Simazine (122-34-9)	A, A-S, AA, AA-S GA	0.5	0.5	H(WS) H(WS)	A A
Sodium (CAS No. Not Applicable)	GA	20,000		H(WS)	H
Strontium 90 (CAS No. Not Applicable)	A, A-S, AA, AA-S	*		H(WS)	G
Remarks: * 8 picocuries per liter. If two or more radionuclides are present, the sum of their doses shall not exceed an annual potential dose of 4 millirems per year.					
Styrene (100-42-5)	A, A-S, AA, AA-S GA	**	5*	H(WS) H(WS)	I J
	A, A-S, AA, AA-S	50		E	U
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Sulfate (CAS No. Not Applicable)	A, A-S, AA, AA-S	250,000		H(WS)	G
	GA	250,000		H(WS)	F
Sulfides, total (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	**		A(C)	
	SA, SB, SC	**		A(C)	
	I		**	A(C)	
	A, A-S, AA, AA-S		50*	E	U
	GA		50*	E	U
Remarks:	Values listed apply to sum of these substances. * Expressed as hydrogen sulfide. ** Refer to entry for "Hydrogen Sulfide."				
Sulfite (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C	200*		A(C)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).				
Tebuthiuron (34014-18-1)	A, A-S, AA, AA-S	50	50	H(WS)	Z
	GA			H(WS)	J
Terbacil (5902-51-2)	GA	50		H(WS)	J
Terbufos (13071-79-9)	A, A-S, AA, AA-S		0.09	H(WS)	B
	GA		0.09	H(WS)	B
Tetrachlorobenzenes (634-66-2; 634-90-2; 95-94-3; 12408-10-5)	A, A-S, AA, AA-S		5***	H(WS)	I
	GA	*		H(WS)	J
	A, A-S, AA, AA-S	10**		E	U
	GA		10**	E	U
Remarks:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to each isomer (1,2,3,4-, 1,2,3,5-, and 1,2,4,5-tetrachlorobenzene) individually. ** Applies to the sum of 1,2,3,4-, 1,2,3,5- and 1,2,4,5-tetrachlorobenzene. *** This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent specific MCL. Value applies to each isomer individually.				
1,1,1,2-Tetrachloroethane (630-20-6)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,1,2,2-Tetrachloroethane (79-34-5)	A, A-S, AA, AA-S	*	0.2	H(WS)	A
	GA			H(WS)	J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Tetrachloroethene (127-18-4)	A, A-S, AA, AA-S		0.7	H(WS)	A
	GA	*		H(WS)	J
	A, A-S, AA, AA-S, B, C, D		1	H(FC)	
	SA, SB, SC, I, SD		1	H(FC)	
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Tetrachloroterephthalic acid (2136-79-0)	GA	50		H(WS)	J
alpha, alpha, 4-Tetrachloro- toluene (5216-25-1)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Tetrahydrofuran (109-99-9)	A, A-S, AA, AA-S		50	H(WS)	Z
	GA		50	H(WS)	Z
1,2,3,4-Tetramethylbenzene (488-23-3)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,2,3,5-Tetramethylbenzene (527-53-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,2,4,5-Tetramethylbenzene (95-93-2)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks:	* This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Thallium (CAS No. Not Applicable)	A, A-S, AA, AA-S		0.5	H(WS)	B
	GA		0.5	H(WS)	B
	A, A-S, AA, AA-S, B, C	8*		A(C)	
	D	20		A(A)	
Remark:	* For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c). Aquatic Type standards apply to acid-soluble form.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
Theophylline (58-55-9)	A, A-S, AA, AA-S	40	40	H(WS)	B
	GA			H(WS)	B
Thiram (137-26-8)	GA	1.8		H(WS)	F
Toluene (108-88-3)	A, A-S, AA, AA-S	5		H(WS)	I
	GA	*		H(WS)	J
	A, A-S, AA, AA-S, B, C, D	6,000		H(FC)	B
	SA, SB, SC, I, SD	6,000		H(FC)	B
	A, A-S, AA, AA-S, B, C		100	A(C)	
	A, A-S, AA, AA-S, B, C, D		480	A(A)	
	SA, SB, SC, I		92	A(C)	
SA, SB, SC, I, SD		430	A(A)		
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Toluene-2,4-diamine (95-80-7)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Toluene-2,5-diamine (95-70-5)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Toluene-2,6-diamine (823-40-5)	A, A-S, AA, AA-S	**	5*	H(WS)	I
	GA			H(WS)	J
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.				
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
o-Toluidine (95-53-4)	A, A-S, AA, AA-S	*	0.6	H(WS)	A
	GA			H(WS)	J
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Tolyltriazole (29385-43-1)	A, A-S, AA, AA-S	GA	50	H(WS)	Z
	GA			H(WS)	Z

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE		
Toxaphene (8001-35-2)	A, A-S, AA, AA-S	0.06		H(WS)	A		
	GA	0.06		H(WS)	A		
	A, A-S, AA, AA-S, B, C, D	$6 \times 10^{-6}$		H(FC)	A		
	SA, SB, SC, I, SD	$6 \times 10^{-6}$		H(FC)	A		
	A, A-S, AA, AA-S, B, C	0.005		A(C)			
	D	1.6*		A(A)			
	SA, SB, SC	0.005		A(C)			
I		0.005		A(C)			
SD			0.07	A(A)			
Remark: *	For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic standard if so determined under 702.15 (d).						
1,2,4-Tribromobenzene (615-54-3)	A, A-S, AA, AA-S	5		H(WS)	I		
	GA	*		H(WS)	J		
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
Tributyltin oxide (56-35-9)	A, A-S, AA, AA-S		50	H(WS)	Z		
	GA		50	H(WS)	Z		
2,4,6-Trichloroaniline (634-93-5)	A, A-S, AA, AA-S	**	5*	H(WS)	I		
	GA			H(WS)	J		
Remarks: *	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL.						
**	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						
Trichlorobenzenes (87-61-6; 120-82-1; 108-70-3; 12002-48-1)	A, A-S, AA, AA-S	**	5***	H(WS)	I		
	GA			H(WS)	J		
	A, A-S, AA, AA-S, B, C			5**	A(C)		
	SA, SB, SC			5**	A(C)		
	I				5**	A(C)	
	A, A-S, AA, AA-S			10**	E	U	
	GA				10**	E	U
	D			50**	E	V	
	SD			50**	E	V	
	Remarks: *			The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to each isomer (1,2,3-, 1,2,4- and 1,3,5-trichlorobenzene) individually.			
**	Applies to the sum of 1,2,3-, 1,2,4- and 1,3,5-trichlorobenzene. For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c).						
***	This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. Value applies to each isomer individually.						
1,1,1-Trichloroethane (71-55-6)	A, A-S, AA, AA-S	5		H(WS)	I		
	GA	*		H(WS)	J		
Remark: *	The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.						

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
1,1,2-Trichloroethane (79-00-5)	A, A-S, AA, AA-S GA	1 1		H(WS) H(WS)	A A
Trichloroethene (79-01-6)	A, A-S, AA, AA-S GA A, A-S, AA, AA-S, B, C, D SA, SB, SC, I, SD	5 * 40 40		H(WS) H(WS) H(FC) H(FC)	I J A A
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
Trichlorofluoromethane (75-69-4)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,4,5-Trichlorophenoxyacetic acid (93-76-5)	GA	35		H(WS)	F
2,4,5-Trichlorophenoxypropionic acid (93-72-1)	A, A-S, AA, AA-S GA	10 0.26		H(WS) H(WS)	G F
1,1,2-Trichloropropane (598-77-6)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,2,3-Trichloropropane (96-18-4)	A, A-S, AA, AA-S GA	0.04 0.04		H(WS) H(WS)	A A
cis-1,2,3-Trichloropropene (13116-57-9)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
trans-1,2,3-Trichloropropene (13116-58-0)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
alpha,2,4-Trichlorotoluene (94-99-5)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
alpha,2,6-Trichlorotoluene (2014-83-7)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
alpha,3,4-Trichlorotoluene (102-47-6)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
alpha,alpha,2-Trichlorotoluene (88-66-4)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
alpha,alpha,4-Trichlorotoluene (13940-94-8)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,3,4-Trichlorotoluene (7359-72-0)	A, A-S, AA, AA-S GA	*	0.34	H(WS) H(WS)	B J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,3,5-Trichlorotoluene (56961-86-5)	A, A-S, AA, AA-S GA	*	0.34	H(WS) H(WS)	B J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,3,6-Trichlorotoluene (2077-46-5)	A, A-S, AA, AA-S GA	*	0.34	H(WS) H(WS)	B J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,4,5-Trichlorotoluene (6639-30-1)	A, A-S, AA, AA-S GA	*	0.34	H(WS) H(WS)	B J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
2,4,6-Trichlorotoluene (23749-65-7)	A, A-S, AA, AA-S GA	*	0.34	H(WS) H(WS)	B J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				
1,1,1-Trichloro-2,2,2-trifluoroethane (354-58-5)	A, A-S, AA, AA-S GA	5 *		H(WS) H(WS)	I J
Remark:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.				

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
1,1,2-Trichloro-1,2,2-trifluoroethane (76-13-1)	A, A-S, AA, AA-S GA	5 *		H(WS)	I
				H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
Trifluralin (1582-09-8)	GA	35		H(WS)	F
1,2,3-Trimethylbenzene (526-73-8)	A, A-S, AA, AA-S GA	5 *		H(WS)	I
				H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
1,2,4-Trimethylbenzene (95-63-6)	A, A-S, AA, AA-S GA	5 *		H(WS)	I
				H(WS)	J
					A(C)
					A(A)
					A(A)
1,2,4-Trimethylbenzene (95-63-6)	A, A-S, AA, AA-S GA	5 *			A(C)
					A(A)
					A(A)
					A(C)
					A(A)
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
1,3,5-Trimethylbenzene (108-67-8)	A, A-S, AA, AA-S GA	5 *		H(WS)	I
				H(WS)	J
Remark: * The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,3,6-Trimethylpyridine (1462-84-6)	A, A-S, AA, AA-S GA		50	H(WS)	Z
				H(WS)	Z
2,4,6-Trimethylpyridine (108-75-8)	A, A-S, AA, AA-S GA		50	H(WS)	Z
				H(WS)	Z
sym-Trinitrobenzene (99-35-4)	A, A-S, AA, AA-S GA	**	5*	H(WS)	I
				H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,3,4-Trinitrotoluene (602-29-9)	A, A-S, AA, AA-S GA	**	5*	H(WS)	I
				H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE
2,3,6-Trinitrotoluene (18292-97-2)	A, A-S, AA, AA-S GA	**	5*	H(WS)	I
				H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,4,5-Trinitrotoluene (610-25-3)	A, A-S, AA, AA-S GA	**	5*	H(WS)	I
				H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
2,4,6-Trinitrotoluene (118-96-7)	A, A-S, AA, AA-S GA	**	5*	H(WS)	I
				H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
3,4,5-Trinitrotoluene (603-15-6)	A, A-S, AA, AA-S GA	**	5*	H(WS)	I
				H(WS)	J
Remarks: * This substance did not receive a review beyond determining that it is in a principal organic contaminant class and that it does not have a more stringent Specific MCL. ** The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
Triphenyl phosphate (115-86-6)	A, A-S, AA, AA-S GA		50	H(WS)	Z
				H(WS)	Z
					A(C)
Triphenyl phosphate (115-86-6)	A, A-S, AA, AA-S, B, C D		40*		A(A)
					A(A)
					A(A)
Remark: * For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d).					
Tritium (CAS No. Not Applicable)	A, A-S, AA, AA-S	*		H(WS)	G
				Remark: * 20,000 picocuries per liter; if two or more radionuclides are present, the sum of their annual dose equivalent to the total body or any organ shall not exceed 4 millirems per year.	
Uranyl ion (CAS No. Not Applicable)	GA		5,000	H(WS)	H
Vanadium (CAS No. Not Applicable)	A, A-S, AA, AA-S, B, C D		14* 190*	A(C)	
				A(A)	
Remark: * For the waters of the Great Lakes System, the Department will substitute a guidance value for the aquatic Type standard if so determined under 702.15 (c) and (d). Aquatic Type standards apply to acid-soluble form.					

Table 1 (Continued)

## NEW YORK STATE AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES

JUNE 1998

SUBSTANCE (CAS No.)	WATER CLASSES	STANDARD (ug/L)	GUIDANCE VALUE (ug/L)	TYPE	BASIS CODE	
Vinyl chloride (75-01-4)	A, A-S, AA, AA-S	2	0.3	H(WS)	A	
	GA			H(WS)	G	
1,2-Xylene (95-47-6)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
	A, A-S, AA, AA-S, B, C			**	A(C)	
	A, A-S, AA, AA-S, B, C, D			**	A(A)	
	SA, SB, SC, I			**	A(C)	
	SA, SB, SC, I, SD			**	A(A)	
Remarks:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
	** Refer to entry for "1,4-Xylene."					
1,3-Xylene (108-38-3)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
	A, A-S, AA, AA-S, B, C			**	A(C)	
	A, A-S, AA, AA-S, B, C, D			**	A(A)	
	SA, SB, SC, I			**	A(C)	
	SA, SB, SC, I, SD			**	A(A)	
Remarks:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
	** Refer to entry for "1,4-Xylene."					
1,4-Xylene (106-42-3)	A, A-S, AA, AA-S	5	*	H(WS)	I	
	GA			H(WS)	J	
	A, A-S, AA, AA-S, B, C			65**	A(C)	
	A, A-S, AA, AA-S, B, C, D			590**	A(A)	
	SA, SB, SC, I			19**	A(C)	
	SA, SB, SC, I, SD			170**	A(A)	
Remarks:	* The principal organic contaminant standard for groundwater of 5 ug/L (described elsewhere in this Table) applies to this substance.					
	** Applies to the sum of 1,2-, 1,3- and 1,4-xylene.					
Zinc (CAS No. Not Applicable)	A, A-S, AA, AA-S	*		2,000	H(WS)	B
	GA			2,000	H(WS)	B
	A, A-S, AA, AA-S, B, C			**	A(C)	
	A, A-S, AA, AA-S, B, C, D			**	A(A)	
	SA, SB, SC, I			66	A(C)	
	SD			95	A(A)	
	A, A-S, AA, AA-S			5,000	E	U
GA	5,000	E	U			
Remarks:	Aquatic Type standards apply to dissolved form.					
	* $\exp(0.85 [\ln(\text{ppm hardness})] + 0.50)$					
	** $0.978 \exp(0.8473 [\ln(\text{ppm hardness})] + 0.884)$					
Zineb (12122-67-7)	GA	1.8		H(WS)	F	
Ziram (137-30-4)	GA	4.2		H(WS)	F	

TABLE 2

EXPLANATION OF BASIS CODES  
IN TABLE 1

JUNE 1998

BASIS CODE	BASIS
A	Oncogenic, Human Health
B	Non-oncogenic, Human Health
F	Former Groundwater Regulations, 6 NYCRR 703.5(a)(3), Human Health or Aesthetics
G	Specific MCL, Human Health or Aesthetics
H	Former Use of or Reference to 10 NYCRR Part 170, Human Health or Aesthetics
I	Principal Organic Contaminant Classes, Human Health
J	Former Groundwater Reference to 10 NYCRR Subpart 5-1 General Standards, Human Health
U	Potable Water, Aesthetics
V	Aquatic Life, Aesthetics
Z	General Organic Guidance Value, Human Health

TABLE 3

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Acenaphthylene	208-96-8
Acephate	30560-19-1
Acetone cyanohydrin	75-86-5
Acetonitrile	75-05-8
Acetophenone	98-86-2
2-Acetylaminofluorene	53-96-3
Allyl alcohol	107-18-6
Anisole	100-66-3
Aramite	140-57-8
Benzaldehyde	100-52-7
Benzeneacetic acid	103-82-2
1,2-Benzenedicarboxaldehyde	643-79-8
Benzenepropanoic acid	501-52-0
Benzoic acid	65-85-0
Benzoic acid, ammonium salt	1863-63-4
Benzo(g,h,i)perylene	191-24-2
Benzo(e)pyrene	192-97-2
Benzyl alcohol	100-51-6
Benzyl chloride	100-44-7
Bis(pentabromophenyl)ether	1163-19-5
4-Bromophenylphenylether	101-55-3
Bromophos	2104-96-3

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Bronopol	52-51-7
1-Butanol	71-36-3
tert-Butyl alcohol	75-65-0
Cacodylic acid	75-60-5
Caprolactam	105-60-1
Captafol	2425-06-1
Carbazole	86-74-8
Carbon disulfide	75-15-0
Chloral	75-87-6
Chloroacetic acid	79-11-8
Chlorobenzilate	510-15-6
4-Chlorobenzoic acid	74-11-3
2-Chloroethyl vinyl ether	110-75-8
4-(4-Chloro-2-methylphenoxy) butyric acid	94-81-5
2-(4-Chloro-2-methylphenoxy) propionic acid	93-65-2
4-Chlorophenyl phenyl ether	7005-72-3
Chlorpyrifos	2921-88-2
Cimectacarb	95266-40-3
Clopyralid	1702-17-6
Cyanazine	21725-46-2
Cyclohexane	110-82-7
Cyclohexanol	108-93-0

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Cyclohexanone	108-94-1
Cyclohexanone oxime	100-64-1
Cyclohexene	110-83-8
Cyclohexylamine	108-91-8
Cyclopentanone	120-92-3
Cyclotrimethylenetrinitramine	121-82-4
2,4-DB	94-82-6
Decanal	112-31-2
Demeton	8065-48-3
Diallate	2303-16-4
Dibenz(a,h)anthracene	55-70-3
Dibenzofuran	132-64-9
Dibromoacetonitrile	3252-43-5
Dibutyltin chloride	683-18-1
Dibutyltin dilaurate	77-58-7
Dichloroacetic acid	79-43-6
2,3-Dichloro-1,4-napthoquinone	117-80-6
alpha, alpha -Dichlorotoluene	98-87-3
Dicyclopentadiene	77-73-6
Diethylamine	109-89-7
2-(Diethylamino)ethanol	100-37-8
Diethylene glycol	111-46-6

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Diethylene glycol monoethyl ether	111-90-0
Diethyl formamide	617-84-4
Diethyl maleate	141-05-9
o,o-Diethyl-o-2-pyrazinyl phosphorothioate	297-97-2
Diethyltin dycaprylate	2641-56-7
2,3-Dihydro-1,6-dimethyl-1H-indene	17059-48-2
2,3-Dihydro-1-methyl-1H-indene	767-58-8
Diisopropylamine	108-18-9
Diisopropyl ether	108-20-3
Dimethoate	60-51-5
3,3'-Dimethoxybenzidine	119-90-4
Dimethylamine	124-40-3
4-(Dimethylamino)azobenzene	60-11-7
7,12-Dimethylbenz(a)anthracene	57-97-6
Dimethylbenzylammonium chloride	1875-92-9
trans-1,4-Dimethylcyclohexane	2207-04-7
Dimethyldioxane	25136-55-4
Dimethyldithiocarbamate	79-45-8
Dimethylethylbenzylammonium chloride	5197-80-8
2,5-Dimethylfuran	625-86-5
1,1-Dimethylhydrazine	57-14-7
1,2-Dimethylhydrazine	540-73-8

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Dimethylphenylcarbinol	617-94-7
Dimethylterephthalate	120-61-6
1,4-Dioxane	123-91-1
Dodecanoic acid	143-07-7
Endosulfan I	959-98-8
Endosulfan II	33213-65-9
Endosulfan sulfate	1031-07-8
Epichlorohydrin	106-89-8
Ethion	563-12-2
2-Ethoxyethanol	110-80-5
2-Ethoxyethanol acetate	111-15-9
Ethyl acetate	141-78-6
Ethyl acrylate	140-88-5
Ethyl di-n-propylthiocarbamate (EPTC)	759-96-4
Ethylene cyanohydrin	109-78-4
Ethyl ether	60-29-7
Ethyl methacrylate	97-63-2
Ethyl methane sulfonate	62-50-0
Famphur	52-85-7
Formaldehyde	50-00-0
Formic acid	64-18-6
Furan	110-00-9

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TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Furazolidone	67-45-8
Furfural	98-01-1
Furium	531-82-8
Glycidaldehyde	765-34-4
n-Heptane	142-82-5
1-Heptanol	111-70-6
2-Heptanol	543-49-7
3-Heptanol	589-82-2
4-Heptanol	589-55-9
Hexamethylene diamine	124-09-4
Hexanate	25056-70-6
n-Hexane	110-54-3
3-Hexanone	589-38-8
Hydrazine	302-01-2
3-Hydroxycarbofuran	16655-82-6
alpha-Hydroxy-alpha-methylbenzeneacetic acid	515-30-0
1,3-Isobenzofurandione	85-44-9
1(3H)-Isobenzofuranone	87-41-2
Isobutyl alcohol	78-83-1
Isodecyl diphenylphosphate	29761-21-5
Isopropyl alcohol	67-63-0
Isopropylamine	75-31-0

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TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Isopropylbenzene hydroperoxide	80-15-9
Isosafrole	120-58-1
Isothiazolones	NA
Linear alkylbenzenesulfonates	NA
Linuron	330-55-2
2,5-Lutidine	589-93-5
Maleic anhydride	108-31-6
Maleic hydrazide	123-33-1
Malononitrile	109-77-3
Methacrylamide	79-39-0
Methanol	67-56-1
Methapyrilene	91-80-5
2-Methoxyethanol	109-86-4
2-Methoxyethanol acetate	110-49-6
2-Methoxy-5-nitroaniline	99-59-2
Methyl acetate	79-20-9
Methylacrylate	96-33-3
Methylamine	74-89-5
2-Methylanthracene	613-12-7
9-Methylanthracene	779-02-2
2-Methylbenzaldehyde	529-20-4
3-Methylbenzaldehyde	620-23-5

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
4-Methylbenzaldehyde	104-87-0
4-Methylbenzenemethanol	589-18-4
2-Methyl benzene sulfonamide	88-19-7
4-Methyl benzene sulfonamide	70-55-3
2-Methylbenzoic acid	118-90-1
3-Methylbenzoic acid	99-04-7
Methyl tert-butyl ether	1634-04-4
3-Methylchoianthrene	56-49-5
Methylcyclopentane	96-37-7
Methylmethanesulfonate	66-27-3
1-Methyl-4-(1-methylethenyl)cyclohexene	138-86-3
2-Methylnaphthalene	91-57-6
Methylolmethacrylamide	923-02-4
4-Methyl-2-pentanone	108-10-1
Methylphthalate	4376-18-5
Metolachlor	51218-45-2
Molinate	2212-67-1
1,4-Naphthoquinone	130-15-4
1-Naphthylamine	134-32-7
2-Naphthylamine	91-59-8
Nitrocyclohexane	1122-60-7
Nitrofurantoin	67-20-9

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Nitrofurazone	59-87-0
2-Nitropropane	79-46-9
4-Nitroquinoline-1-oxide	56-57-5
N-Nitrosodi-N-butylamine	924-16-3
N-Nitrosodiethylamine	55-18-5
N-Nitrosodimethylamine	62-75-9
N-Nitrosodipropylamine	621-64-7
N-Nitrosomethylethylamine	10595-95-6
N-Nitroso-N-methyl urea	684-93-5
N-Nitrosomorpholine	59-89-2
N-Nitrosopiperidine	100-75-4
N-Nitrosopyrrolidine	930-55-2
Nonanal	124-19-6
1-Nonanol	143-08-8
Octamethylpyrophosphoramine	152-16-9
Oxalic acid, benzyl ester	35448-14-7
Pebulate	1114-71-2
Pentamate	136-25-4
Phenacetin	62-44-2
alpha-Picoline	109-06-8
Polybutene(1-propene,2-methyl homopolymer)	9003-27-4
Prodiamine	29091-21-2

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
Profuralin	26399-36-0
Pronamide	23950-58-5
1-Propanol	71-23-8
1-Propene	115-07-1
Propionitrile	107-12-0
Propylene glycol	58-55-6
Propylene glycol monoethyl ether	19089-47-5
Propylene glycol monomethyl ether	1589-49-7
Propylene oxide	75-56-9
Quaternary ammonium compounds	NA
Quinoline	91-22-5
1,4-Quinone dioxide	105-11-3
Reserpine	50-55-5
Rhodamine WT	37299-86-8
Ronnel	299-84-3
Rotenone	83-79-4
Safrole	94-59-7
Sodium adipate, disodium salt	7486-38-6
Sodium diethyldithiocarbamate	148-18-5
Strychnine	57-24-9
Tetraethyl dithiopyrophosphate	3689-24-5
Tetraethyl lead	78-00-2
Tetraethyl tin	597-64-8

TABLE 3 (Continued)

PARTIAL LIST OF SUBSTANCES NOT REGULATED BY THE  
PRINCIPAL ORGANIC CONTAMINANT (POC) GROUNDWATER STANDARD

JUNE 1998

Note: Refer to Text of Part I for Explanation

(No standard or guidance value for groundwater is available  
for these substances as of the date of this document)

SUBSTANCE	CAS NO.
2-(Thiocyanomethylthio) benzothiazole	21564-17-0
Thiofanox	39196-18-4
Thiourea	62-56-6
Toluene diisocyanate	584-84-9
Triallate	2303-17-5
Trichloroacetic acid	76-03-9
alpha, alpha, alpha-Trichlorotoluene	98-07-7
Triethylamine	121-44-8
o,o,o-Triethylphosphorothioate	126-68-1
3,3,5-Trimethylcyclohexanone	873-94-9
Trimethyl phosphate	512-56-1
Vernolate	1929-77-7
Vinyl acetate	108-05-4
Warfarin	81-81-2
NA = Not Applicable	

TABLE 4

## DEFINITION FOR PRINCIPAL ORGANIC CONTAMINANT CLASSES\*

(excerpted from 6 NYCRR Section 700.1)

JUNE 1998

Principal organic contaminant classes means the following classes of organic chemicals.

- (1) Halogenated alkane: 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  $C_nH_yX_z$ , 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. Specifically excluded from this class are chloroform, bromoform, bromodichloromethane and dibromochloromethane.
- (2) Halogenated ether: Compound containing carbon (C), hydrogen (H), oxygen (O) and halogen (X) (where X = F, Cl, Br and/or I) having the general formula  $C_nH_yX_zO$ , 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.

\*Note: Determining the applicability of the POC groundwater standard to a specific substance can be a complex process that should not be undertaken using these definitions alone. Refer to Section III of the Introduction of this TOGS (page 7) for instructions.

## PART II GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)

The Division of Water (DOW) regulates point source discharges to class GA groundwater primarily through the use of effluent limitations that have been established statewide. These effluent limitations are set at concentrations that should prevent contaminants from exceeding ambient groundwater standards and guidance values, which are applicable in the saturated zone. Class GA groundwaters are all fresh groundwaters. Groundwater effluent limitations are provided in Table 5 and discussed in this Part. (Ambient standards and guidance values that relate to these effluent limitations were provided in Table 1 of this TOGS and described in Part I).

### A. DEFINITIONS

This section presents definitions for key terms that are used in the text and tables. The definitions are similar to the ones that appear in regulation, Part 700. Additional explanation is provided where appropriate.

1. "Groundwaters" mean those waters in saturated zones.
2. "Saturated zones" mean any extensive portion of the earth's crust that contains sufficient water to fill all interconnected voids or pore space.
3. "Fresh groundwaters" mean those groundwaters having a chloride concentration equal to or less than 250 mg/L or a total dissolved solids concentration equal to or less than 1,000 mg/L.
4. "Saline groundwaters" mean groundwaters having a chloride concentration of more than 250 mg/L or a total dissolved solids concentration of more than 1,000 mg/L.
5. "Groundwater standards" and "groundwater guidance values" both mean such measures of purity or quality for any groundwaters in relation to their reasonable and necessary use. "Groundwater standards" are established by the Department pursuant to section 17-0301 of the Environmental Conservation Law, which means the values are included in regulation. "Groundwater guidance values" are established by the Department pursuant to section 702.1 of Title 6, which means the specific values are not in regulation.

Such standards and guidance values are often referred to as ambient values in this document to emphasize that they apply to samples of groundwater and are distinct from effluent limitations, which apply to samples of wastewater at the point of discharge.

6. "Groundwater effluent limitations" mean any restriction on quantities, qualities, rates and concentrations of chemical, physical, biological, and other constituents of effluents that are discharged into or allowed to run from an outlet or point source or any other discharge within the meaning of section 17-0501 of the Environmental Conservation Law into groundwater or unsaturated zones. Some groundwater effluent limitations are in regulation (703.6); the remainder are guidance.

### B. GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)

A groundwater effluent limitation is derived to prevent a contaminant from exceeding the ambient standard or guidance value in the saturated zone. An effluent limitation generally is set at or near the ambient value, partly on the assumption that for many toxic substances, sustained high percent removal in the unsaturated zone cannot be relied upon. The approach used provides a high degree of certainty that the ambient value will not be exceeded and also avoids the need for site-specific evaluations, which would be technically difficult, costly and time consuming.

Groundwater effluent limitations are presented in Table 5, alphabetically by substance. The same substance names as in Table 1 are used. The reader is cautioned that, as for ambient values, groundwater effluent limitations may apply to substances that may be identified only by a group entry, including "Principal organic contaminant." Guidance in Part I, Sections A and B should be useful to determining whether an effluent limitation exists for a particular substance.

The second column lists the groundwater effluent limitation in ug/L, unless otherwise noted. The third column, entitled "Category," provides information about the basis for the effluent limitation. (The Category is not the same as the Basis Code in Table 1.) The five Categories are as follows:

- Category A Effluent limitations that are in regulation (6 NYCRR 703.6)
- Category B Effluent limitations that are numerically equal to ambient guidance values, as provided in 702.16(c)(1).
- Category C Effluent limitations that are derived in this document for substances that have an ambient standard, but no corresponding effluent limitation in 703.6. (For organic substances, the effluent limitations have been set equal to the ambient standards. For metals, the effluent limitations have been set at twice the ambient standard.)
- Category D Effluent limitations for sodium and ammonia require case-by-case determinations. Significant removal of these substances can occur in the unsaturated zone and will be a function of site-specific factors.

Also, as indicated in Table 5, effluent limitations for radiological parameters will be established through Radiation Control Permits, Part 380.

As listed under "Organic substances, total" in Table 5, an effluent limitation of 100 ug/L for the total of certain organic substances is applicable, as provided in 702.16(c)(4). The substances that can be specified for this limitation are those organic substances that have an ambient groundwater standard or guidance value less than 100 ug/L. This includes all substances covered by the principal organic contaminant (POC) groundwater standard (Table 1) and other applicable "group" entries, whether they are listed individually in this TOGS or not.

### C. IMPLEMENTATION OF GROUNDWATER EFFLUENT LIMITATIONS

#### 1. Gross or Net Limitations.

Effluent limitations as listed in Table 5 are defined as gross limitations (i.e., without mathematical subtraction of the amounts present in intake water). These gross effluent limitations, however, may not be appropriate where the concentration of a substance in the receiving aquifer exceeds the effluent limitation. General guidance for these situations is provided in other TOGS documents relating to the preparation of SPDES permits.

#### 2. Modifications of Effluent Limitations

Section 702.19 allows, under certain conditions, modification of a groundwater effluent limitation. This includes those effluent limitations in 703.6 and those derived as numerically equivalent to a H(W) Type guidance value. The included limitations are thus those designated as Categories A and B in Table 5. Such modifications may be allowed where the applicant demonstrates that a less restrictive effluent limitation will be sufficient to prevent groundwater concentrations from exceeding the ambient value. SPDES applications for such modifications are governed by the Uniform Procedures Act and require public notice of the proposed modification.

#### 3. Exceptions to Effluent Limitations

The water quality regulations, section 702.21, provide exceptions for three activities to the requirement to impose the numerical effluent limitations in Table 5. Effluent limitations for the two point source activities, i.e., certain sewage and land application systems, should be determined on a case-by-case basis to achieve or maintain ambient standards and guidance values.

Table 5 NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA) JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Acenaphthene (83-32-9)	20	B
Acetone (67-64-1)	50	B
Acrolein (107-02-8)	5	C
Acrylamide (79-06-1)	5	C
Acrylic acid (79-10-7)	50	B
Acrylonitrile (107-13-1)	5	C
Alachlor (15972-60-8)	0.5	A
Aldicarb (116-06-3)	*	
Remark: * See "Aldicarb and Methomyl."		
Aldicarb and Methomyl (116-06-3;16752-77-5)	0.35	A
Aldicarb sulfone (1646-88-4)	2	B
Aldicarb sulfoxide (1646-87-3)	4	B
Aldrin (309-00-2)	ND	A
Alkyl dimethyl benzyl ammonium chloride (68391-01-5)	50	B
Alkyl diphenyl oxide sulfonates (CAS No. Not Applicable)	50*	B
Remark: * Applies to each alkyl diphenyl oxide sulfonate individually.		
Allyl chloride (107-05-1)	5	C
Aluminum (CAS No. Not Applicable)	2,000	A
Ametryn (834-12-8)	50	C
4-Aminobiphenyl (92-67-1)	5	C
Aminocresols (95-84-1; 2835-95-2; 2835-99-6)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Aminomethylene phosphonic acid salts (CAS No. Not Applicable)	50*	B
Remark: * Applies to each aminomethylene phosphonic acid salt individually.		
Aminopyridines (462-08-8; 504-24-5; 504-29-0; 26445-05-6)	1*	B
Remark: * Applies to the sum of these substances.		
3-Aminotoluene (108-44-1)	5	C
4-Aminotoluene (106-49-0)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Ammonia and Ammonium (7664-41-7; CAS No. Not Applicable) Remark: * $\text{NH}_3 + \text{NH}_4^+$ as N. Case-by-case determination of need and quantity.	*	D
Aniline (62-53-3)	5	C
Anthracene (120-12-7)	50	B
Antimony (CAS No. Not Applicable)	6	A
Arsenic (CAS No. Not Applicable)	50	A
Aryltriazoles (CAS No. Not Applicable) Remark: * Applies to each aryltriazole individually.	50*	B
Asbestos (fibers > 10 um) (CAS No. Not Applicable)	14,000,000 fibers/L	A
Atrazine (1912-24-9)	7.5	A
Azinphosmethyl (86-50-0)	4.4	A
Azobenzene (103-33-3)	5	C
Barium (CAS No. Not Applicable)	2,000	A
Benefin (1861-40-1)	35	A
Benz(a)anthracene (56-55-3)	0.002	B
Benzene (71-43-2)	1	A
Benzidine (92-87-5)	5	C
Benzisothiazole (271-61-4)	50	B
Benzo(b)fluoranthene (205-99-2)	0.002	B
Benzo(k)fluoranthene (207-08-9)	0.002	B
Benzo(a)pyrene (50-32-8)	ND	A
Beryllium (CAS No. Not Applicable)	3	B
1,1'-Biphenyl (92-52-4)	5	C
Bis(2-chloroethoxy)methane (111-91-1)	5	C
Bis(2-chloroethyl)ether (111-44-4)	1.0	A
Bis(chloromethyl)ether (542-88-1)	5	C
Bis(2-chloro-1-methylethyl)ether (108-60-1)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Bis(2-ethylhexyl)phthalate (117-81-7)	5	A
Boric acid, Borates & Metaborates (CAS No. Not Applicable) Remark: * Applies as boron equivalents to the sum of these substances.	125*	B
Boron (CAS No. Not Applicable)	2,000	C
Bromacil (314-40-9)	4.4	A
Bromide (CAS No. Not Applicable)	2,000	B
Bromobenzene (108-86-1)	5	C
Bromochloromethane (74-97-5)	5	C
Bromodichloromethane (75-27-4)	50	B
Bromoform (75-25-2)	50	B
Bromomethane (74-83-9)	5	C
Butachlor (23184-66-9)	3.5	A
cis-2-Butenal (15798-64-8)	5	C
trans-2-Butenal (123-73-9)	5	C
cis-2-Butenenitrile (1190-76-7)	5	C
trans-2-Butenenitrile (627-26-9)	5	C
Butoxyethoxyethanol (112-34-5)	50	B
Butoxypropanol (5131-66-8)	50	B
Butylate (2008-41-5)	50	C
n-Butylbenzene (104-51-8)	5	C
sec-Butylbenzene (135-98-8)	5	C
tert-Butylbenzene (98-06-6)	5	C
Butyl benzyl phthalate (85-68-7)	50	B
Butyl isopropyl phthalate (CAS No. Not Applicable)	50	B
Cadmium (CAS No. Not Applicable)	10	A
Captan (133-06-2)	18	A
Carbaryl (63-25-2)	29	A

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Carbofuran (1563-66-2)	15	B
Carbon tetrachloride (56-23-5)	5	A
Carboxin (5234-68-4)	50	C
Chloramben (CAS No. Not Applicable)	50*	A
Remark: *	Includes related forms that convert to the organic acid upon acidification to a pH of 2 or less; and esters of the organic acid.	
Chloranil (118-75-2)	5	C
Chlordane (57-74-9)	0.05	A
Chloride (CAS No. Not Applicable)	500,000	A
Chlorinated dibenzo-p-dioxins and Chlorinated dibenzofurans (CAS No. Not Applicable)	7 x 10 <sup>-7</sup> equivalents of 2,3,7,8-TCDD*	A
Remark: *	Value is for the total of the chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans as equivalents of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) as specified by the ambient Class GA H(WS) standard in Table 1 of this document.	
2-Chloroaniline (95-51-2)	5	C
3-Chloroaniline (108-42-9)	5	C
4-Chloroaniline (106-47-8)	5	C
Chlorobenzene (108-90-7)	5	C
4-Chlorobenzotrifluoride (98-56-6)	5	C
1-Chlorobutane (109-69-3)	5	C
Chloroethane (75-00-3)	5	C
Chloroform (67-66-3)	7	A
Chloromethyl methyl ether (107-30-2)	5	C
2-Chloronaphthalene (91-58-7)	10	B
2-Chloronitrobenzene (88-73-3)	5	C
3-Chloronitrobenzene (121-73-3)	5	C
4-Chloronitrobenzene (100-00-5)	5	C
Chloroprene (126-99-8)	5	C
Chlorothalonil (1897-45-6)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
2-Chlorotoluene (95-49-8)	5	C
3-Chlorotoluene (108-41-8)	5	C
4-Chlorotoluene (108-43-4)	5	C
4-Chloro-o-toluidine (95-69-2)	5	C
5-Chloro-o-toluidine (95-79-4)	5	C
3-Chloro-1,1,1-trifluoropropane (460-35-5)	5	C
Chromium (CAS No. Not Applicable)	100	C
Chromium (hexavalent) (CAS No. Not Applicable)	100	A
Chrysene (218-01-9)	0.002	B
Copper (CAS No. Not Applicable)	1,000	A
Cyanide (CAS No. Not Applicable)	400	A
Cyanogen bromide (506-68-3)	5	C
Cyanogen chloride (506-77-4)	5	C
Dalapon (CAS No. Not Applicable)	50*	C
Remark: *	Includes related forms that convert to the organic acid upon acidification to a pH of 2 or less; and esters of the organic acid.	
p,p'-DDD (72-54-8)	0.3	A
p,p'-DDE (72-55-9)	0.2	A
p,p'-DDT (50-29-3)	0.2	A
Dechlorane Plus (13560-89-9)	5	C
Diazinon (333-41-5)	0.7	A
1,2-Dibromobenzene (583-53-9)	5	C
1,3-Dibromobenzene (108-36-1)	5	C
1,4-Dibromobenzene (106-37-6)	5	C
Dibromochloromethane (124-48-1)	50	B
1,2-Dibromo-3-chloropropane (96-12-8)	0.04	A
Dibromodichloromethane (594-18-3)	5	C
Dibromomethane (74-95-3)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
2,2-Dibromo-3-nitropropionamide (10222-01-2)	50	B
Di-n-butyl phthalate (84-74-2)	50	A
Dicamba (1918-00-9)	0.44	A
Dichlorobenzenes (95-50-1;541-73-1;106-47-6)	3*	A
Remark: * Applies to each dichlorobenzene individually.		
3,3'-Dichlorobenzidine (91-94-1)	5	C
3,4-Dichlorobenzotrifluoride (328-84-7)	5	C
cis-1,4-Dichloro-2-butene (1476-11-5)	5	C
trans-1,4-Dichloro-2-butene (110-57-6)	5	C
Dichlorodifluoromethane (75-71-8)	5	C
1,1-Dichloroethane (75-34-3)	5	C
1,2-Dichloroethane (107-06-2)	0.6	A
1,1-Dichloroethene (75-35-4)	5	C
cis-1,2-Dichloroethene (156-59-2)	5	C
trans-1,2-Dichloroethene (156-60-5)	5	C
Dichlorofluoromethane (75-43-4)	5	C
2,4-Dichlorophenol (120-83-2)	*	
Remark: * See "Phenolic compounds (total phenols)."		
2,4-Dichlorophenoxyacetic acid (94-75-7)	50	A
1,1-Dichloropropane (78-99-9)	5	C
1,2-Dichloropropane (78-87-5)	1	A
1,3-Dichloropropane (142-28-9)	5	C
2,2-Dichloropropane (594-20-7)	5	C
1,1-Dichloropropene (563-58-6)	5	C
1,3-Dichloropropene (sum of cis- and trans- isomers) (542-75-6)	0.4	A
2,3-Dichlorotoluene (32768-54-0)	5	C
2,4-Dichlorotoluene (95-73-8)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
2,5-Dichlorotoluene (19398-61-9)	5	C
2,6-Dichlorotoluene (118-69-4)	5	C
3,4-Dichlorotoluene (95-75-0)	5	C
3,5-Dichlorotoluene (25186-47-4)	5	C
Dieldrin (60-57-1)	0.004	A
Di(2-ethylhexyl)adipate (103-23-1)	20	A
Diethyl phthalate (84-66-2)	50	B
1,2-Difluoro-1,1,2,2-tetrachloroethane (76-12-0)	5	C
1,2-Diisopropylbenzene (577-55-9)	5	C
1,3-Diisopropylbenzene (99-62-7)	5	C
1,4-Diisopropylbenzene (100-18-5)	5	C
N,N-Dimethylaniline (121-69-7)	1	A
2,3-Dimethylaniline (87-59-2)	5	C
2,4-Dimethylaniline (95-68-1)	5	C
2,5-Dimethylaniline (95-78-3)	5	C
2,6-Dimethylaniline (87-62-7)	5	C
3,4-Dimethylaniline (95-64-7)	5	C
3,5-Dimethylaniline (108-69-0)	5	C
3,3'-Dimethylbenzidine (119-93-7)	5	C
4,4'-Dimethylbiphenyl (538-39-6)	5	C
4,4'-Dimethyldiphenylmethane (4957-14-6)	5	C
Dimethylformamide (68-12-2)	50	B
alpha, alpha-Dimethyl phenethylamine (122-09-8)	5	C
2,4-Dimethylphenol (105-67-9)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Dimethyl phthalate (131-11-3)	50	B

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
2,4-Dinitrophenol (51-28-5)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Dimethyl tetrachloroterephthalate (1861-32-1)	50	C
1,3-Dinitrobenzene (99-65-0)	5	C
2,3-Dinitrotoluene (602-01-7)	5	C
2,4-Dinitrotoluene (121-14-2)	5	C
2,5-Dinitrotoluene (619-15-8)	5	C
2,6-Dinitrotoluene (606-20-2)	5	C
3,4-Dinitrotoluene (610-39-9)	5	C
3,5-Dinitrotoluene (618-85-9)	5	C
Di-n-octyl phthalate (117-84-0)	50	B
Dinoseb (88-85-7)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Diphenamid (957-51-7)	50	C
Diphenylamine (122-39-4)	5	C
1,1-Diphenylhydrazine (530-50-7)	ND	C
1,2-Diphenylhydrazine (122-66-7)	ND	A
Diquat (2764-72-9)	20	A
Dissolved solids, total (CAS No. Not Applicable)	*	A
Remark: * 1,000 mg/L; applies only in the counties of Nassau and Suffolk.		
Disulfoton (298-04-4)	*	
Remark: * See "Phorate and Disulfoton."		
Dodecylguanidine acetate and Dodecylguanidine hydrochloride (2439-10-3; 13590-97-1)	50*	B
Remark: * Applies to the sum of these substances.		
Dyphylline (479-18-5)	50	B
Endothall (145-73-3)	50	B

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Endrin (72-20-8)	ND	A
Endrin aldehyde (7421-93-4)	5	C
Endrin ketone (53494-70-5)	5	C
Ethylbenzene (100-41-4)	5	C
Ethylene chlorohydrin (107-07-3)	50	B
Ethylene dibromide (106-93-4)	6 x 10 <sup>-4</sup>	A
Ethylene glycol (107-21-1)	50	B
Ethylene oxide (75-21-8)	0.05	B
Ethylenethiourea (96-45-7)	ND	A
Ferbam (14484-64-1)	4.2	A
Fluometuron (2164-17-2)	50	C
Fluoranthene (206-44-0)	50	B
Fluorene (86-73-7)	50	B
Fluoride (CAS No. Not Applicable)	3,000	A
Foaming agents (CAS No. Not Applicable)	1,000*	A
Remark: * Determined as methylene blue active substances (MBAS) or by other tests as specified by the commissioner.		
Folpet (133-07-3)	50	A
Glyphosate (1071-83-6)	50	B
Gross alpha radiation (CAS No. Not Applicable)	*	
Remark: * Established through Radiation Control Permits (Part 380).		
Gross beta radiation (CAS No. Not Applicable)	*	
Remark: * Established through Radiation Control Permits (Part 380).		
Guaifenesin (93-14-1)	50	B
Heptachlor (76-44-8)	0.04	A
Heptachlor epoxide (1024-57-3)	0.03	A
Hexachlorobenzene (118-74-1)	0.04	A
Hexachlorobutadiene (87-68-3)	0.5	A

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
alpha-Hexachlorocyclohexane (319-84-6)	0.01	A
beta-Hexachlorocyclohexane (319-85-7)	0.04	A
delta-Hexachlorocyclohexane (319-86-8)	0.04	A
epsilon-Hexachlorocyclohexane (6108-10-7)	0.04	A
gamma-Hexachlorocyclohexane (58-89-9)	0.05	A
Hexachlorocyclopentadiene (77-47-4)	5	C
Hexachloroethane (67-72-1)	5	C
Hexachlorophene (70-30-4)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Hexachloropropene (1888-71-7)	5	C
2-Hexanone (591-78-6)	50	B
Hexazinone (51235-04-2)	50	C
Hydrogen sulfide (7783-06-4)	*	
Remark: * See "Sulfides, total."		
Hydroquinone (123-31-9)	*	
Remark: * See "Phenolic compounds (total phenols)."		
1-Hydroxyethylidene-1,1-diphosphonic acid (2809-21-4)	50	B
2-(2-Hydroxy-3,5-di-tert-pentylphenyl)-benzotriazole (25973-55-1)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Indeno (1,2,3-cd) pyrene (193-39-5)	0.002	B
Iron (CAS No. Not Applicable)	600*	A
Remark: * Also see "Iron and Manganese."		
Iron and Manganese (CAS No. Not Applicable)	1,000*	A
Remark: * Applies to the sum of these substances.		
Isodrin (465-73-6)	5	C
Isophorone (78-59-1)	50	B
Isopropalin (33820-53-0)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Isopropylbenzene (98-82-8)	5	C
2-Isopropyltoluene (527-84-4)	5	C
3-Isopropyltoluene (535-77-3)	5	C
4-Isopropyltoluene (99-87-6)	5	C
Kepone (143-50-0)	ND	A
Lead (CAS No. Not Applicable)	50	A
Magnesium (CAS No. Not Applicable)	35,000	B
Malathion (121-75-5)	7.0	A
Mancozeb (8018-01-7)	1.8	A
Maneb (12427-38-2)	1.8	A
Manganese (CAS No. Not Applicable)	600*	A
Remark: * Also see "Iron and Manganese."		
Mercaptobenzothiazole (149-30-4)	50	B
Mercury (CAS No. Not Applicable)	1.4	A
Methacrylic acid (79-41-4)	50	B
Methacrylonitrile (126-98-7)	5	C
Methomyl (16752-77-5)	*	
Remark: * See "Aldicarb and Methomyl."		
Methoxychlor (72-43-5)	35	A
(1-Methoxyethyl) benzene (4013-34-7)	50	B
(2-Methoxyethyl) benzene (3558-60-9)	50	B
N-Methylaniline (100-61-8)	5	C
Methylbenz(a)anthracenes (CAS No. Not Applicable)	0.002*	B
Remark: * Applies to the sum of these substances.		
Methyl chloride (74-87-3)	5	C
2-Methyl-4-chlorophenoxyacetic acid (94-74-6)	0.44	A
4,4'-Methylene-bis-(2-chloroaniline) (101-14-4)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
4,4'-Methylene-bis-(N-methyl)aniline (1807-55-2)	5	C
4,4'-Methylene-bis-(N,N'-dimethyl) aniline (101-61-1)	5	C
Methylene bithiocyanate (6317-18-6)	50	B
Methylene chloride (dichloromethane) (75-09-2)	5	A
4-(1-Methylethoxy)-1-butanol (31600-69-8)	50	B
2-Methylethyl-1,3-dioxolane (126-39-6)	50	B
Methyl ethyl ketone (78-93-3)	50	B
Methyl iodide (74-88-4)	5	C
Methyl methacrylate (80-62-6)	50	A
Methyl parathion (298-00-0)	*	
Remark: * See "Parathion and Methyl parathion."		
alpha-Methylstyrene (98-83-9)	5	C
2-Methylstyrene (611-15-4)	5	C
3-Methylstyrene (100-80-1)	5	C
4-Methylstyrene (622-97-9)	5	C
Metribuzin (21087-64-9)	50	C
Mirex (2385-85-5)	0.03	A
Nabam (142-59-6)	1.8	A
Naphthalene (91-20-3)	10	B
Niacinamide (98-92-0)	500	B
Nickel (CAS No. Not Applicable)	200	A
Nitralin (4726-14-1)	35	A
Nitrate (expressed as N) (CAS No. Not Applicable)	20,000	A
Nitrate and Nitrite (expressed as N) (CAS No. Not Applicable)	20,000	A
Nitrioltriacetic acid (CAS No. Not Applicable)	3*	A
Remark: * Includes related forms that convert to nitrioltriacetic acid upon acidification to a pH of 2.3 or less."		
Nitrite (expressed as N) (CAS No. Not Applicable)	2,000	A

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
2-Nitroaniline (88-74-4)	5	C
3-Nitroaniline (99-09-2)	5	C
4-Nitroaniline (100-01-6)	5	C
Nitrobenzene (98-95-3)	0.4	A
Nitrogen, total (expressed as N) (CAS No. Not Applicable)	10,000*	A
Remark: * Applies only in the counties of Nassau and Suffolk.		
N-Nitrosodiphenylamine (86-30-6)	50	B
2-Nitrotoluene (88-72-2)	5	C
3-Nitrotoluene (99-08-1)	5	C
4-Nitrotoluene (99-99-0)	5	C
5-Nitro-o-toluidine (99-55-8)	5	C
Octachlorostyrene (29082-74-4)	0.2	A
Oil and Grease (CAS No. Not Applicable)	15,000*	A
Remark: * Applies to the sum of oil and grease.		
Organic substances, total (CAS No. Not Applicable)	100*	
Remark: * This value applies to the total of all organic substances listed in this Table with a groundwater effluent limitation less than 100 ug/L. Included in the total are all organic substances covered by the principal organic contaminant value and those in other "group" entries, whether or not the substances are individually listed in this Table.		
Oxaryl (23135-22-0)	50	C
Paraquat (4685-14-7)	3.0	A
Parathion (56-38-2)	*	
Remark: * See "Parathion and Methyl parathion."		
Parathion and Methyl parathion (56-38-2; 298-00-0)	1.5*	A
Remark: * Applies to the sum of these substances.		
Pendimethalin (40487-42-1)	5	C
Pentachlorobenzene (608-93-5)	5	C
Pentachloroethane (76-01-7)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Pentachloronitrobenzene (82-68-8)	ND	A
Pentachlorophenol (87-86-5)	*	
Remark: * See "Phenolic compounds (total phenols)."		
pH (CAS No. Not Applicable)	*	A
Remark: * pH shall not be lower than 6.5 or the pH of the natural groundwater, whichever is lower, nor shall be greater than 8.5 or the pH of the natural groundwater, whichever is greater.		
Phenanthrene (85-01-8)	50	B
Phenol (108-95-2)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Phenolic compounds (total phenols) (CAS No. Not Applicable)	2*	A
Remark: * Applies to the sum of these substances.		
Phenols, total chlorinated (CAS No. Not Applicable)	*	
Remark: * See "Phenolic compounds (total phenols)."		
Phenols, total unchlorinated (CAS No. Not Applicable)	*	
Remark: * See "Phenolic compounds (total phenols)."		
1,2-Phenylenediamine (95-54-5)	5	C
1,3-Phenylenediamine (108-45-2)	5	C
1,4-Phenylenediamine (106-50-3)	5	C
Phenyl ether (101-84-8)	10	B
Phenylhydrazine (100-63-0)	5	C
Phenylpropanolamine (14838-15-4)	50	B
3-Phenyl-1-propene (637-50-3)	5	C
cis-1-Phenyl-1-propene (766-90-5)	5	C
trans-1-Phenyl-1-propene (873-66-5)	5	C
Phorate (298-02-2)	*	
Remark: * See "Phorate and Disulfoton."		

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Phorate and Disulfoton (298-02-2; 298-04-4)	ND*	A
Remark: * Applies to the sum of these substances.		
Picloram (CAS No. Not Applicable)	50*	C
Remark: * Includes: related forms that convert to the organic acid upon acidification to a pH of 2 or less; and esters of the organic acid.		
Polybrominated biphenyls (CAS No. Not Applicable)	5*	C
Remark: * Applies to each congener individually.		
Polychlorinated biphenyls (CAS No. Not Applicable)	0.09*	A
Remark: * Applies to the sum of these substances.		
Principal organic contaminant (CAS No. Not Applicable)	5*	C
Remark: * Applies to each individual substance to which the principal organic contaminant (POC) class GA ambient groundwater standard applies (whether listed in this TOGS or not) <u>except</u> for those substances with a groundwater effluent limitation other than 5 ug/L listed in this Table.		
	For the convenience of the reader, the groundwater effluent limitations of 5 ug/L for <u>some</u> (but not all) individual POCs are listed in this Table.	
Prometon (1610-18-0)	50	C
Propachlor (1918-16-7)	35	A
Propanil (709-98-8)	7.0	A
Propazine (139-40-2)	16	A
Propham (122-42-9)	50	C
n-Propylbenzene (103-65-1)	5	C
Pyrene (129-00-0)	50	B
Pyridine (110-86-1)	50	B
Radium 226 (CAS No. Not Applicable)	*	
Remark: * Established through Radiation Control Permits, Part 380.		
Radium 226 and Radium 228 (CAS No. Not Applicable)	*	
Remark: * Established through Radiation Control Permits, Part 380.		
Radium 228 (CAS No. Not Applicable)	*	
Remark: * Established through Radiation Control Permits, Part 380.		

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Selenium (CAS No. Not Applicable)	20	A
Silver (CAS No. Not Applicable)	100	A
Simazine (122-34-9)	0.5	A
Sodium (CAS No. Not Applicable)	*	D
Remark: * Case-by-case evaluation.		
Styrene (100-42-5)	930	A
Sulfate (CAS No. Not Applicable)	500,000	A
Sulfide (CAS No. Not Applicable)	1,000	A
Tebuthiuron (34014-18-1)	50	C
Terbacil (5902-51-2)	50	C
Terbufos (13071-79-9)	0.09	B
Tetrachlorobenzenes (634-66-2; 634-90-2; 95-94-3; 12408-10-5)	*	*
Remark: * Value of 5 ug/L, Category C applies to each tetrachlorobenzene individually. Value of 10 ug/L, Category B applies to the sum of these substances.		
1,1,1,2-Tetrachloroethane (630-20-6)	5	C
1,1,1,2-Tetrachloroethane (79-34-5)	5	C
Tetrachloroethene (127-18-4)	5	C
Tetrachloroterephthalic acid (2136-79-0)	50	C
alpha, alpha, alpha, 4-Tetrachlorotoluene (5216-25-1)	5	C
Tetrahydrofuran (109-99-9)	50	B
1,2,3,4-Tetramethylbenzene (488-23-3)	5	C
1,2,3,5-Tetramethylbenzene (527-53-7)	5	C
1,2,4,5-Tetramethylbenzene (95-93-2)	5	C
Thallium (CAS No. Not Applicable)	0.5	B
Theophylline (58-55-9)	40	B
Thiram (137-26-8)	1.8	A
Toluene (108-88-3)	5	C

Table 5 (Continued)		
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)		
JUNE 1998		
SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
Toluene-2,4-diamine (95-80-7)	5	C
Toluene-2,5-diamine (95-70-5)	5	C
Toluene-2,6-diamine (823-40-5)	5	C
o-Toluidine (95-53-4)	5	C
Tolyltriazole (29385-43-1)	50	B
Toxaphene (8001-35-2)	0.06	A
1,2,4-Tribromobenzene (615-54-3)	5	C
Tributyltin oxide (56-35-9)	50	B
2,4,6-Trichloroaniline (634-93-5)	5	C
Trichlorobenzenes (87-61-6; 120-82-1; 108-70-3; 12002-48-1)	*	*
Remark: * Value of 5 ug/L, Category C applies to each trichlorobenzene individually. Value of 10 ug/L, Category B applies to the sum of these substances.		
1,1,1-Trichloroethane (71-55-6)	5	C
1,1,2-Trichloroethane (79-00-5)	1	A
Trichloroethene (79-01-6)	5	A
Trichlorofluoromethane (75-69-4)	5	C
2,4,5-Trichlorophenoxyacetic acid (93-76-5)	35	A
2,4,5-Trichlorophenoxypropionic acid (93-72-1)	0.26	A
1,1,2-Trichloropropane (598-77-6)	5	C
1,2,3-Trichloropropane (96-18-4)	0.04	A
cis-1,2,3-Trichloropropene (13116-57-9)	5	C
trans-1,2,3-Trichloropropene (13116-58-0)	5	C
alpha,2,4-Trichlorotoluene (94-99-5)	5	C
alpha,2,6-Trichlorotoluene (2014-83-7)	5	C
alpha,3,4-Trichlorotoluene (102-47-6)	5	C
alpha,alpha,2-Trichlorotoluene (88-66-4)	5	C
alpha,alpha,4-Trichlorotoluene (13940-94-8)	5	C

Table 5 (Continued)  
NEW YORK STATE GROUNDWATER EFFLUENT LIMITATIONS (CLASS GA)  
JUNE 1998

SUBSTANCE (CAS No.)	MAXIMUM ALLOWABLE CONCENTRATION (ug/L)	CATEGORY
2,3,4-Trichlorotoluene (7359-72-0)	5	C
2,3,5-Trichlorotoluene (56961-86-5)	5	C
2,3,6-Trichlorotoluene (2077-46-5)	5	C
2,4,5-Trichlorotoluene (6639-30-1)	5	C
2,4,6-Trichlorotoluene (23749-65-7)	5	C
1,1,1-Trichloro-2,2,2-trifluoroethane (354-58-5)	5	C
1,1,2-Trichloro-1,2,2-trifluoroethane (76-13-1)	5	C
Trifluralin (1582-09-8)	35	A
1,2,3-Trimethylbenzene (526-73-8)	5	C
1,2,4-Trimethylbenzene (95-63-6)	5	C
1,3,5-Trimethylbenzene (108-67-8)	5	C
2,3,6-Trimethylpyridine (1462-84-6)	50	B
2,4,6-Trimethylpyridine (108-75-8)	50	B
sym-Trinitrobenzene (99-35-4)	5	C
2,3,4-Trinitrotoluene (602-29-9)	5	C
2,3,6-Trinitrotoluene (18292-97-2)	5	C
2,4,5-Trinitrotoluene (610-25-3)	5	C
2,4,6-Trinitrotoluene (118-96-7)	5	C
3,4,5-Trinitrotoluene (603-15-6)	5	C
Triphenyl phosphate (115-86-6)	50	B
Uranyl ion (CAS No. Not Applicable)	10,000	C
Vinyl chloride (75-01-4)	2	A
1,2-Xylene (95-47-6)	5	C
1,3-Xylene (108-38-3)	5	C
1,4-Xylene (106-42-3)	5	C
Zinc (CAS No. Not Applicable)	5,000	A
Zineb (12122-67-7)	1.8	A
Ziram (137-30-4)	4.2	A

**INDEX OF TOGS 1.1.1 TABLE 1, 3 AND 5 ENTRIES BY  
CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER**

JUNE 1998

- Notes: 1. This index refers to the user to Table 1, 3 or 5 of this TOGS. Entries within each Table are listed alphabetically. As this index indicates, a few entries are listed in both Tables 1 and 3. Substances in Table 1 with an ambient groundwater value also have a groundwater effluent limitation and are thus also listed in Table 5. The user is cautioned that not all substances included in "group" entries are individually listed in this index, and should read the text of Parts I and II of this TOGS.
2. Where an entry includes multiple substances, underlining identifies the specific substances that corresponds to the CAS number listed. Entries having no CAS number are indicated by "NA" (not applicable).
3. CAS numbers that represent groups of substances, including pairs of cis- and trans- isomers, may not be included in this index. The user may need to determine individual substances and CAS numbers.
4. Where entries in this index are separated by a semicolon, the table listings are also so separated and apply to the entry before and after the semicolon, respectively.

CAS Number	Entry	Table
NA	Alkyl diphenyl oxide sulfonates	1,5
NA	Aluminum, ionic; <u>Aluminum</u>	1;5
NA	Aminomethylene phosphonic acid salts	1,5
NA	Ammonia and <u>Ammonium</u>	1,5
NA	Antimony	1,5
NA	Arsenic	1,5
NA	Aryltriazoles	1,5
NA	Asbestos	1,5
NA	Barium	1,5
NA	Beryllium	1,5
NA	Boric acid, Borates and Metaborates	1,5
NA	Boron	1,5
NA	Bromide	1,5
NA	Butyl isopropyl phthalate	1,5
NA	Cadmium	1,5
NA	Chloramben	1,5
NA	Chloride	1,5
NA	Chlorinated dibenzo-p-dioxins and Chlorinated dibenzofurans	1,5

INDEX OF TOGS 1.1.1 TABLE 1, 3 AND 5 ENTRIES BY  
 CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
 JUNE 1998  
 (Continued)

CAS Number	Entry	Table
NA	Chlorine, Total Residual	1
NA	Chromium	1,5
NA	Chromium (hexavalent)	1,5
NA	Cobalt	1
NA	Copper	1,5
NA	Cyanide	1,5
NA	Dalapon	1,5
NA	Dissolved solids, total	5
NA	Fluoride	1,5
NA	Foaming agents	1,5
NA	Gross alpha radiation	1,5
NA	Gross beta radiation	1,5
NA	Iron; <u>Iron</u> and Manganese	1,5;1,5
NA	Isothiazolones, total; Isothiazolones	1;3
NA	Lead	1,5
NA	Linear alkylbenzene sulfonates (LAS)	1,3
NA	Magnesium	1,5
NA	Manganese; Iron and <u>Manganese</u>	1,5;1,5
NA	Mercury	1,5
NA	Methylbenz(a)anthracenes	1,5
NA	Nickel	1,5
NA	Nitrate (expressed as N); <u>Nitrate</u> and Nitrite (expressed as N)	1,5;1,5
NA	Nitrotriacetic acid	1,5
NA	Nitrite (expressed as N); Nitrate and <u>Nitrite</u> (expressed as N)	1,5;1,5
NA	Nitrogen, total (expressed as N)	5
NA	Oil and Grease	5
NA	Organic substances, total	5
NA	pH	5
NA	Phenolic compounds (total phenols)	1,5

INDEX OF TOGS 1.1.1 TABLE 1, 3 AND 5 ENTRIES BY  
 CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
 JUNE 1998  
 (Continued)

CAS Number	Entry	Table
NA	Phenols, total chlorinated	1,5
NA	Phenols, total unchlorinated	1,5
NA	Phosphorus	1
NA	Picloram	1,5
NA	Polybrominated biphenyls	1,5
NA	Polychlorinated biphenyls	1,5
NA	Principal organic contaminant	1,5
NA	Quaternary ammonium compounds	1,3
NA	Radium 226; <u>Radium 226</u> and Radium 228	1,5;1,5
NA	Radium 228; Radium 226 and <u>Radium 228</u>	1,5;1,5
NA	Selenium	1,5
NA	Silver	1,5
NA	Sodium	1,5
NA	Strontium 90	1
NA	Sulfate	1,5
NA	Sulfides, total; Sulfide	1,5
NA	Sulfite	1
NA	Thallium	1,5
NA	Tritium	1
NA	Uranyl ion	1,5
NA	Vanadium	1
NA	Zinc	1,5
50-00-0	Formaldehyde	3
50-29-3	p,p'-DDT	1,5
50-32-8	Benzo(a)pyrene	1,5
50-55-5	Reserpine	3
51-28-5	2,4-Dinitrophenol	1,5
52-51-7	Bronopol	3
52-85-7	Famphur	3

INDEX OF TOGS 1.1.1 TABLE 1, 3 AND 5 ENTRIES BY  
 CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
 JUNE 1998  
 (Continued)

CAS Number	Entry	Table
53-96-3	2-Acetylaminofluorene	3
55-18-5	N-Nitrosodiethylamine	3
55-70-3	Dibenz(a,h)anthracene	3
56-23-5	Carbon tetrachloride	1,5
56-35-9	Tributyltin oxide	1,5
56-38-2	Parathion; Parathion & Methyl parathion	1;1,5
56-49-5	3-Methylcholanthrene	3
56-55-3	Benz(a)anthracene	1,5
56-57-5	4-Nitroquinoline-1-oxide	3
57-14-7	1,1-Dimethylhydrazine	3
57-24-9	Strychnine	3
57-74-9	Chlordane	1,5
57-97-6	7, 12-Dimethylbenz(a)anthracene	3
58-55-6	Propylene glycol	3
58-55-9	Theophylline	1,5
58-89-9	gamma-Hexachlorocyclohexane	1,5
59-87-0	Nitrofurazone	3
59-89-2	N-Nitrosomorpholine	3
60-11-7	4-(Dimethylamino)azobenzene	3
60-29-7	Ethyl ether	3
60-51-5	Dimethoate	3
60-57-1	Aldrin and Dieldrin; Dieldrin	1;1,5
62-44-2	Phenacetin	3
62-50-0	Ethyl methane sulfonate	3
62-53-3	Aniline	1,5
62-56-6	Thiourea	3
62-75-9	N-Nitrosodimethylamine	3
63-25-2	Carbaryl	1,5
64-18-6	Formic acid	3

INDEX OF TOGS 1.1.1 TABLE 1, 3 AND 5 ENTRIES BY  
 CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
 JUNE 1998  
 (Continued)

CAS Number	Entry	Table
65-85-0	Benzoic acid	3
66-27-3	Methylmethanesulfonate	3
67-20-9	Nitrofurantoin	3
67-45-8	Furazolidone	3
67-56-1	Methanol	3
67-63-0	Isopropyl alcohol	3
67-64-1	Acetone	1,5
67-66-3	Chloroform	1,5
67-72-1	Hexachloroethane	1,5
68-12-2	Dimethylformamide	1,5
70-30-4	Hexachlorophene	1,5
70-55-3	4-Methyl benzene sulfonamide	3
71-23-8	1-Propanol	3
71-36-3	1-Butanol	3
71-43-2	Benzene	1,5
71-55-6	1,1,1-Trichloroethane	1,5
72-20-8	Endrin	1,5
72-43-5	Methoxychlor	1,5
72-54-8	p,p'-DDD	1,5
72-55-9	p,p'-DDE	1,5
74-11-3	4-Chlorobenzoic acid	3
74-83-9	Bromomethane	1,5
74-87-3	Methyl chloride	1,5
74-88-4	Methyl iodide	1,5
74-89-5	Methylamine	3
74-95-3	Dibromomethane	1,5
74-97-5	Bromochloromethane	1,5
75-00-3	Chloroethane	1,5
75-01-4	Vinyl chloride	1,5

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CAS Number	Entry	Table
75-05-8	Acetonitrile	3
75-09-2	Methylene chloride	1,5
75-15-0	Carbon disulfide	3
75-21-8	Ethylene oxide	1,5
75-25-2	Bromoform	1,5
75-27-4	Bromodichloromethane	1,5
75-31-0	Isopropylamine	3
75-34-3	1,1-Dichloroethane	1,5
75-35-4	1,1-Dichloroethene	1,5
75-43-4	Dichlorofluoromethane	1,5
75-56-9	Propylene oxide	3
75-60-5	Cacodylic acid	3
75-65-0	tert-Butyl alcohol	3
75-69-4	Trichlorofluoromethane	1,5
75-71-8	Dichlorodifluoromethane	1,5
75-86-5	Acetone cyanohydrin	3
75-87-6	Chloral	3
76-01-7	Pentachloroethane	1,5
76-03-9	Trichloroacetic acid	3
76-12-0	1,2-Difluoro-1,1,2,2-tetrachloroethane	1,5
76-13-1	1,1,2-Trichloro-1,2,2-trifluoroethane	1,5
76-44-8	Heptachlor	1,5
77-47-4	Hexachlorocyclopentadiene	1,5
77-58-7	Dibutyltin dilaurate	3
77-73-6	Dicyclopentadiene	3
78-00-2	Tetraethyl lead	3
78-59-1	Isophorone	1,5
78-83-1	Isobutyl alcohol	3
78-87-5	1,2-Dichloropropane	1,5

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 CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
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CAS Number	Entry	Table
78-93-3	Methyl ethyl ketone	1,5
78-99-9	1,1-Dichloropropane	1,5
79-00-5	1,1,2-Trichloroethane	1,5
79-01-6	Trichloroethene	1,5
79-06-1	Acrylamide	1,5
79-10-7	Acrylic acid	1,5
79-11-8	Chloroacetic acid	3
79-20-9	Methyl acetate	3
79-34-5	1,1,2,2-Tetrachloroethane	1,5
79-39-0	Methacrylamide	3
79-41-4	Methacrylic acid	1,5
79-43-6	Dichloroacetic acid	3
79-45-8	Dimethyldithiocarbamate	3
79-46-9	2-Nitropropane	3
80-15-9	Isopropylbenzene hydroperoxide	3
80-62-6	Methyl methacrylate	1,5
81-81-2	Warfarin	3
82-68-8	Pentachloronitrobenzene	1,5
83-32-9	Acenaphthene	1,5
83-79-4	Rotenone	3
84-66-2	Diethyl phthalate	1,5
84-74-2	Di-n-butylphthalate	1,5
85-00-7	See 2764-72-9	
85-01-8	Phenanthrene	1,5
85-44-9	1,3-Isobenzofurandione	3
85-68-7	Butyl benzyl phthalate	1,5
86-30-6	N-Nitrosodiphenylamine	1,5
86-50-0	Azinphosmethyl	1,5
86-73-7	Fluorene	1,5

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CAS Number	Entry	Table
86-74-8	Carbazole	3
87-41-2	1(3H)-Isobenzofuranone	3
87-59-2	2,3-Dimethylaniline	1,5
87-61-6	Trichlorobenzenes (1,2,3-)	1,5
87-62-7	2,6-Dimethylaniline	1,5
87-68-3	Hexachlorobutadiene	1,5
87-86-5	Pentachlorophenol	1,5
88-19-7	2-Methyl benzene sulfonamide	3
88-66-4	alpha, alpha,2-Trichlorotoluene	1,5
88-72-2	2-Nitrotoluene	1,5
88-73-3	2-Chloronitrobenzene	1,5
88-74-4	2-Nitroaniline	1,5
88-85-7	Dinoseb	1,5
91-20-3	Naphthalene	1,5
91-22-5	Quinoline	3
91-57-6	2-Methylnaphthalene	1,3
91-58-7	2-Chloronaphthalene	1,5
91-59-8	2-Naphthylamine	3
91-80-5	Methapyrilene	3
91-94-1	3,3'-Dichlorobenzidine	1,5
92-52-4	1,1'-Biphenyl	1,5
92-67-1	4-Aminobiphenyl	1,5
92-87-5	Benzidine	1,5
93-14-1	Guaifenesin	1,5
93-65-2	2-(4-Chloro-2-methylphenoxy)propionic acid	3
93-72-1	2,4,5-Trichlorophenoxypropionic acid	1,5
93-76-5	2,4,5-Trichlorophenoxyacetic acid	1,5
94-59-7	Safrole	3
94-74-6	2-Methyl-4-chlorophenoxyacetic acid	1,5

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CAS Number	Entry	Table
94-75-7	2,4-Dichlorophenoxyacetic acid	1,5
94-81-5	4-(4-Chloro-2-methylphenoxy)butyric acid	3
94-82-6	2,4-DB	3
94-99-5	alpha,2,4-Trichlorotoluene	1,5
95-47-6	1,2-Xylene	1,5
95-49-8	2-Chlorotoluene	1,5
95-50-1	Dichlorobenzenes (1,2-)	1,5
95-51-2	2-Chloroaniline	1,5
95-53-4	o-Toluidine	1,5
95-54-5	1,2-Phenylenediamine	1,5
95-63-6	1,2,4-Trimethylbenzene	1,5
95-64-7	3,4-Dimethylaniline	1,5
95-68-1	2,4-Dimethylaniline	1,5
95-69-2	4-Chloro-o-toluidine	1,5
95-70-5	Toluene-2,5-diamine	1,5
95-73-8	2,4-Dichlorotoluene	1,5
95-75-0	3,4-Dichlorotoluene	1,5
95-78-3	2,5-Dimethylaniline	1,5
95-79-4	5-Chloro-o-toluidine	1,5
95-80-7	Toluene-2,4-diamine	1,5
95-84-1	Aminocresols (2-Amino-para-cresol)	1,5
95-93-2	1,2,4,5-Tetramethylbenzene	1,5
95-94-3	Tetrachlorobenzenes (1,2,4,5-)	1,5
96-12-8	1,2-Dibromo-3-chloropropane	1,5
96-18-4	1,2,3-Trichloropropane	1,5
96-19-5	See 13116-57-9 and 13116-58-0	
96-33-3	Methylacrylate	3
96-37-7	Methylcyclopentane	3
96-45-7	Ethylenethiourea	1,5

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CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
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CAS Number	Entry	Table
97-63-2	Ethyl methacrylate	3
98-01-1	Furfural	3
98-06-6	tert-Butylbenzene	1,5
98-07-7	alpha, alpha, alpha-Trichlorotoluene	3
98-56-6	4-Chlorobenzotrifluoride	1,5
98-82-8	Isopropylbenzene	1,5
98-83-9	alpha-Methylstyrene	1,5
98-86-2	Acetophenone	3
98-87-3	alpha, alpha-Dichlorotoluene	3
98-92-0	Niacinamide	1,5
98-95-3	Nitrobenzene	1,5
99-04-7	3-Methylbenzoic acid	3
99-08-1	3-Nitrotoluene	1,5
99-09-2	3-Nitroaniline	1,5
99-35-4	sym-Trinitrobenzene	1,5
99-55-8	5-Nitro-o-toluidine	1,5
99-59-2	2-Methoxy-5-nitroaniline	3
99-62-7	1,3-Diisopropylbenzene	1,5
99-65-0	1,3-Dinitrobenzene	1,5
99-87-6	4-Isopropyltoluene	1,5
99-99-0	4-Nitrotoluene	1,5
100-00-5	4-Chloronitrobenzene	1,5
100-01-6	4-Nitroaniline	1,5
100-18-5	1,4-Diisopropylbenzene	1,5
100-37-8	2-(Diethylamino)ethanol	3
100-41-4	Ethylbenzene	1,5
100-42-5	Styrene	1,5
100-44-7	Benzyl chloride	3
100-51-6	Benzyl alcohol	3

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CAS Number	Entry	Table
100-52-7	Benzaldehyde	3
100-61-8	N-Methylaniline	1,5
100-63-0	Phenyldiazine	1,5
100-64-1	Cyclohexanone oxime	3
100-66-3	Anisole	3
100-75-4	N-Nitrosopiperidine	3
100-80-1	3-Methylstyrene	1,5
101-14-4	4,4'-Methylene-bis-(2-chloroaniline)	1,5
101-55-3	4-Bromophenylphenylether	3
101-61-1	4,4'-Methylene-bis-(N,N'-dimethyl)aniline	1,5
101-84-8	Phenyl ether	1,5
102-47-6	alpha, 3,4-Trichlorotoluene	1,5
103-23-1	Di(2-ethylhexyl)adipate	1,5
103-33-3	Azobenzene	1,5
103-65-1	n-Propylbenzene	1,5
103-82-2	Benzeneacetic acid	3
104-51-8	n-Butylbenzene	1,5
104-87-0	4-Methylbenzaldehyde	3
105-11-3	1,4-Quinone dioxide	3
105-60-1	Caprolactam	3
105-67-9	2,4-Dimethylphenol	1,5
106-37-6	1,4-Dibromobenzene	1,5
106-42-3	1,4-Xylene	1,5
106-43-4	4-Chlorotoluene	1,5
106-46-7	Dichlorobenzenes (1,4-)	1,5
106-47-8	4-Chloroaniline	1,5
106-49-0	4-Aminotoluene	1,5
106-50-3	1,4-Phenylenediamine	1,5
106-89-8	Epichlorohydrin	3

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 CHEMICAL ABSTRACTS SERVICE REGISTRY (CAS) NUMBER  
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CAS Number	Entry	Table
106-93-4	Ethylene dibromide	1,5
107-02-8	Acrolein	1,5
107-05-1	Allyl chloride	1,5
107-06-2	1,2-Dichloroethane	1,5
107-07-3	Ethylene chlorohydrin	1,5
107-12-0	Propionitrile	3
107-13-1	Acrylonitrile	1,5
107-18-6	Allyl alcohol	3
107-21-1	Ethylene glycol	1,5
107-30-2	Chloromethyl methyl ether	1,5
108-05-4	Vinyl acetate	3
108-10-1	4-Methyl-2-pentanone	3
108-18-9	Diisopropylamine	3
108-20-3	Diisopropyl ether	3
108-31-6	Maleic anhydride	3
108-36-1	1,3-Dibromobenzene	1,5
108-38-3	1,3-Xylene	1,5
108-41-8	3-Chlorotoluene	1,5
108-42-9	3-Chloroaniline	1,5
108-44-1	3-Aminotoluene	1,5
108-45-2	1,3-Phenylenediamine	1,5
108-60-1	Bis(2-chloro-1-methylethyl)ether	1,5
108-67-8	1,3,5-Trimethylbenzene	1,5
108-69-0	3,5-Dimethylaniline	1,5
108-70-3	Trichlorobenzenes (1,3,5-)	1,5
108-75-8	2,4,6-Trimethylpyridine	1,5
108-86-1	Bromobenzene	1,5
108-88-3	Toluene	1,5
108-90-7	Chlorobenzene	1,5

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CAS Number	Entry	Table
108-91-8	Cyclohexylamine	3
108-93-0	Cyclohexanol	3
108-94-1	Cyclohexanone	3
108-95-2	Phenol	1,5
109-06-8	alpha-Picoline	3
109-69-3	1-Chlorobutane	1,5
109-77-3	Malononitrile	3
109-78-4	Ethylene cyanohydrin	3
109-86-4	2-Methoxyethanol	3
109-89-7	Diethylamine	3
109-99-9	Tetrahydrofuran	1,5
110-00-9	Furan	3
110-49-6	2-Methoxyethanol acetate	3
110-54-3	n-Hexane	3
110-57-6	trans-1,4-Dichloro-2-butene	1,5
110-75-8	2-Chloroethyl vinyl ether	3
110-80-5	2-Ethoxyethanol	3
110-82-7	Cyclohexane	3
110-83-8	Cyclohexene	3
110-86-1	Pyridine	1,5
111-15-9	2-Ethoxyethanol acetate	3
111-44-4	Bis(2-chloroethyl)ether	1,5
111-46-6	Diethylene glycol	3
111-70-6	1-Heptanol	3
111-90-0	Diethylene glycol monoethyl ether	3
111-91-1	Bis(2-chloroethoxy)methane	1,5
112-31-2	Decanal	3
112-34-5	Butoxyethoxyethanol	1,5
115-07-1	1-Propene	3

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CAS Number	Entry	Table
115-29-7	Endosulfan	1,3
115-86-6	Triphenyl phosphate	1,5
116-06-3	Aldicarb; Aldicarb and Methomyl	1,5
117-80-6	2,3-Dichloro-1,4-naphthoquinone	3
117-81-7	Bis(2-ethylhexyl)phthalate	1,5
117-84-0	Di-n-octyl phthalate	1,5
118-69-4	2,6-Dichlorotoluene	1,5
118-74-1	Hexachlorobenzene	1,5
118-75-2	Chloranil	1,5
118-90-1	2-Methylbenzoic acid	3
118-96-7	2,4,6-Trinitrotoluene	1,5
119-90-4	3,3'-Dimethoxybenzidine	3
119-93-7	3,3'-Dimethylbenzidine	1,5
120-12-7	Anthracene	1,5
120-58-1	Isosafrole	3
120-61-6	Dimethylterephthalate	3
120-82-1	Trichlorobenzenes (1,2,4-)	1,5
120-83-2	2,4-Dichlorophenol	1,5
120-92-3	Cyclopentanone	3
121-14-2	2,4-Dinitrotoluene	1,5
121-44-8	Triethylamine	3
121-69-7	N,N-Dimethylaniline	1,5
121-73-3	3-Chloronitrobenzene	1,5
121-75-5	Malathion	1,5
121-82-4	Cyclotrimethylenetrinitramine	3
122-09-8	alpha, alpha-Dimethyl phenethylamine	1,5
122-34-9	Simazine	1,5
122-39-4	Diphenylamine	1,5
122-42-9	Propham	1,5

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CAS Number	Entry	Table
122-66-7	Diphenylhydrazines (1,2-); 1,2-Diphenylhydrazine	1,5
123-31-9	Hydroquinone	1,5
123-33-1	Maleic hydrazide	3
123-73-9	trans-2-Butenal	1,5
123-91-1	1,4-Dioxane	3
124-09-4	Hexamethylene diamine	3
124-19-6	Nonanal	3
124-40-3	Dimethylamine	3
124-48-1	Dibromochloromethane	1,5
126-39-6	2-Methylethyl-1,3-dioxolane	1,5
126-68-1	o,o,o-Triethylphosphorothioate	3
126-75-0	Demeton (-S)	1
126-98-7	Methacrylonitrile	1,5
126-99-8	Chloroprene	1,5
127-18-4	Tetrachloroethene	1,5
129-00-0	Pyrene	1,5
130-15-4	1,4-Naphthoquinone	3
131-11-3	Dimethyl phthalate	1,5
132-64-9	Dibenzofuran	3
133-06-2	Captan	1,5
133-07-3	Folpet	1,5
134-32-7	1-Naphthylamine	3
135-98-8	sec-Butylbenzene	1,5
136-25-4	Pentamate	3
137-26-8	Thiram	1,5
137-30-4	Ziram	1,5
138-86-3	1-Methyl-4-(1-methylethanyl)cyclohexene	3
139-40-2	Propazine	1,5
140-57-8	Aramite	3

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CAS Number	Entry	Table
140-88-5	Ethyl acrylate	3
141-05-9	Diethyl maleate	3
141-78-6	Ethyl acetate	3
142-28-9	1,3-Dichloropropane	1,5
142-59-6	Nabam	1,5
142-82-5	n-Heptane	3
143-07-7	Dodecanoic acid	3
143-08-8	1-Nonanol	3
143-50-0	Kepone	1,5
145-73-3	Endothall	1,5
148-18-5	Sodium diethyldithiocarbamate	3
149-30-4	Mercaptobenzothiazole	1,5
152-16-9	Octamethylpyrophosphoramine	3
156-59-2	cis-1,2-Dichloroethene	1,5
156-60-5	trans-1,2-Dichloroethene	1,5
191-24-2	Benzo(g,h,i)perylene	3
192-97-2	Benzo(e)pyrene	3
193-39-5	Indeno (1,2,3-cd)pyrene	1,5
205-99-2	Benzo(b)fluoranthene	1,5
206-44-0	Fluoranthene	1,5
207-08-9	Benzo(k)fluoranthene	1,5
208-96-8	Acenaphthylene	3
218-01-9	Chrysene	1,5
271-61-4	Benzisothiazole	1,5
297-97-2	o,o-Diethyl-o-2-pyrazinyl phosphorothioate	3
298-00-0	Parathion & Methyl parathion	1,5
298-02-2	Phorate & Disulfoton	1,5
298-03-3	Demeton (-o)	1
298-04-4	Phorate & Disulfoton	1,5

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CAS Number	Entry	Table
299-84-3	Ronnel	3
302-01-2	Hydrazine	1,3
309-00-2	Aldrin; Aldrin & Dieldrin	1,5;1
314-40-9	Bromacil	1,5
319-84-6	alpha-Hexachlorocyclohexane	1,5
319-85-7	beta-Hexachlorocyclohexane	1,5
319-86-8	delta-Hexachlorocyclohexane	1,5
328-84-7	3,4-Dichlorobenzotrifluoride	1,5
330-55-2	Linuron	3
333-41-5	Diazinon	1,5
354-58-5	1,1,1-Trichloro-2,2,2-trifluoroethane	1,5
460-35-5	3-Chloro-1,1,1-trifluoropropane	1,5
462-08-8	Aminopyridines (3-)	1,5
465-73-6	Isodrin	1,5
479-18-5	Dyphylline	1,5
488-23-3	1,2,3,4-Tetramethylbenzene	1,5
501-52-0	Benzenepropanoic acid	3
504-24-5	Aminopyridines (4-)	1,5
504-29-0	Aminopyridines (2-)	1,5
506-68-3	Cyanogen bromide	1,5
506-77-4	Cyanogen chloride	1,5
510-15-6	Chlorobenzilate	3
512-56-1	Trimethyl phosphate	3
515-30-0	alpha-Hydroxy-alpha-methylbenzeneacetic acid	3
526-73-8	1,2,3-Trimethylbenzene	1,5
527-53-7	1,2,3,5-Tetramethylbenzene	1,5
527-84-4	2-Isopropyltoluene	1,5
529-20-4	2-Methylbenzaldehyde	3

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CAS Number	Entry	Table
530-50-7	Diphenylhydrazines (1,1-); 1,1-Diphenylhydrazine	1,5
531-82-8	Furium	3
535-77-3	3-Isopropyltoluene	1,5
538-39-6	4,4'-Dimethylbibenzyl	1,5
540-73-8	1,2-Dimethylhydrazine	3
541-73-1	Dichlorobenzenes (1,3-)	1,5
542-75-6	1,3-Dichloropropene (sum of cis- and trans-)	1,5
542-88-1	Bis(chloromethyl)ether	1,5
543-49-7	2-Heptanol	3
563-12-2	Ethion	3
563-58-6	1,1-Dichloropropene	1,5
577-55-9	1,2-Diisopropylbenzene	1,5
583-53-9	1,2-Dibromobenzene	1,5
584-84-9	Toluene diisocyanate	3
589-18-4	4-Methylbenzenemethanol	3
589-38-8	3-Hexanone	3
589-55-9	4-Heptanol	3
589-82-2	3-Heptanol	3
589-93-5	2,5-Lutidine	3
591-78-6	2-Hexanone	1,5
594-18-3	Dibromodichloromethane	1,5
594-20-7	2,2-Dichloropropane	1,5
597-64-8	Tetraethyl tin	3
598-77-6	1,1,2-Trichloropropane	1,5
602-01-7	2,3-Dinitrotoluene	1,5
602-29-9	2,3,4-Trinitrotoluene	1,5
603-15-6	3,4,5-Trinitrotoluene	1,5
606-20-2	2,6-Dinitrotoluene	1,5
608-73-1	See 58-89-9; 319-84-6; 319-85-7; 319-86-8; and 6108-10-7	

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608-93-5	Pentachlorobenzene	1,5
610-25-3	2,4,5-Trinitrotoluene	1,5
610-39-9	3,4-Dinitrotoluene	1,5
611-15-4	2-Methylstyrene	1,5
613-12-7	2-Methylanthracene	3
615-54-3	1,2,4-Tribromobenzene	1,5
617-84-4	Diethyl formamide	3
617-94-7	Dimethylphenylcarbinol	3
618-85-9	3,5-Dinitrotoluene	1,5
619-15-8	2,5-Dinitrotoluene	1,5
620-23-5	3-Methylbenzaldehyde	3
621-64-7	N-Nitrosodipropylamine	3
622-97-9	4-Methylstyrene	1,5
625-86-5	2,5-Dimethylfuran	3
627-26-9	trans-2-Butenenitrile	1,5
630-20-6	1,1,1,2-Tetrachloroethane	1,5
634-66-2	Tetrachlorobenzenes (1,2,3,4-)	1,5
634-90-2	Tetrachlorobenzenes (1,2,3,5-)	1,5
634-93-5	2,4,6-Trichloroaniline	1,5
637-50-3	3-Phenyl-1-propene	1,5
643-79-8	1,2-Benzenedicarboxaldehyde	3
683-18-1	Dibutyltin chloride	3
684-93-5	N-Nitroso-N-methyl urea	3
709-98-8	Propanil	1,5
759-96-4	Ethyl di-n-propylthiocarbamate (EPTC)	3
764-41-0	See 1476-11-5 and 110-57-6	
765-34-4	Glycidaldehyde	3
766-90-5	cis-1-Phenyl-1-propene	1,5
767-58-8	2,3-Dihydro-1-methyl-1H-indene	3

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834-12-8	Ametryn	1,5
873-66-5	trans-1-Phenyl-1-propene	1,5
873-94-9	3,3,5-Trimethylcyclohexanone	3
923-02-4	Methylolmethacrylamide	3
924-16-3	N-Nitrosodi-N-butylamine	3
930-55-2	N-Nitrosopyrrolidine	3
957-51-7	Diphenamid	1,5
959-98-8	Endosulfan I	3
1024-57-3	Heptachlor epoxide	1,5
1031-07-8	Endosulfan sulfate	3
1071-83-6	Glyphosate	1,5
1114-71-2	Pebulate	3
1122-60-7	Nitrocyclohexane	3
1163-19-5	Bis(pentabromophenyl)ether	3
1190-76-7	cis-2-Butenenitrile	1,5
1321-12-6	See 88-72-2; 99-08-1 and 99-99-0	
1330-20-7	See 95-47-6; 106-42-3 and 108-38-3	
1462-84-6	2,3,6-Trimethylpyridine	1,5
1476-11-5	cis-1,4-Dichloro-2-butene	1,5
1563-66-2	Carbofuran	1,5
1582-09-8	Trifluralin	1,5
1589-49-7	Propylene glycol monomethyl ether	3
1610-18-0	Prometon	1,5
1634-04-4	Methyl tert-butyl ether	3
1646-87-3	Aldicarb sulfoxide	1,5
1646-88-4	Aldicarb sulfone	1,5
1702-17-6	Clopyralid	3
1807-55-2	4,4'-Methylene-bis-(N-methyl)aniline	1,5

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1861-40-1	Benefin	1,5
1863-63-4	Benzoic acid, ammonium salt	3
1875-92-9	Dimethylbenzylammonium chloride	3
1888-71-7	Hexachloropropene	1,5
1897-45-6	Chlorothalonil	1,5
1912-24-9	Atrazine	1,5
1918-00-9	Dicamba	1,5
1918-16-7	Propachlor	1,5
1929-77-7	Vernolate	3
2008-41-5	Butylate	1,5
2014-83-7	alpha, 2,6-Trichlorotoluene	1,5
2077-46-5	2,3,6-Trichlorotoluene	1,5
2104-96-3	Bromophos	3
2136-79-0	Tetrachloroterephthalic acid	1,5
2164-17-2	Fluometuron	1,5
2207-04-7	trans-1,4-Dimethyl cyclohexane	3
2212-67-1	Molinate	3
2303-16-4	Diallate	3
2303-17-5	Triallate	3
2385-85-5	Mirex	1,5
2425-06-1	Captafol	3
2439-10-3	Dodecylguanidine acetate and Dodecylguanidine hydrochloride	1,5
2641-56-7	Diethyltin dycaprylate	3
2764-72-9	Diquat	1,5
2809-21-4	1-Hydroxyethylidene-1,1-diphosphonic acid	1,5
2835-95-2	Aminocresols (5-Amino-ortho-cresol)	1,5
2835-99-6	Aminocresols (4-Amino-meta-cresol)	1,5
2921-88-2	Chlorpyrifos	3

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3252-43-5	2,2-Dibromo-3-nitropropionamide & Dibromoacetonitrile; Dibromoacetonitrile	1,3
3558-60-9	(2-Methoxyethyl)benzene	1,5
3689-24-5	Tetraethyl dithiopyrophosphate	3
4013-34-7	(1-Methoxyethyl)benzene	1,5
4170-30-3	See 123-73-9 and 15798-64-8	
4376-18-5	Methylphthalate	3
4685-14-7	Paraquat	1,5
4726-14-1	Nitralin	1,5
4786-20-3	See 1190-76-7 and 627-26-9	
4957-14-6	4,4'-Dimethyldiphenylmethane	1,5
5131-66-8	Butoxypropanol	1,5
5197-80-8	Dimethylethylbenzylammonium chloride	3
5216-25-1	alpha, alpha, alpha, 4-Tetrachlorotoluene	1,5
5234-68-4	Carboxin	1,5
5902-51-2	Terbacil	1,5
6108-10-7	epsilon-Hexachlorocyclohexane	1,5
6317-18-6	Methylene bithiocyanate	1,5
6639-30-1	2,4,5-Trichlorotoluene	1,5
7005-72-3	4-Chlorophenyl phenyl ether	3
7359-72-0	2,3,4-Trichlorotoluene	1,5
7421-93-4	Endrin aldehyde	1,5
7486-38-6	Sodium adipate, disodium salt	3
7664-41-7	Ammonia and Ammonium	1,5
7783-06-4	Hydrogen sulfide	1,5
8001-35-2	Toxaphene	1,5
8018-01-7	Mancozeb	1,5
8065-48-3	Demeton	1,3
9003-27-4	Polybutene(1-propene, 2-methyl homopolymer)	3
10061-01-5	see 542-75-6	

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10061-02-6	see 542-75-6	
10222-01-2	2,2-Dibromo-3-nitropropionamide & Dibromoacetonitrile	1,5
10595-95-6	N-Nitrosomethylethylamine	3
12002-48-1	Trichlorobenzenes	1,5
12122-67-7	Zineb	1,5
12408-10-5	Tetrachlorobenzenes	1,5
12427-38-2	Maneb	1,5
13071-79-9	Terbufos	1,5
13116-57-9	cis-1,2,3-Trichloropropene	1,5
13116-58-0	trans-1,2,3-Trichloropropene	1,5
13560-89-9	Dechlorane Plus	1,5
13590-97-1	Dodecylguanidine acetate and Dodecylguanidine hydrochloride	1,5
13940-94-8	alpha, alpha, 4-Trichlorotoluene	1,5
14484-64-1	Ferbam	1,5
14838-15-4	Phenylpropanolamine	1,5
15798-64-8	cis-2-Butenal	1,5
15972-60-8	Alachlor	1,5
16655-82-6	3-Hydroxycarbofuran	3
16752-77-5	Aldicarb & Methomyl	1,5
17059-48-2	2,3-Dihydro-1,6-dimethyl-1H-indene	3
18292-97-2	2,3,6-Trinitrotoluene	1,5
19089-47-5	Propylene glycol monoethyl ether	3
19398-61-9	2,5-Dichlorotoluene	1,5
21087-64-9	Metribuzin	1,5
21564-17-0	2-(Thiocyanomethylthio)benzothiazole	3
21725-46-2	Cyanazine	3
23135-22-0	Oxamyl	1,5
23184-66-9	Butachlor	1,5
23749-65-7	2,4,6-Trichlorotoluene	1,5

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23950-58-5	Pronamide	3
25056-70-6	Hexanate	3
25136-55-4	Dimethyldioxane	3
25154-54-5*	See 99-65-0	
25167-93-5	See 88-73-3; 100-00-5 and 121-73-3	
25168-05-2	See 95-49-8; 106-43-4 and 108-41-8	
25186-47-4	3,5-Dichlorotoluene	1,5
25265-76-3	See 95-54-5; 106-50-3 and 108-45-2	
25321-09-9	See 99-62-7; 100-18-5 and 577-55-9	
25321-14-6	See 121-14-2; 602-01-7; 606-20-2; 610-39-9; 618-85-9 and 619-15-8	
25321-22-6	See 95-50-1; 106-46-7 and 541-73-1	
25551-13-7	See 95-63-6; 108-67-8 and 526-73-8	
25973-55-1	2-(2-Hydroxy-3,5-di-tert-pentylphenyl)benzotriazole	1,5
26399-36-0	Profluralin	3
26445-05-6	Aminopyridines	1,5
26523-64-8	See 76-13-1 and 354-58-5	
27134-26-5	See 95-51-2; 106-47-8 and 108-42-9	
29082-74-4	Octachlorostyrene	1,5
29091-21-2	Prodiamine	3
29385-43-1	Tolyltriazole	1,5
29611-84-5*	See 108-75-8 and 1462-84-6	
29761-21-5	Isodecyl diphenyl phosphate	1,3
29797-40-8	See 95-73-8; 95-75-0; 118-69-4; 19398-61-9; 25186-47-4 and 32768-54-0	
30560-19-1	Acephate	3
31600-69-8	4-(1-Methylethoxy)-1-butanol	1,5
32768-54-0	2,3-Dichlorotoluene	1,5
33213-65-9	Endosulfan II	3
33820-53-0	Isopropalin	1,5
34014-18-1	Tebuthiuron	1,5

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35448-14-7	Oxalic acid, benzyl ester	3
37299-86-8	Rhodamine WT	3
39196-18-4	Thiofanox	3
40487-42-1	Pendimethalin	1,5
51218-45-2	Metolachlor	3
51235-04-2	Hexazinone	1,5
53494-70-5	Endrin ketone	1,5
56961-86-5	2,3,5-Trichlorotoluene	1,5
68391-01-5	Alkyl dimethyl benzyl ammonium chloride	1,5
95266-40-3	Cimectacarb	3
* This non-individual CAS number also refers to one or more individual substances that are not specifically listed in the table. These individual substances, however, may be encompassed by a group entry in Table 1 (for example, Principal Organic Contaminant or Phenolic Compounds). Refer to the text of Part I of this document for an explanation of group entries.		

s/s (6/17/98)  
N.G. Kaul, P.E.  
Director  
Division of Water

October 2006

Final NYSDOH CEH BEEI Soil Vapor Intrusion Guidance

**FINAL**

**Guidance for Evaluating Soil Vapor Intrusion  
in the State of New York**

October 2006

Prepared by:



**NEW YORK STATE DEPARTMENT OF HEALTH**  
Center for Environmental Health  
Bureau of Environmental Exposure Investigation

**Soil Vapor Intrusion Guidance Release History**

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February 2005 — Public comment draft

**Contact Information**

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**New York State Departments of Health and Environmental Conservation —  
Web Sites on Soil Vapor Intrusion**

This guidance, policy documents, training documents, fact sheets, etc. are available to the public on the following web sites:

*New York State Department of Health*  
[http://www.health.state.ny.us/environmental/indoors/vapor\\_intrusion](http://www.health.state.ny.us/environmental/indoors/vapor_intrusion)

*New York State Department of Environmental Conservation*  
<http://www.dec.state.ny.us/website/der/guidance/vapor/index.html>

As new information becomes available (e.g., revisions or amendments to the guidance, new fact sheets, etc.), these web sites will be updated accordingly.

## Preface

This guidance has been prepared by the New York State Department of Health (NYSDOH) in consultation with the New York State Department of Environmental Conservation (NYSDEC) — collectively referred to as "the State" throughout this document. It is intended as general guidance for parties evaluating soil vapor intrusion in the State of New York. The guidance is not a regulation, rule or requirement.

The guidance describes the State's methodology for evaluating soil vapor intrusion at a site. It reflects our experience in conducting soil vapor intrusion investigations and presents a reasonable and practical approach to identifying and addressing current and potential human exposures to contaminated subsurface vapors associated with known or suspected volatile chemical contamination. The approach presented is analogous to the approach taken when investigating contamination in other environmental media (e.g., groundwater, soil, etc.) and addressing corresponding exposure concerns.

The guidance is organized into five sections:

**Section 1** introduces the concept of soil vapor intrusion, associated human exposure issues, factors affecting soil vapor intrusion, factors affecting indoor air quality, and the general approach recommended to evaluating vapor intrusion;

**Section 2** provides guidance on collecting appropriate and relevant data that can be used to identify current or potential human exposures;

**Section 3** discusses how the investigation data are evaluated, recommends actions based on the evaluation, and presents tools that are used when determining appropriate actions to address exposures;

**Section 4** provides an overview of soil vapor intrusion mitigation methods and basic recommendations pertaining to their selection for use, installation and design, post-mitigation testing, operation, maintenance and monitoring, termination of operation, and annual certification; and

**Section 5** describes outreach techniques commonly used to inform the community about soil vapor intrusion issues.

The State recommends that the guidance be considered anywhere soil vapor intrusion is evaluated in the State of New York — whether the evaluation is undertaken voluntarily by a corporation, a municipality, or private citizen, or whether it is performed under one of the State's environmental remediation programs.

### PLEASE NOTE:

- While soil vapor intrusion can also occur with "naturally-occurring" subsurface gases (e.g., radon, methane and hydrogen sulfide), the document discusses soil vapor intrusion in terms of environmental contamination only.
- The guidance document addresses soil vapor intrusion. However, vapor intrusion can also occur through direct volatilization of contaminants from groundwater into indoor air. This can occur when, for example, a basement slab is in contact with contaminated groundwater, contaminated groundwater enters (floods) a basement or crawl space, or contaminated groundwater enters a sump pit drainage system. In such cases, volatile

chemicals can be transferred directly from groundwater to indoor air without the intervening contamination of soil vapor. Although exposures of this nature are not discussed in this guidance, they should be addressed on a site-specific and building-specific basis.

- Throughout the guidance references are made to specific brands of field equipment. These references are for discussion purposes only and are intended to be illustrative. They should not be interpreted as endorsements by the State of any one company or their products.

**ACRONYMNS and ABBREVIATIONS**

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ASTM	American Society for Testing and Materials	OM&M	Operation, Maintenance and Monitoring
ATSDR	Agency for Toxic Substance and Disease Registry	OSHA	Occupational Safety and Health Administration
BASE	Building Assessment and Survey Evaluation	OVM	Organic Vapor Monitor
BTSA	[NYSDOH] Bureau of Toxic Substance Assessment	PCBs	Polychlorinated Biphenyls
CME	Continuing Medical Education	PCE	Tetrachloroethene or Perchloroethylene
CSEMs	Case Studies in Environmental Medicine	PID	Photoionization Detector
DUSR	Data Usability Summary Report	QA/QC	Quality Assurance/Quality Control
ELAP	Environmental Laboratory Approval Program	RIOPA	Relationship of Indoor, Outdoor, and Personal Air
EPA	United States Environmental Protection Agency	SF <sub>6</sub>	Sulfur Hexafluoride
GC	Gas Chromatograph	SSD	Sub-slab Depressurization System
HEI	Health Effects Institute	SIM	Selective Ion Monitoring
HVAC	Heating, Ventilating and Air-conditioning	SMD	Sub-Membrane Depressurization
mcg/m <sup>3</sup>	micrograms per cubic meter	SVE	Soil Vapor Extraction
MeCl	Methylene Chloride	SVOCs	Semi-volatile Organic Compounds
MEK	Methyl Ethyl Ketone; 2-Butanone	TAL	Target Analyte List
MTBE	Methyl- <i>tert</i> -Butyl Ether	TCA	Trichloroethane
NAPL	Non-Aqueous Phase Liquid	TCDD	Tetrachlorodibenzo- <i>p</i> -Dioxin Equivalents
NYSDEC	New York State Department of Environmental Conservation	TCE	Trichloroethene
NYSDOH	New York State Department of Health	TCL	Target Compound List
		VOCs	Volatile Organic Compounds

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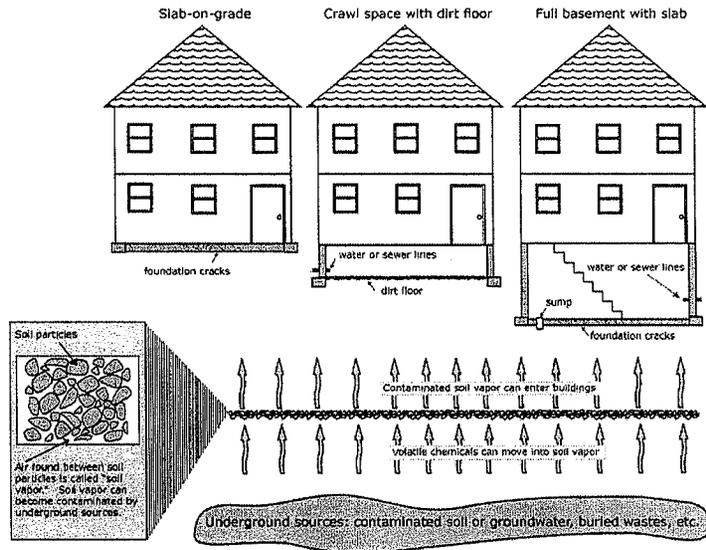
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**Section 1: Introduction**

This section introduces the concept of soil vapor intrusion, associated human exposure issues, factors affecting soil vapor intrusion, factors affecting indoor air quality, and the general approach to evaluating vapor intrusion.

**1.1 Soil vapor intrusion**

The phrase "soil vapor intrusion" refers to the process by which volatile chemicals migrate from a subsurface source into the indoor air of buildings. Soil vapor, also referred to as soil gas, is the air found in the pore spaces between soil particles (Figure 1.1). Primarily because of a difference between interior and exterior pressures, soil vapor can enter a building through cracks or perforations in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation. For example, heating, ventilation or air-conditioning (HVAC) systems and/or the operation of large mechanical appliances (e.g., exhaust fans, dryers, etc.) may create a negative pressure that can draw soil vapor into the building. This intrusion is similar to how radon gas enters buildings from the subsurface.



**Figure 1.1**  
Generalized diagram of soil vapor intrusion

Soil vapor can become contaminated when chemicals evaporate from subsurface sources. Chemicals that can emit vapors are called "volatile chemicals." Volatile chemicals include volatile organic compounds (VOCs), some semi-volatile organic compounds (SVOCs), and some inorganic substances such as elemental mercury. Subsurface sources of volatile chemicals can include the following:

- a. groundwater or soil that contains volatile chemicals;
- b. non-aqueous phase liquid (NAPL);
- c. buried wastes; and
- d. underground storage tanks or drums.

If soil vapor is contaminated and enters a building, indoor air quality may be affected.

When contaminated vapors are present in the zone directly next to or under the foundation of a building, vapor intrusion is possible. Soil vapor can enter a building whether the building is old or new, or whether it is on a slab or has a crawl space or basement (Figure 1.1). However, the subsurface source of the contaminated vapor (e.g., contaminated soil or groundwater) does not need to be directly beneath a structure to contaminate the vapor immediately beneath the building's foundation (as suggested in Figure 1.1).

**1.2 Soil vapor intrusion and human exposure**

Humans can be exposed to contaminated soil vapor when the vapor is drawn into the building due to pressure differences [Section 1.1] and mixed with the indoor air. Inhalation is the primary route of exposure, or the manner in which the volatile chemicals, once in the indoor air, actually enter the body.

Both current and potential exposures are considered when evaluating soil vapor intrusion at sites (i.e., locations of suspected or known environmental contamination). *Current* exposures exist when vapor intrusion is documented in an occupied building. *Potential* exposures exist when volatile chemicals are present in the vapor phase beneath a building, but have not affected indoor air quality due to current site conditions. Potential exposures also exist when there is a chance that contaminated soil vapors may move beneath existing buildings not currently affected, when indoor air is affected but the building is currently unoccupied, or when there is a chance that new buildings can be built over existing subsurface vapor contamination.

Exposure to a volatile chemical due to vapor intrusion does not necessarily mean that health effects will occur. Whether or not a person experiences health effects depends on several factors, including the length of exposure (short-term or acute versus long-term or chronic), the amount of exposure (i.e., dose), the frequency of exposure, the toxicity of the volatile chemical and the individual's sensitivity to the chemical.

**1.3 Factors affecting soil vapor migration and intrusion**

Predicting the extent of soil vapor contamination from soil or groundwater contamination, as well as the potential for human exposure from soil vapor intrusion into buildings, is complicated by factors that can affect soil vapor migration and intrusion. For example, soil vapor contaminant plumes may not mimic groundwater contaminant plumes since different factors affect the migration pattern of each medium. In addition to the operation of HVAC systems, the operation of kitchen vents in restaurants or of elevators in office buildings may

induce pressure gradients that result in the migration of vapor-phase contaminants away from a groundwater source of vapors and toward these buildings. This is similar to when the pumping of production wells or water supply wells draws contaminated groundwater away from its natural flow path.

Factors that can affect soil vapor migration and intrusion generally fall into two categories: environmental and building factors. Examples of environmental factors are provided in Table 1.1, and examples of building factors in Table 1.2. These factors are considered when conducting an investigation of the soil vapor intrusion pathway [Section 2] and when evaluating the results [Section 3].

**Table 1.1** Environmental factors that may affect soil vapor intrusion

Environmental Factor	Description
Soil conditions	Generally, dry, coarse-grained soils facilitate the migration of subsurface vapors and wet, fine-grained or highly organic soils retard migration.
Volatile chemical concentrations	The potential for vapor intrusion generally increases with increasing concentrations of volatile chemicals in groundwater or subsurface soils, as well as with the presence of NAPL.
Source location	The potential for vapor intrusion generally decreases with increasing distance between the subsurface source of vapor contamination and overlying buildings. For example, the potential for vapor intrusion associated with contaminated groundwater decreases with increasing depth to groundwater.
Groundwater conditions	Volatile chemicals dissolved in groundwater may off-gas to the vadose zone from the surface of the water table. If contaminated groundwater is overlain by clean water (upper versus lower aquifer systems or significant downward groundwater gradients), then vapor phase migration or partitioning of the volatile chemicals is unlikely. Additionally, fluctuations in the groundwater table may result in contaminant smear zones. The "smear zone" is the area of subsurface soil contamination within the range of depths where the water table fluctuates. Chemicals floating on top of the water table, such as petroleum components, can sorb onto soils within this zone as the water table fluctuates. Sorption of chemicals can influence their gaseous and aqueous phase diffusion in the subsurface, and ultimately the rate at which they migrate.
Surface confining layer	A surface confining layer (e.g., frost layer, pavement or buildings) may temporarily or permanently retard the migration of subsurface vapors to outdoor air. Confining layers can also prevent rainfall from reaching subsurface soils, creating relatively dry soils that further increase the potential for soil vapor migration.
Fractures in bedrock and/or tight clay soils	Fractures in bedrock and desiccation fractures in clay can increase the potential for vapor intrusion beyond that expected for the bulk, unfractured bedrock or clay matrix by facilitating vapor migration (in horizontal and vertical directions) and movement of contaminated groundwater along spaces between fractures.
Underground conduits	Underground conduits (e.g., sewer and utility lines, drains or tree roots, septic systems) with highly permeable bedding materials relative to native materials can serve as preferential pathways for vapor migration due to relatively low resistance to flow.
Weather conditions	Wind and barometric pressure changes and thermal differences between air and surrounding soils may induce pressure gradients that affect soil vapor intrusion.
Biodegradation processes	Depending upon environmental conditions (e.g., soil moisture, oxygen levels, pH, mineral nutrients, organic compounds, and temperature), the presence of appropriate microbial populations, and the degradability of the volatile chemical of concern, biodegradation in the subsurface may reduce the potential for vapor intrusion. For example, readily biodegradable chemicals in soil vapor may not migrate a significant distance from a source area while less degradable chemicals may travel farther.

**Table 1.2** Building factors that may affect vapor intrusion

Building Factor	Description
Operation of HVAC systems, fireplaces, and mechanical equipment (e.g., clothes dryers or exhaust fans/vents)	Operation may create a pressure differential between the building or indoor air and the surrounding soil that induces or retards the migration of vapor-phase contaminants toward and into the building. Vapor intrusion can be enhanced as the air vented outside is replaced.
Heated building	When buildings are closed up and heated, a difference in temperature between the inside and outdoor air induces a stack effect, venting warm air from higher floors to the outside. Vapor intrusion can be enhanced as the air is replaced in the lower parts of the building.
Air exchange rates	The rate at which outdoor air replenishes indoor air may affect vapor migration into a building as well the indoor air quality. For example, newer construction is typically designed to limit the exchange of air with the outside environment. This may result in the accumulation of vapors within a building.
Foundation type	Earthen floors and fieldstone walls may serve as preferential pathways for vapor intrusion.
Foundation integrity	Expansion joints or cold joints, wall cracks, or block wall cavities may serve as preferential pathways for vapor intrusion.
Subsurface features that penetrate the building's foundation	Foundation perforations for subsurface features (e.g., electrical, gas, sewer or water utility pipes, sumps, and drains) may serve as a preferential pathway for vapor intrusion.

#### 1.4 Factors affecting indoor air quality

Chemicals are a part of our everyday life. They are found in the household products we use and in items we bring into our homes. As such, chemicals are found in indoor air of homes not affected by intrusion of contaminated soil vapor. Examples of alternate sources of volatile chemicals in indoor air are given in Table 1.3. Similarly, volatile chemicals can be in the outdoor air that enters a home or place of business. Certain commercial and industrial facilities, such as gasoline stations and dry cleaners, and vehicle exhaust are examples of possible sources of volatile chemicals in outdoor air.

Commonly found concentrations of these chemicals in indoor and outdoor air are referred to as "background levels." These levels are generally determined from the results of samples collected in homes, offices and outdoor areas not known to be affected by external sources of volatile chemicals (for example, a home not known to be near a chemical spill, a hazardous waste site, a dry-cleaner, or a factory). Background sources of volatile chemicals are considered when conducting an investigation of the soil vapor intrusion pathway [Section 2] and when evaluating the results [Section 3].

**Table 1.3** Alternate sources of volatile chemicals in indoor air

Source	Description
Outdoor air	Outdoor sources of pollution can affect indoor air quality due to the exchange of outdoor and indoor air in buildings through natural ventilation, mechanical ventilation or infiltration. Outdoor sources of volatile compounds include automobiles, lawn mowers, oil storage tanks, dry cleaners, gasoline stations, industrial facilities, etc.
Attached or underground garages	Volatile chemicals from sources stored in the garage (e.g., automobiles, lawn mowers, oil storage tanks, gasoline containers, etc.) can affect indoor air quality due to the exchange of air between the garage and indoor space.
Off-gassing	Volatile chemicals may off-gas from building materials (e.g., adhesives or caulk), furnishings (e.g., new carpets or furniture), recently dry-cleaned clothing, or areas (such as floors or walls) contaminated by historical use of volatile chemicals in a building. Volatile chemicals may also off-gas from contaminated groundwater that infiltrates into the basement (e.g., at a sump) or during the use of contaminated domestic well water (e.g., at a tap or in a shower).
Household products	Household products include, but are not limited to, cleaners, mothballs, cigarette smoke, paints, paint strippers and thinners, air fresheners, lubricants, glues, solvents, pesticides, fuel oil storage, and gasoline storage.
Occupant activities	For example, in non-residential settings, the use of volatile chemicals in industrial or commercial processes or in products used for building maintenance. In residential settings, the use of products containing volatile chemicals for hobbies (e.g., glues, paints, etc.) or home businesses. People working at industrial or commercial facilities where volatile chemicals are used may bring the chemicals into their home on their clothing.
Indoor emissions	These include, but are not limited to, combustion products from gas, oil and wood heating systems that are vented outside improperly, as well as emissions from industrial process equipment and operations.

#### 1.5 General approach to evaluating soil vapor intrusion

Since no two sites are exactly alike, the approach to evaluating soil vapor intrusion is dependent upon site-specific conditions. A thorough understanding of the site, including its history of use, characteristics (e.g., geology, geography, identified environmental contamination, etc.) and potentially exposed populations, is used to develop an investigation plan. Existing information is reviewed to determine what data are available and what additional data should be collected (i.e., to guide the investigation). In addition, factors affecting soil vapor migration and intrusion [Section 1.3] and indoor air quality [Section 1.4] are also considered when both conducting an investigation [Section 2] and evaluating the results [Section 3].

This data gathering and review process should be repeated until each of the following questions can be answered:

- [1] Are subsurface vapors contaminated (i.e., soil vapor as defined in Section 1.1, including vapors located immediately beneath the foundation or slab of a building)? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?
- [2] What are the current and potential exposures to contaminated subsurface vapors via soil vapor intrusion?
- [3] What actions, if any, should be taken to prevent or mitigate exposures related to soil vapor intrusion and to remediate subsurface vapor contamination?

When determining what actions, if any, are appropriate to mitigate current or prevent future human exposures, all information known about a site is considered (i.e., a "whole picture" approach is taken) because each site presents its own unique set of circumstances. This information includes, but is not limited to, the following: nature and extent of contamination in all environmental media, factors affecting vapor migration and intrusion, current and future site uses, off-site land uses, presence of alternate sources of volatile chemicals, and completed or proposed remedial actions.

Actions taken to minimize or prevent exposures typically do not preclude the site from being used for a desired purpose or from being developed. If appropriate, mitigation systems can be installed at existing buildings or installed during the construction of new buildings. In many cases, installation of mitigation systems on new buildings may be a prudent, proactive action. The costs associated with installing a system at the time of a building's construction are often considerably less than the costs associated with retrofitting a system to the building after construction is completed. Furthermore, in many parts of New York State, the mitigation system would also address concerns about human exposures to radon. To learn more about radon in New York State, please refer to the Radon: Frequently Asked Questions Fact Sheet in Appendix H or visit the NYSDOH's web site at <http://www.health.state.ny.us/nysdoh/radon/radonhom.htm> or contact the NYSDOH's Radon Program at 1-800-458-1158.

#### 1.6 Conceptual site model

In accordance with the NYSDEC's *Draft DER-10 Technical Guidance for Site Investigation and Remediation* (NYSDEC 2002), subsurface vapors and soil vapor intrusion should be included in an overall conceptual model for the site. As described in the NYSDEC's technical guidance, a conceptual site model should be used to develop a general understanding of the site to evaluate potential risks to public health and the environment and to assist in identifying and setting priorities for the activities to be conducted at the site. The conceptual site model also identifies potential sources of contamination, types of contaminants and affected media, release mechanisms and potential contaminant pathways, and actual/potential human and environmental receptors.

The components of a conceptual site model specific to soil vapor intrusion are provided throughout Section 1 of the guidance. The general approach for evaluating soil vapor intrusion described in Section 1.5 is analogous to the development of a conceptual site model specific to soil vapor intrusion. For additional information about the use of conceptual site models in the investigation and remediation of sites or a description of the conceptual site model process, the reader is referred to the NYSDEC's technical guidance.

#### 1.7 Applicability of guidance

This guidance should be considered anywhere soil vapor intrusion is evaluated in the State of New York, whether the evaluation is being undertaken voluntarily by a corporation, a municipality, or private citizen, or under one of the state's environmental remediation programs.

##### 1.7.1 Residential and non-residential settings

The guidance should be followed in residential and non-residential settings where people may be exposed involuntarily to chemicals from soil vapor intrusion.

##### 1.7.2 Chlorinated and non-chlorinated volatile chemical sites

The guidance should be used when evaluating soil vapor intrusion at chlorinated and non-chlorinated volatile chemical sites, including petroleum hydrocarbon sites and manufactured gas plant sites. While the likelihood for exposures related to soil vapor intrusion may differ between sites due to site-specific conditions and chemical-specific properties, the extent of volatile chemical contamination and the nature of the contamination, these factors should be considered when developing the conceptual site model and implementing an investigation plan (as discussed in Sections 1.5 and 1.6). For example, if the conceptual site model suggests that soil vapor intrusion is not a concern at a petroleum hydrocarbon site due to biodegradation, the work plan might include the measurement of select bioparameters (e.g., oxygen, carbon dioxide, methane, etc.), along with the petroleum hydrocarbons, at varying depths to demonstrate bioattenuation in the vadose. The work plan might include sub-slab vapor sampling as well to demonstrate that conditions beneath nearby buildings are also resulting in bioattenuation of the petroleum hydrocarbons.

##### 1.7.3 Current, new and past remedial sites

As discussed in the NYSDEC's Program Policy *DER-13: Strategy for Prioritizing Vapor Intrusion Evaluations at Remedial Sites in New York* (NYSDEC 2006), the soil vapor intrusion pathway will be evaluated at all completed, current and future remedial sites New York State. This soil vapor intrusion guidance document complements the NYSDEC's policy by providing recommendations on how to evaluate soil vapor intrusion. The combined goal of the policy and guidance documents is to conduct soil vapor intrusion evaluations as efficiently and effectively as possible at all remedial sites in New York.

#### 1.8 Updates to the guidance

The investigation, evaluation, mitigation and remediation of soil vapor are evolving disciplines and this guidance document will be updated periodically, as appropriate. The history of the document's release is provided on the inside of the cover page. In addition, changes to the document are noted in Appendix A. The current version of the document supersedes previous versions. The current version of the guidance is available on the NYSDOH's web site ([http://www.health.state.ny.us/environmental/indoors/vapor\\_intrusion/](http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/)) or by contacting the NYSDOH's Bureau of Environmental Exposure Investigation [see Contact Information on the inside of the cover page]. Revisions or amendments to the guidance will be posted on the NYSDOH's web site.

## Section 2: Investigation of the Soil Vapor Intrusion Pathway

Soil vapor is an environmental medium, like groundwater and soil, that should be characterized during the investigation of a site. This section provides guidance on collecting appropriate and relevant data that can be used to identify current or potential human exposures to contaminated subsurface vapors associated with a site. As discussed in Section 1.5, no two sites are exactly alike. Site-specific and/or building-specific conditions may warrant modifying the recommendations herein. Therefore, guidance provided in this section is presented in terms of general steps and strategies that should be applied when approaching an investigation of soil vapor intrusion.

### 2.1 Sites at which an investigation is appropriate

Data collected to date do not support the use of pre-determined concentrations of volatile chemicals (i.e., screening criteria) in either groundwater or soil to trigger a soil vapor intrusion investigation. Therefore, although the level of investigation may vary, the pathway should be investigated at any site with the following:

- an existing subsurface source (e.g., on the basis of preliminary environmental sampling) or likely subsurface source (e.g., on the basis of known previous land uses) of volatile chemicals [Section 1.1]; and
- existing buildings or the possibility that buildings may be constructed near a subsurface source of volatile chemicals.

### 2.2 Types of samples

The following are types of samples that are collected to investigate the soil vapor intrusion pathway:

- subsurface vapor samples:
  - soil vapor samples (i.e., soil vapor samples not beneath the foundation or slab of a building) and
  - sub-slab vapor samples (i.e., soil vapor samples immediately beneath the foundation or slab of a building);
- crawl space air samples;
- indoor air samples; and
- outdoor air samples.

The types of samples that should be collected depend upon the specific objective(s) of the sampling, as described below.

#### 2.2.1 Soil vapor

Soil vapor samples are collected to determine whether this environmental medium is contaminated, characterize the nature and extent of contamination, and identify possible sources of the contamination. Our experience to date indicates soil vapor results alone typically cannot be relied upon to rule out sampling at nearby buildings. For example, concentrations of volatile chemicals in sub-slab vapor samples have been substantially higher (e.g., by a factor of 100 or more) than concentrations found in nearby soil vapor

samples (e.g., collected at 8 feet below grade near the building). This may be due to differences in factors such as soil moisture content and pressure gradients. Therefore, exposures are evaluated primarily based on sub-slab vapor, indoor air and outdoor air sampling results and soil vapor results are primarily used as a tool to guide these investigations.

Soil vapor sampling results are also used when evaluating the effectiveness of direct or indirect measures to remediate contaminated subsurface vapors. (Soil vapor extraction is an example of a direct remedial measure, and groundwater pumping and treating an indirect measure.)

#### 2.2.2 Sub-slab vapor

Sub-slab vapor samples are collected to characterize the nature and extent of soil vapor contamination immediately beneath a building with a basement foundation and/or a slab-on-grade. Sub-slab vapor sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating the following:

- current human exposures;
- the potential for future human exposures (e.g., if the structural integrity of the building changes or the use of the building changes); and
- site-specific attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

Sub-slab vapor samples are often collected after soil vapor characterization and/or other environmental sampling (e.g., soil and groundwater characterization) indicate they are warranted. Sub-slab samples are typically collected concurrently with indoor and outdoor air samples. However, outside of the heating season, sub-slab vapor samples may be collected independently depending on the sampling objective (e.g., to characterize the extent of subsurface vapor contamination outside of the heating season to develop a more comprehensive, focused investigation plan for the heating season).

#### 2.2.3 Crawl space air

Similar to sub-slab vapor samples, crawl space air samples are collected to characterize the nature and extent of contamination immediately beneath a building with a crawl space foundation. Crawl space air sampling results are used in conjunction with indoor air and outdoor air sampling results when evaluating the following:

- current human exposures; and
- the potential for future human exposures (e.g., if the structural integrity of the building changes or the use of the building changes).

#### 2.2.4 Indoor air

Indoor air samples are collected to characterize exposures to air within a building, including those with earthen floors. Indoor air sampling results are used when evaluating the following:

- a. *current* human exposures;
- b. the potential for *future* exposures (e.g., if a currently vacant building should become occupied); and
- c. site-specific attenuation factors (e.g., the ratio of indoor air to sub-slab vapor concentrations).

Indoor air samples are often collected after subsurface vapor characterization and other environmental sampling (e.g., soil and groundwater characterization) indicate they are warranted. When indoor air samples are collected, concurrent sub-slab vapor, crawl space air (if applicable) and outdoor air samples are collected to evaluate the indoor air results appropriately. However, indoor air and outdoor air samples, without sub-slab vapor samples, may be collected when confirming the effectiveness of a mitigation system [Section 4].

In addition, site-specific situations may warrant collecting indoor air samples prior to characterizing subsurface vapors and/or without concurrent sub-slab vapor sampling to examine immediate inhalation hazards. Examples of such situations may include, but are not limited to, the following:

- a. in response to a spill event to qualitatively and/or quantitatively characterize the contamination;
- b. if high readings are obtained in a building when screening with field equipment (e.g., a photoionization detector (PID), an organic vapor analyzer, or an explosimeter) and the source is unknown;
- c. if significant odors are present and the source needs to be characterized; or
- d. if groundwater beneath the building is contaminated, the building is prone to groundwater intrusion or flooding (e.g., sump pit overflows), and subsurface vapor sampling is not feasible. In these situations, the collection of water samples from the sump may also be appropriate.

#### 2.2.5 Outdoor air

Outdoor air samples are collected to characterize site-specific background outdoor air conditions. Outdoor air samples should be collected simultaneously with indoor air samples to evaluate the potential influence, if any, of outdoor air on the indoor air sampled. Outdoor air samples may also be collected concurrently with soil vapor samples to identify potential outdoor air interferences associated with infiltration of outdoor air into the sampling apparatus while the soil vapor was collected.

### 2.3 Phase of a site investigation in which to sample

There is no single phase (e.g., preliminary site characterization or remedial investigation) of a site investigation during which sampling to evaluate the soil vapor intrusion pathway is appropriate. Initiation of investigation activities for this specific purpose should be determined on a site-by-site basis. However, if exposures due to soil vapor intrusion appear likely at any point during the investigation, evaluation of this exposure pathway should not be delayed.

If the locations of likely source areas are reasonably known, sampling earlier during the investigation of a site rather than later is recommended because of the iterative nature of the sampling process [Section 2.5]. However, if current site conditions are not well-defined, then sampling after contamination in other environmental media (e.g., groundwater and soil) has been characterized may be considered. In the latter scenario, groundwater, soil and other site information may be used to guide an investigation of the soil vapor intrusion pathway, such as selecting locations for subsurface vapor samples based on likely migration pathways and source areas [Sections 2.6.1 and 2.6.2]. At a minimum, depth to groundwater and soil stratigraphy should be identified prior to collecting soil vapor samples.

Sampling may be delayed at parcels that are undeveloped or contain unoccupied buildings provided

- a. characterization of the parcel is not needed to
  1. address exposures in the surrounding area;
  2. design remedial measures for subsurface vapor contamination; or
  3. monitor or confirm the effectiveness of remedial measures; and
- b. measures are in place that assure that the parcel will not be developed, or buildings occupied, without addressing exposure concerns [Section 3.6].

If exposures due to soil vapor intrusion appear likely, and a delay of sampling is contemplated, the State (i.e., the NYSDEC and NYSDOH) should be informed of the contemplated delay and the rationale for the delay. Furthermore, the party contemplating the delay should consider any comments the State may have on the information provided.

### 2.4 Time of year in which to sample

#### 2.4.1 Soil vapor

Soil vapor samples are collected at any time during the year. Often, sampling is completed during the summer so the results can be used as a tool when selecting buildings to be sampled during the heating season.

#### 2.4.2 Buildings

Sub-slab vapor samples and, unless immediate sampling is appropriate, indoor air samples are typically collected during the heating season because soil vapor intrusion is more likely to occur when a building's heating system is in operation and doors and windows are closed. In New York State, heating systems are generally expected to be operating routinely from November 15th to March 31st. However, these dates are not absolute; the timeframe for sampling may vary depending on factors such as the location of the site (e.g., upstate versus downstate) and the weather conditions for a particular year.

A soil vapor intrusion investigation at a building may be conducted outside of the heating season if the concern for vapor intrusion is greater during another time of year. This may occur at certain industrial buildings, for instance, where HVAC systems are actively managed to control the ratio of recirculated indoor air to make-up air from outside the building. Information about the site and potentially affected structures, including the factors discussed in Section 1.3, should be considered in determining the timing of an investigation.

Samples may be collected at any time of year if exposures due to soil vapor intrusion appear likely. However, samples collected at times when soil vapor intrusion is not expected to have its greatest effect on indoor air quality (typically, samples collected outside of the heating season) should not be used to rule out exposures. For example, results indicating "no further action" or "monitoring required" should be verified when soil vapor intrusion is believed to be most likely to ensure these actions are protective throughout the year.

## 2.5 Number of sampling rounds

Investigating the soil vapor intrusion pathway usually involves more than one round of subsurface vapor, indoor air and/or outdoor air sampling, for reasons such as the following:

- a. to characterize the nature and extent of subsurface vapor contamination (similar to the delineation of groundwater contamination) and to address corresponding exposure concerns;
- b. to evaluate fluctuations in concentrations due to
  1. different weather conditions (e.g., seasonal effects),
  2. changes in building conditions (e.g., various operating conditions of a building's HVAC system),
  3. changes in source strength, or
  4. vapor migration or contaminant biodegradation processes (particularly when degradation products may be more toxic than the parent compounds); or
- c. to confirm sampling results or the effectiveness of mitigation or remedial systems.

Overall, as discussed in Section 1.5, successive rounds of sampling should be conducted until the following questions can be answered:

- a. Are subsurface vapors contaminated? If so, what are the nature and extent of contamination? What is/are the source(s) of the contamination?
- b. What are the current and potential exposures to contaminated subsurface vapors?
- c. What actions, if any, are appropriate to prevent or mitigate exposures and to remediate subsurface vapor contamination?

Toward this end, multiple rounds of sampling may be appropriate to characterize the nature and extent of subsurface vapor contamination such that

- a. both potential and current exposures are addressed [Section 2.6];
- b. measures can be designed to remediate subsurface vapor contamination, either directly (e.g., SVE system) or indirectly (e.g., soil excavation or groundwater remediation), given that monitoring and mitigation are considered temporary measures implemented to address exposures related to vapor intrusion until contaminated environmental media are remediated [Section 3.4]; and
- c. the effectiveness of remedial measures can be monitored and confirmed (e.g., endpoint sampling) [Section 4.5].

## 2.6 Sampling locations

The general approach for selecting sampling locations as part of a soil vapor intrusion investigation is similar to the approach for the investigation of other environmental media (e.g., soil and groundwater). Sampling locations should be selected with consideration of the conceptual site model [Section 1.6]. These locations should be selected to meet the stated objectives of the sampling program. Additionally, similar to the investigation of soil and groundwater, it is typical to start at a known or suspected source and work outward. The specific approach, however, will be dependent upon site-specific and building-specific conditions.

### 2.6.1 Soil vapor

If available, existing environmental data (e.g., groundwater and soil data) and site background information should be used to select locations for sampling soil vapor as part of a vapor intrusion investigation. Locations will vary depending upon surface features (e.g., presence or absence of buildings, areas of pavement, or vacant lot) and subsurface characteristics (e.g., soil stratigraphy, buried structures, utility corridors, or clay lenses), as well as the specific purpose of the sampling. Therefore, a figure illustrating proposed sampling locations (with respect to both areal position and depth), actual locations sampled in the field, and relevant on-site and off-site features should be included in all sampling work plans and reports.

Examples of how locations may vary given the specific purpose of the sampling follow. They include general guidelines that should be followed when selecting soil vapor sampling locations:

- a. to evaluate the **potential for current on-site or off-site exposures**, samples should be collected
  1. in the vicinity of a building's foundation [see special sampling consideration at the end of Section 2.6.1 if sampling around a building with no surrounding surface confining layer], as well as between the building's foundation and the source (if known and not located beneath the building),
  2. along the site's perimeter, and
  3. at a depth comparable to the depth of foundation footings (determined on a building-specific or site-specific basis) or at least 1 foot above the water table in areas where the groundwater table is less than 6 feet below grade;
- b. to evaluate the **potential for future exposures if development** on a known or suspected contaminated area on-site or off-site is possible, representative samples should be collected
  1. in areas with either known or suspected subsurface sources of volatile chemicals, in areas where elevated readings were obtained with field equipment during previous environmental investigations, and in areas of varying concentrations of contamination in the upper groundwater,
  2. in a grid pattern across the area (at an appropriate spacing interval for the size of the area) if information is limited for the area, and
  3. at multiple depths from the suspected subsurface source, or former source, to a depth comparable to the expected depth of foundation footings;

- c. to evaluate the **potential for off-site soil vapor contamination**, samples should be collected
  - 1. along the site's perimeter,
  - 2. in areas of potential subsurface sources of vapor contamination (e.g., a groundwater plume that has migrated off-site), and
  - 3. at a depth comparable to the depth of foundation footings (determined on a site-specific basis) or at least 1 foot above the water table in areas where the groundwater table is less than 6 feet below grade;
- d. to evaluate on-site and off-site **preferential migration pathways** in areas with low permeability soils, samples should be collected
  - 1. along preferential soil vapor flow paths, such as sewer lines, utility corridors, trenches, pipelines, and other subsurface structures that are likely to be bedded with higher permeability materials, and
  - 2. at depths corresponding to these subsurface features (will depend on site-specific conditions);
- e. to characterize on-site or off-site **contamination in the vadose zone**, samples should be collected
  - 1. in areas with either known or suspected sources of volatile chemicals, in areas where elevated readings were obtained with field equipment (e.g., PID) during previous soil and groundwater investigations, and in areas of varying concentrations of contamination in the upper groundwater regime, and
  - 2. at appropriate depths associated with these areas (will depend on site-specific conditions); and
- f. to investigate the **influence of contaminated groundwater or soil on soil vapor** and to characterize the **vertical profile** of contamination, samples should be collected from clusters of soil vapor probes at varying depths in the vadose zone [Figure 2.2, Section 2.7.1] and preferably in conjunction with the collection of groundwater or soil samples.

Soil vapor samples collected at depths shallower than 5 feet below grade may be prone to negative bias due to infiltration of outdoor air. Therefore, samples from these depths should be collected only if appropriate (based on site-specific conditions), and sampling procedures and results should be reviewed accordingly. The depth of sampling near buildings with slab-on-grade foundations is dependent upon site-specific conditions (e.g., building surrounded by grassy or surface confining layer).

When collecting soil vapor samples around a building with no surrounding surface confining layer (e.g., pavement or sidewalk), samples should be located in native or undisturbed soils away from fill material surrounding the building (approximately 10 feet away from the building) to avoid sampling in an area that may be influenced by the building's operations. For example, operation of HVAC systems, fireplaces, or mechanical equipment (e.g., clothes dryers or exhaust fans/vents) in a building may exacerbate the infiltration of outdoor air into the vadose zone adjacent to the building. As a result, soil vapor samples collected in uncovered areas adjacent to the building may not be representative.

Investigations of soil vapor contamination should proceed outward from known or suspected subsurface sources, as appropriate, on an areal basis until the nature and extent of

subsurface vapor contamination has been characterized and human exposures have been addressed.

#### 2.6.2 Sub-slab vapor

Existing environmental data (e.g., soil vapor, groundwater and soil data), site background information, and building construction details (e.g., basement, slab-on-grade, or multiple types of foundations, HVAC systems, etc.) should be considered when selecting buildings and locations within buildings for sub-slab vapor sampling.

At a minimum, these general guidelines should be followed when selecting buildings to sample for sub-slab vapors:

- a. buildings, including residential dwellings, located above or directly adjacent to known or suspected areas of subsurface volatile chemical contamination should be sampled;
- b. buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled; and
- c. buildings within known or suspected areas of subsurface volatile chemical contamination that are used or occupied by sensitive population groups (e.g., daycare facilities, schools, nursing homes, etc.) should be given special consideration for sampling.

Investigations of sub-slab vapor and/or indoor air contamination should proceed outward from known or suspected sources, as appropriate, on an areal basis until the nature and extent of subsurface vapor contamination has been characterized and potential and current human exposures have been addressed. In cases of widespread vapor contamination and depending upon the basis for making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination [Section 3.3.1]), a representative number of buildings from an identified study area, rather than each building, may be sampled. Prior to implementation, this type of sampling approach should be approved by State agency personnel.

Within a building, sub-slab vapor samples should be collected

- a. in at least one central location away from foundation footings, and
- b. from the soil or aggregate immediately below the basement slab or slab-on-grade.

The number of sub-slab vapor samples that should be collected in a building depends upon the number of slabs (e.g., multiple slabs-on-grade in a large warehouse) and foundation types (e.g., combined basement and slab-on-grade in a residence). At least one sub-slab vapor sample should be collected from each representative area.

#### 2.6.3 Indoor air

Existing environmental data (e.g., soil vapor, groundwater and soil data), site background information, and building construction details (e.g., basement, slab-on-grade, or multiple types of foundations; number and operation of HVAC systems; elevator shafts; tunnels or other confined-space entry points; etc.) should be considered when selecting buildings and

locations within buildings for indoor air sampling. Indoor air samples are typically collected concurrently with sub-slab vapor and outdoor air samples [Section 2.2.4].

At a minimum, these general guidelines should be followed when selecting buildings to sample for indoor air:

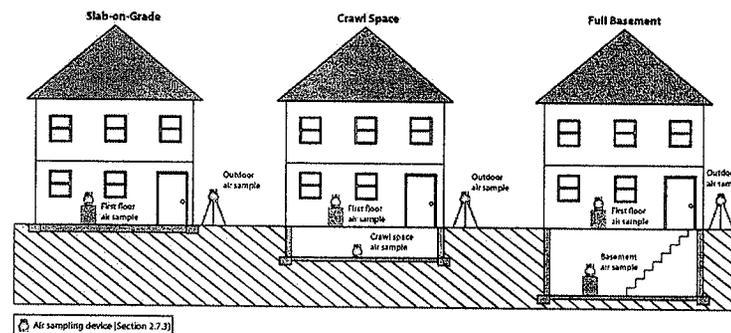
- where sub-slab vapor samples were collected without indoor air samples, buildings in which elevated concentrations of contaminants were measured in sub-slab vapor samples should be sampled;
- buildings, including residential dwellings, located above or directly adjacent to known or suspected subsurface sources of volatile chemicals or known soil vapor contamination should be sampled;
- buildings in which screening with field equipment (e.g., PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) suggests a completed migration pathway, such as when readings are above background and from unidentified sources or when readings show increasing gradients, should be sampled; and
- buildings within known or suspected areas of subsurface volatile chemical contamination that are used or occupied by sensitive population groups (e.g., daycare facilities, schools, nursing homes, etc.) should be given special consideration for sampling.

To characterize contaminant concentration trends and potential exposures, indoor air samples should be collected

- from the crawl space area,
- from the basement (where vapor infiltration is suspected, such as near sump pumps or indoor wells, or in a central location) at a height approximately three feet above the floor to represent a height at which occupants normally are seated and/or sleep,
- from the lowest level living space (in centrally-located, high activity use areas) at a height approximately three feet above the floor to represent a height at which occupants normally are seated and/or sleep, and
- if in a commercial setting (e.g., a strip mall), from multiple tenant spaces at a height approximately three feet above the floor to represent a height at which occupants normally are seated.

These locations are illustrated in Figure 2.1.

Investigations of indoor air contamination should proceed outward from known or suspected subsurface sources, as appropriate, on an areal basis until potential and current human exposures associated with soil vapor intrusion have been addressed. In cases of widespread vapor contamination and depending upon the basis for making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination), a representative number of buildings from an identified study area, rather than each building, may be sampled. Prior to implementation, this type of sampling approach should be approved by State agency personnel.



**Figure 2.1**  
Schematic of indoor and outdoor air sampling locations

#### 2.6.4 Outdoor air

Typically, an outdoor air sample is collected outside of each building where an indoor air sample is collected. However, if several buildings are being sampled within a localized area, representative outdoor air samples may be appropriate. For example, one outdoor air sample may be sufficient for three houses being sampled in a cul-de-sac. Outdoor air samples should be collected from a representative upwind location, away from wind obstructions (e.g., trees or bushes), and at a height above the ground to represent breathing zones (3 to 5 feet) [Figure 2.1]. A representative sample is one that is not biased toward obvious sources of volatile chemicals (e.g., automobiles, lawn mowers, oil storage tanks, gasoline stations, industrial facilities, etc.). For buildings with HVAC systems that draw outdoor air into the building, an outdoor air sample collected near the outdoor air intake may be appropriate.

#### 2.7 Sampling protocols

The procedures recommended here may be modified depending on site-specific conditions, the sampling objectives, or emerging technologies and methodologies. Alternative sampling procedures should be described thoroughly and proposed in a work plan submitted for review by the State. The State will review and comment on the proposed procedure and consider the efficacy of the alternative sampling procedure based on the objectives of investigation. In all cases, work plans should thoroughly describe the proposed sampling procedure. Similarly, the procedures that were implemented in the field should be documented and included in the final report of the sampling results.

## 2.7.1 Soil vapor

Soil vapor probe installations [Figure 2.2] may be permanent, semi-permanent or temporary. In general, permanent or semi-permanent installations are preferred for data consistency reasons and to ensure outdoor air infiltration does not occur. Temporary probes should only be used if measures are taken to ensure that an adequate surface seal is created to prevent outdoor air infiltration and if tracer gas is used at every sampling location. [See Section 2.7.5 for additional information about the use of tracer gas when collecting soil vapor samples.] Soil vapor implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any permanent construction protocol:

- implants should be installed using an appropriate method based on site conditions (e.g., direct push, manually driven, auger — if necessary to attain the desired depth or if sidewall smearing is a concern, etc.);
- porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be used to create a sampling zone 1 to 2 feet in length;
- implants should be fitted with inert tubing (e.g., polyethylene, stainless steel, nylon, Teflon®, etc.) of the appropriate size (typically 1/8 inch to 1/4 inch diameter) and of laboratory or food grade quality to the surface;
- soil vapor probes should be sealed above the sampling zone with a bentonite slurry for a minimum distance of 3 feet to prevent outdoor air infiltration and the remainder of the borehole backfilled with clean material;
- for multiple probe depths, the borehole should be grouted with bentonite between probes to create discrete sampling zones or separate nested probes should be installed [Figure 2.2]; and
- steps should be taken to minimize infiltration of water or outdoor air and to prevent accidental damage (e.g., setting a protective casing around the top of the probe tubing and grouting in place to the top of bentonite, sloping the ground surface to direct water away from the borehole like a groundwater monitoring well, etc.).

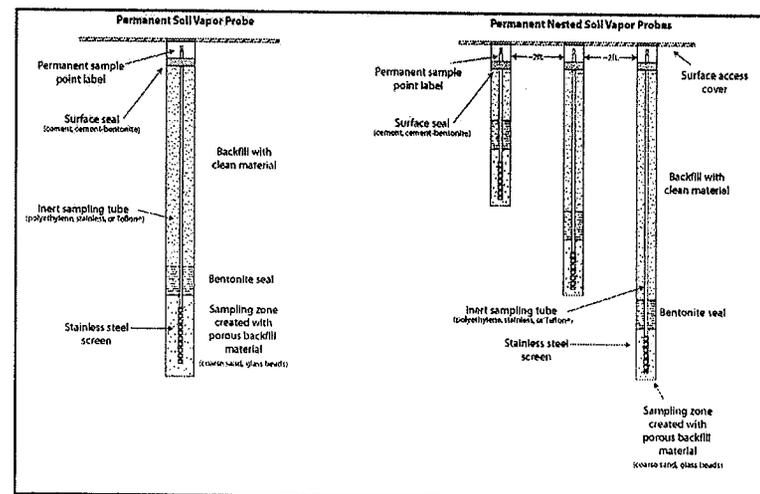


Figure 2.2

Schematics of a generic permanent soil vapor probe and permanent nested soil vapor probes

[Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]

To obtain representative samples and to minimize possible discrepancies, soil vapor samples should be collected in the following manner at all locations:

- at least 24 hours after the installation of permanent probes and shortly after the installation of temporary probes, one to three implant volumes (i.e., the volume of the sample probe and tube) should be purged prior to collecting the samples;
- flow rates for both purging and collecting should not exceed 0.2 liters per minute to minimize outdoor air infiltration during sampling;
- samples should be collected, using conventional sampling methods, in an appropriate container — one which
  - meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),
  - is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and
  - is certified clean by the laboratory;

- d. sample size depends upon the volume of that will achieve minimum reporting limits [Section 2.9]; and
- e. a tracer gas (e.g., helium, butane, sulfur hexafluoride, etc.) should be used when collecting soil vapor samples to verify that adequate sampling techniques are being implemented (i.e., to verify infiltration of outdoor air is not occurring) [Section 2.7.5].

In some cases, weather conditions may present certain limitations on soil vapor sampling. For example, condensation in the sample tubing may be encountered during winter sampling due to low outdoor air temperatures. Devices, such as tube warmers, may be used to address these conditions. Anticipated limitations to the sampling should be discussed prior to the sampling event so appropriate measures can be taken to address these difficulties and produce representative and reliable data.

When soil vapor samples are collected, the following actions should be taken to document local conditions during sampling that may influence interpretation of the results:

- a. if sampling near a commercial or industrial building, uses of volatile chemicals during normal operations of the facility should be identified;
- b. outdoor plot sketches should be drawn that include the site, area streets, neighboring commercial or industrial facilities (with estimated distance to the site), outdoor air sampling locations (if applicable), and compass orientation (north);
- c. weather conditions (e.g., precipitation and outdoor temperature) should be noted for the past 24 to 48 hours; and
- d. any pertinent observations should be recorded, such as odors and readings from field instrumentation.

Additional information that could be gathered to assist in the interpretation of the results includes barometric pressure, wind speed and wind direction.

The field sampling team should maintain a sample log sheet summarizing the following:

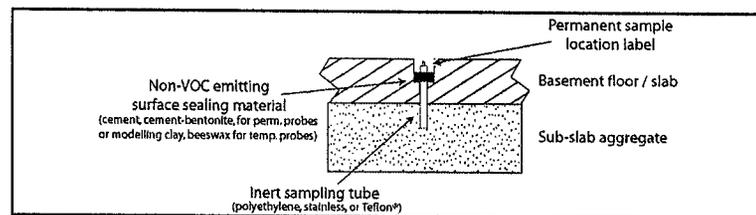
- a. sample identification,
- b. date and time of sample collection,
- c. sampling depth,
- d. identity of samplers,
- e. sampling methods and devices,
- f. purge volumes,
- g. volume of soil vapor extracted,
- h. If canisters used, the vacuum before and after samples were collected,
- i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and
- j. chain of custody protocols and records used to track samples from sampling point to analysis.

### 2.7.2 Sub-slab vapor

During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time. Prior to installation of the sub-slab vapor probe, the building floor should be inspected and any penetrations (cracks, floor drains, utility perforations, sumps, etc.) should be noted and recorded. Probes should be installed at locations where the potential for ambient air infiltration via floor penetrations is minimal.

Sub-slab vapor probe installations [Figure 2.3] may be permanent, semi-permanent or temporary. A vacuum should not be used to remove drilling debris from the sampling port. Sub-slab implants or probes should be constructed in the same manner at all sampling locations to minimize possible discrepancies. The following procedures should be included in any construction protocol:

- a. permanent recessed probes should be constructed with brass or stainless steel tubing and fittings;
- b. temporary probes should be constructed with inert tubing (e.g., polyethylene, stainless steel, nylon, Teflon®, etc.) of the appropriate size (typically 1/8 inch to 1/4 inch diameter), and of laboratory or food grade quality;
- c. tubing should not extend further than 2 inches into the sub-slab material;
- d. porous, inert backfill material (e.g., glass beads, washed #1 crushed stone, etc.) should be added to cover about 1 inch of the probe tip for permanent installations; and
- e. the implant should be sealed to the surface with non-VOC-containing and non-shrinking products for temporary installations (e.g., permagum grout, melted beeswax, putty, etc.) or cement for permanent installations.



**Figure 2.3**

Schematic of a generic sub-slab vapor probe

[Note: Many variations exist and may be proposed in a work plan. Proposed installations should meet the sampling objectives and requirements of the analytical methods.]

To obtain representative samples that meet the data quality objectives, sub-slab vapor samples should be collected in the following manner:

- a. after installation of the probes, one to three volumes (i.e., the volume of the sample probe and tube) must be purged prior to collecting the samples to ensure samples collected are representative;
- b. flow rates for both purging and collecting must not exceed 0.2 liters per minute to minimize ambient air infiltration during sampling; and
- c. samples should be collected, using conventional sampling methods, in an appropriate container — one which
  - i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),
  - ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa® canisters if analyzing by using EPA Method TO-15), and
  - iii. is certified clean by the laboratory;
- d. sample size depends upon the volume of that will achieve minimum reporting limits [Section 2.9], the flow rate, and the sampling duration; and
- e. ideally, samples should be collected over the same period of time as concurrent indoor and outdoor air samples.

When sub-slab vapor samples are collected, the following actions should be taken to document conditions during sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

- a. historic and current storage and uses of volatile chemicals should be identified, especially if sampling within a commercial or industrial building (e.g., use of volatile chemicals in commercial or industrial processes and/or during building maintenance);
- b. the use of heating or air conditioning systems during sampling should be noted;
- c. floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system air supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed;
- d. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas;
- e. weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported; and
- f. any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected

contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

The field sampling team should maintain a sample log sheet summarizing the following:

- a. sample identification,
- b. date and time of sample collection,
- c. sampling depth,
- d. identity of samplers,
- e. sampling methods and devices,
- f. soil vapor purge volumes,
- g. volume of soil vapor extracted,
- h. if canisters used, vacuum of canisters before and after samples collected,
- i. apparent moisture content (dry, moist, saturated, etc.) of the sampling zone, and
- j. chain of custody protocols and records used to track samples from sampling point to analysis.

### 2.7.3 Indoor air

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time. If possible, prior to collecting indoor samples, a pre-sampling inspection [Section 2.11.1] should be performed to evaluate the physical layout and conditions of the building being investigated, to identify conditions that may affect or interfere with the proposed sampling, and to prepare the building for sampling. This process is described in Section 2.11.1.

In general, indoor air samples should be collected in the following manner:

- a. sampling duration should reflect the exposure scenario being evaluated without compromising the detection limit or sample collection flow rate (e.g., an 8 hour sample from a workplace with a single shift versus a 24 hour sample from a workplace with multiple shifts). To ensure that air is representative of the locations sampled and to avoid undue influence from sampling personnel, samples should be collected for at least 1 hour. If the goal of the sampling is to represent average concentrations over longer periods, then longer duration sampling periods may be appropriate. Typically, 24 hour samples are collected from residential settings;
- b. personnel should avoid lingering in the immediate area of the sampling device while samples are being collected;
- c. sample flow rates must conform to the specifications in the sample collection method and, if possible, should be consistent with the flow rates for concurrent outdoor air and sub-slab samples; and
- d. samples must be collected, using conventional sampling methods, in an appropriate container — one which

- i. meets the objectives of the sampling (e.g., investigation of areas where low or high concentrations of volatile chemicals are expected; to minimize losses of volatile chemicals that are susceptible to photodegradation),
- ii. is consistent with the sampling and analytical methods (e.g., low flow rate; Summa<sup>®</sup> canisters if analyzing by using EPA Method TO-15), and
- iii. is certified clean by the laboratory.

At sites with tetrachloroethene contamination, passive air monitors that are specifically analyzed for tetrachloroethene (i.e., "perc badges") are commonly used to collect indoor and outdoor air samples. If site characterization activities indicate that degradation products of tetrachloroethene also represent a vapor intrusion concern, perc badges may be used to indicate the likelihood of vapor intrusion (i.e., by using tetrachloroethene as a surrogate) followed, as appropriate, by more comprehensive sampling and laboratory analyses to quantify both tetrachloroethene and its degradation products. Perc badge samples ideally should be collected over a twenty-four hour period, but for no less than eight hours.

The following actions should be taken to document conditions during indoor air sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

- a. historic and current uses and storage of volatile chemicals should be identified, especially if sampling within a commercial or industrial building (e.g., use of volatile chemicals in commercial or industrial processes and/or during building maintenance);
- b. a product inventory survey documenting sources of volatile chemicals present in the building during the indoor air sampling that could potentially influence the sample results should be completed [Section 2.11.2];
- c. the use of heating or air conditioning systems during sampling should be noted;
- d. floor plan sketches should be drawn that include the floor layout with sampling locations, chemical storage areas, garages, doorways, stairways, location of basement sumps or subsurface drains and utility perforations through building foundations, HVAC system supply and return registers, compass orientation (north), footings that create separate foundation sections, and any other pertinent information should be completed;
- e. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations (if applicable), compass orientation (north), and paved areas;
- f. weather conditions (e.g., precipitation and indoor and outdoor temperature) and ventilation conditions (e.g., heating system active and windows closed) should be reported; and
- g. any pertinent observations, such as spills, floor stains, smoke tube results, odors and readings from field instrumentation (e.g., vapors via PID, ppbRAE, Jerome Mercury Vapor Analyzer, etc.), should be recorded.

Additional documentation that could be gathered to assist in the interpretation of the results includes information about air flow patterns and pressure relationships obtained by using smoke tubes or other devices (especially between floor levels and between suspected contaminant sources and other areas), the barometric pressure and photographs to accompany floor plan sketches.

The field sampling team should maintain a sample log sheet summarizing the following:

- a. sample identification,
- b. date and time of sample collection,
- c. sampling height,
- d. identity of samplers,
- e. sampling methods and devices,
- f. depending upon the method, volume of air sampled,
- g. if canisters are used, vacuum of canisters before and after samples collected, and
- h. chain of custody protocols and records used to track samples from sampling point to analysis.

#### 2.7.4 Outdoor air

Outdoor air samples should be collected simultaneously with indoor air samples to evaluate the potential influence, if any, of outdoor air on indoor air quality. They may also be collected simultaneously with soil vapor samples to identify potential outdoor air interferences associated with infiltration of outdoor air into the sampling apparatus while the soil vapor was collected. To obtain representative samples that meet the data quality objectives, outdoor air samples should be collected in a manner consistent with that for indoor air samples (described in Section 2.7.3).

The following actions should be taken to document conditions during outdoor air sampling and ultimately to aid in the interpretation of the sampling results [Section 3]:

- a. outdoor plot sketches should be drawn that include the building site, area streets, outdoor air sampling locations, the location of potential interferences (e.g., gasoline stations, factories, lawn movers, etc.), compass orientation (north), and paved areas;
- b. weather conditions (e.g., precipitation and outdoor temperature) should be reported; and
- c. any pertinent observations, such as odors, readings from field instrumentation, and significant activities in the vicinity (e.g., operation of heavy equipment or dry cleaners) should be recorded.

#### 2.7.5 Tracer gas

When collecting soil vapor samples as part of a vapor intrusion evaluation, a tracer gas serves as a quality assurance/quality control measure to verify the integrity of the soil vapor probe seal. Without the use of a tracer, there is no way to verify that a soil vapor sample has not been diluted by outdoor air.

Depending on the nature of the contaminants of concern, a number of different compounds can be used as a tracer. Typically, sulfur hexafluoride (SF<sub>6</sub>) or helium are used as tracers because they are readily available, have low toxicity, and can be monitored with portable measurement devices. Butane and propane (or other gases) could also be used as a tracer in some situations. Compounds other than those mentioned here may be appropriate, provided they meet project-specific data quality objectives. Where applicable, steps should

be taken to ensure that the gas used by the laboratory to clean the air sampling container is different from the gas used as a tracer during sampling (e.g., helium).

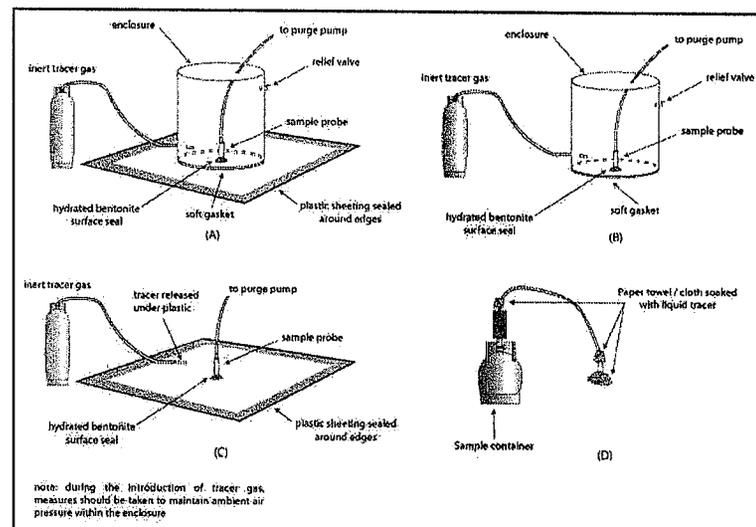
The protocol for using a tracer gas is straightforward: simply enrich the atmosphere in the immediate vicinity of the area where the probe intersects the ground surface with the tracer gas, and measure a vapor sample from the probe for the presence of high concentrations (> 10%) of the tracer. A cardboard box, a plastic pail, or even a garbage bag can serve to keep the tracer gas in contact with the probe during the testing. If there are concerns about infiltration of ambient air through other parts of the sampling train (such as around the fittings, not just at the probe/ground interface), then consideration should be given to ensuring that the tracer gas is in contact with the entire sampling apparatus. In these cases, field personnel may prefer to use a liquid tracer — soaking paper towels with a liquid tracer and placing the towels around the probe/ground interface, around fittings, and/or in the corner of a shroud.

There are two basic approaches to testing for the tracer gas:

1. include the tracer gas in the list of target analytes reported by the laboratory; or
2. use a portable monitoring device to analyze a sample of soil vapor for the tracer prior to and after sampling for the compounds of concern. (Note that the tracer gas samples can be collected via syringe, Tedlar® bag etc. They need not be collected in Summa® canisters or minicans.)

The advantage of the second approach is that the real time tracer sampling results can be used to confirm the integrity of the probe seals prior to formal sample collection.

Figure 2.4 depicts common methods for using tracer gas. In examples a, b and c, the tracer gas is released in the enclosure prior to initially purging the sample point. Care should be taken to avoid excessive purging prior to sample collection. Care should also be taken to prevent pressure build-up in the enclosure during introduction of the tracer gas. Inspection of the installed sample probe, specifically noting the integrity of the surface seal and the porosity of the soil in which the probe is installed, will help to determine the tracer gas setup. Figure 2.4a may be most effective at preventing tracer gas infiltration, however, it may not be appropriate in some situations depending on site-specific conditions. Figures 2.4b and 2.4c may be sufficient for probes installed in tight soils with well-constructed surface seals. Figure 2d provides an example of using a liquid tracer. In all cases, the same tracer gas application should be used for all probes at any given site.



**Figure 2.4**  
Schematics of generic tracer gas applications when collecting soil vapor samples

Because minor leakage around the probe seal should not materially affect the usability of the soil vapor sampling results, the mere presence of the tracer gas in the sample should not be a cause for alarm. Consequently, portable field monitoring devices with detection limits in the low ppm range are more than adequate for screening samples for the tracer. If high concentrations (> 10%) of tracer gas are observed in a sample, the probe seal should be enhanced to reduce the infiltration of outdoor air.

Where permanent or semi-permanent sampling probes are used, tracer gas samples should be collected at each of the sampling probes during the initial stages of a soil vapor sampling program. If the results of the initial samples indicate that the probe seals are adequate, reducing the number of locations at which tracer gas samples are employed may be considered. At a minimum, tracer gas samples should be collected with at least 10% of the soil vapor samples collected in subsequent sampling rounds. When using permanent soil vapor probes as part of a long-term monitoring program, annual testing of the probe integrity is recommended. Where temporary probes are used, tracer gas should be used at every sampling location, every time.

**2.8 Quality assurance/quality control (QA/QC)**

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

In general, appropriate QA/QC procedures should be followed during all aspects of sample collection and analysis to ensure that sampling error is minimized and high quality data are obtained. Sampling team members should avoid actions (e.g., fueling vehicles, using permanent marking pens, wearing freshly dry-cleaned clothing or personal fragrances, etc.) which can cause sample interference in the field. Portable air monitoring equipment or field instrumentation should be properly maintained, calibrated and tested to ensure validity of measurements. Air sampling equipment should be stored, transported and between samples decontaminated in a manner consistent with the best environmental consulting practices to minimize problems such as field contamination and cross-contamination. Samples should be collected using certified clean sample devices. Where applicable, steps should be taken to ensure that the gas used by the laboratory to clean the sample device is different from the gas used as a tracer during sampling (e.g., helium). Samples should meet sample holding times and temperatures, and should be delivered to the analytical laboratory as soon as possible after collection. In addition, laboratory accession procedures should be followed, including field documentation (sample collection information and locations), chain of custody, field blanks, field sample duplicates and laboratory duplicates, as appropriate.

Some methods call for collecting samples in duplicate (e.g., indoor air sampling using passive sampling devices for tetrachloroethene) to assess errors. Duplicate and/or split samples should be collected in accordance with the sampling and analytical methods being implemented.

For certain regulatory programs, a Data Usability Summary Report (DUSR) or equivalent report may be required to determine whether or not the data, as presented, meets the site or project specific criteria for data quality and data use. This requirement may dictate the level of QC and the category of data deliverable to request from the laboratory. Guidance on preparing these reports is available by contacting the NYSDEC's Division of Environmental Remediation.

New York State Public Health Law requires laboratories analyzing environmental samples collected from within New York State to have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. If ELAP certification is not currently required for an analyte (e.g., trichloroethene), the analysis should be performed by a laboratory that has ELAP certification for similar compounds in air and uses analytical methods with minimum reporting limits similar to background (e.g., tetrachloroethene via EPA Method TO-15). Questions about a laboratory's current certification status should be directed to an ELAP representative at 518-485-5570 or by email at [elap@health.state.ny.us](mailto:elap@health.state.ny.us).

The work plan should state that all samples that will be used to make decisions on appropriate actions to address exposures and environmental contamination will be analyzed by an ELAP-certified laboratory. The name of the laboratory should also be provided. Similarly, the name of the laboratory that was used should be included in the report of the sampling results. For samples collected and tested in the field for screening purposes by using field testing technology, the qualifications of the field technician should be documented in the work plan.

**2.9 Analytical methods**

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

Proposed analytical procedures should be identified in work plans. Similarly, the analytical procedures that were used and corresponding reporting limits should be identified when reporting the sampling results. When selecting an appropriate analytical method, the data quality objectives should be considered. As described in Section 3, comparing sampling results for volatile chemicals with background concentrations and with indoor air/sub-slab vapor matrices are critical components of the data evaluation process. Therefore, samples should be analyzed by methods that can achieve minimum reporting limits to allow for comparison of the results with background levels and with the levels presented in the matrices [Section 3.4.2]. If there are additional data quality objectives, they should be considered also. Typically, a minimum reporting limit of 1 microgram per cubic meter (1 mcg/m<sup>3</sup>) or less is sufficient for most analytes. Examples of commonly used analytical methods include the following:

- EPA Method TO-15 for a wide range of VOCs (e.g., samples from evacuated canisters),
- NYSDOH Method 311-9 for tetrachloroethene (i.e., samples from perc badges),
- EPA Method TO-17 for VOCs (e.g., samples collected with sorbent tubes), and
- EPA Method TO-15 for VOCs with selective ion monitoring (SIM) (e.g., to achieve minimum reporting limits lower than those achieved with Method TO-15 alone).

The laboratory should verify that they are capable of detecting the appropriate analytes and can report them at the appropriate reporting limit.

**2.9.1 Subsurface vapor**

Soil vapor and sub-slab vapor samples should be analyzed for a wide range of volatile chemicals during the first round of sampling (at a minimum) — unless it can be demonstrated that an abbreviated or site-specific analyte list is appropriate. This is analogous to analyzing groundwater samples for a suite of compounds (e.g., EPA's target analyte list/target compound list (TAL/TCL) chemicals) during the initial rounds of site characterization. Based on the initial sampling results, development and application of a site-specific analyte list may be considered for analysis of subsequent soil vapor and sub-slab vapor samples.

If a site-specific analyte list is developed, it should include the following:

- volatile chemicals which have been previously detected in environmental media (e.g., soil, groundwater and air) at the site;
- volatile chemicals which are known or demonstrated constituents of the contamination in question (e.g., petroleum products or tars from former manufactured gas plants); and
- expected degradation products of the chemicals mentioned in a or b.

A site-specific analyte list might also include indicator compounds to assist in identifying and differentiating subsurface sources of volatile chemical contamination. The following are examples of indicator compounds that have been included in site-specific analyte lists given the nature of the contamination or type of site:

- a. gasoline: benzene, toluene, ethylbenzene, xylenes, trimethylbenzene isomers, individual C-4 to C-8 aliphatics (e.g., hexane, cyclohexane, dimethylpentane, 2,2,4-trimethylpentane, etc.), and appropriate oxygenate additives (e.g., methyl-*tert*-butyl ether, ethanol, etc.);
- b. middle distillate fuels (#2 fuel oil, diesel and kerosene): n-nonane, n-decane, n-undecane, n-dodecane, ethylbenzene, xylenes, trimethylbenzene isomers, tetramethylbenzene isomers, naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene;
- c. manufactured gas plant sites: trimethylbenzene isomers, tetramethylbenzene isomers, thiopenes, indene, indane, and naphthalene;
- d. natural gas: propane, propene, butane, iso-butane, methylbutane, and n-pentane with lower levels of higher molecular weight aliphatic, olefinic, and some aromatic compounds; and
- e. solvent-using industries: the solvent and its expected degradation products (e.g., tetrachloroethene, trichloroethene, dichloroethene(s), and vinyl chloride).

### 2.9.2 Indoor air

Indoor and outdoor air samples should be analyzed for a wide range of volatile chemicals if there are no existing data for subsurface vapors — unless it can be demonstrated that an abbreviated or site-specific analyte list is appropriate. If indoor air sampling is appropriate based on the levels of volatile chemicals in subsurface vapors, analysis of indoor air samples specifically for those volatile chemicals may be considered.

### 2.9.3 Outdoor air

Outdoor air samples should be analyzed in a manner consistent with corresponding indoor air samples.

## 2.10 Field laboratories and mobile gas chromatographs (GCs)

Use of field laboratories and mobile GCs as screening tools when collecting soil vapor samples may be considered on a site-specific basis. However, without ELAP certification, screening tools such as these are not acceptable when collecting sub-slab vapor, indoor air and outdoor air samples for the purpose of evaluating exposures related to soil vapor intrusion. ELAP certification for a particular laboratory does not indicate mobile laboratory or GC certification. Mobile laboratories and GCs have specific certification requirements through ELAP. Questions regarding a mobile laboratory's certification should be directed to the laboratory itself.

## 2.11 Surveys and pre-sampling building preparation

[Reference: NYSDOH's *Indoor Air Sampling & Analysis Guidance (February 1, 2005)*]

### 2.11.1 Pre-sampling building inspection and preparation

A pre-sampling inspection should be performed prior to each sampling event to identify and minimize conditions that may interfere with the proposed testing. The inspection should evaluate the type of structure, floor layout, air flows and physical conditions of the building(s) being studied. This information, along with information on sources of potential

indoor air contamination [Section 2.11.2], should be identified on a building inventory form. An example of a building inventory form is given in Appendix B. Items to be included in the building inventory include the following:

- a. construction characteristics, including foundation cracks and utility penetrations or other openings that may serve as preferential pathways for vapor intrusion;
- b. presence of an attached garage;
- c. recent renovations or maintenance to the building (e.g., fresh paint, new carpet or furniture);
- d. mechanical equipment that can affect pressure gradients (e.g., heating systems, clothes dryers or exhaust fans);
- e. use or storage of petroleum products (e.g., fuel containers, gasoline operated equipment and unvented kerosene heaters); and
- f. recent use of petroleum-based finishes or products containing volatile chemicals.

Each room on the floor of the building being tested and on lower floors, if possible, should be inspected. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Where applicable, readings should be provided in units that denote the calibration gas (e.g., isobutylene-equivalent ppm, benzene-equivalent ppm, etc.).

Potential interference from products or activities releasing volatile chemicals should be controlled to the extent practicable. Removing the source from the indoor environment prior to testing is the most effective means of reducing interference. Ensuring that containers are tightly sealed may be sufficient. When testing for volatile organic compounds, containers should be tested with portable vapor monitoring equipment to determine whether compounds are leaking. The inability to eliminate potential interference may be justification for not testing, especially when testing for similar compounds at low levels. The investigator should consider the possibility that chemicals may adsorb onto porous materials and may take time to dissipate.

In some cases, the goal of the testing is to evaluate the impact from products used or stored in the building (e.g., pesticide misapplications, school renovation projects). If the goal of the testing is to determine whether products are an indoor volatile chemical contaminant source, the removing these sources does not apply.

Once interfering conditions are corrected (if applicable), ventilation may be appropriate prior to sampling to minimize residual contamination in the indoor air. If ventilation is appropriate, it should be completed 24 hours or more prior to the scheduled sampling time. Where applicable, ventilation can be accomplished by operating the building's HVAC system to maximize outside air intake. Opening windows and doors, and operating exhaust fans may also help or may be appropriate if the building has no HVAC system.

Air samples are sometimes designed to represent typical exposure in a mechanically ventilated building and the operation of HVAC systems during sampling should be noted on

the building inventory form [Appendix B]. When samples are collected, the building's HVAC system should be operating in a manner consistent with normal operating conditions when the building is occupied (e.g., schools, businesses, etc.). Unnecessary building ventilation should be avoided within 24 hours prior to and during sampling. During colder months, heating systems should be operating to maintain normal indoor air temperatures (i.e., 65 – 75 °F) for at least 24 hours prior to and during the scheduled sampling time.

Depending upon the goal of the indoor air sampling, some situations may warrant deviation from the above protocol regarding building ventilation. In such cases, building conditions and sampling efforts should be understood and noted within the framework and scope of the investigation.

To avoid potential interferences and dilution effects, occupants should make a reasonable effort to avoid the following for 24 hours prior to sampling:

- a. opening any windows, fireplace dampers, openings or vents;
- b. operating ventilation fans unless special arrangements are made;
- c. smoking in the building;
- d. painting;
- e. using a wood stove, fireplace or other auxiliary heating equipment (e.g., kerosene heater);
- f. operating or storing automobile in an attached garage;
- g. allowing containers of gasoline or oil to remain within the house or garage area, except for fuel oil tanks;
- h. cleaning, waxing or polishing furniture, floors or other woodwork with petroleum- or oil-based products;
- i. using air fresheners, scented candles or odor eliminators;
- j. engaging in any hobbies that use materials containing volatile chemicals;
- k. using cosmetics including hairspray, nail polish, nail polish removers, perfume/cologne, etc.;
- l. lawn mowing, paving with asphalt, or snow blowing;
- m. applying pesticides;
- n. using building repair or maintenance products, such as caulk or roofing tar; and
- o. bringing freshly dry-cleaned clothing or furnishings into the building.

#### 2.11.2 Product inventory

The primary objective of the product inventory is to identify potential air sampling interference by characterizing the occurrence and use of chemicals and products throughout the building, keeping in mind the goal of the investigation and site-specific contaminants of concern. For example, it is not appropriate to provide detailed information for each individual container of like items. However, it is appropriate to indicate that "20 bottles of perfume" or "12 cans of latex paint" were present with containers in good condition. This information is used to help formulate an indoor environment profile.

An inventory should be provided for each room on the floor of the building being tested and on lower floors, if possible. This is important because even products stored in another area of a building can affect the air of the room being tested.

The presence and description of odors (e.g., solvent, moldy) and portable vapor monitoring equipment readings (e.g., PIDs, ppbRAE, Jerome Mercury Vapor Analyzer, etc.) should be noted and used to help evaluate potential sources. This includes taking readings near products stored or used in the building. Where applicable, readings should be provided in units that denote the calibration gas (e.g., isobutylene-equivalent ppm, benzene-equivalent ppm, etc.).

Products in buildings should be inventoried every time air is tested to provide an accurate assessment of the potential contribution of volatile chemicals. If available, chemical ingredients of interest (e.g., analyte list) should be recorded for each product. If the ingredients are not listed on the label, record the product's exact and full name, and the manufacturer's name, address and telephone number, if available. In some cases, material Safety Data Sheets may be useful for identifying confounding sources of volatile chemicals in air. Adequately documented photographs of the products and their labeled ingredients can supplement the inventory and facilitate recording the information.

#### 2.12 Role of modeling

At sites where there is a potential for human exposures to subsurface contamination due to soil vapor intrusion (as described in Section 2.1), use of modeling as the sole means of evaluating potential exposures should be avoided. The limitations of modeling (e.g., exclusion of preferential migration pathways) introduce uncertainty as to whether human exposure is occurring, in absence of actual field data. Conclusions drawn from modeling should be verified with actual field data. For example, if modeling results indicate indoor air concentrations are predicted to be below applicable guidelines or levels of concern, indoor air and/or sub-slab vapor sampling would be appropriate to verify a conclusion that mitigation or other actions are not needed.

Modeling may, however, be used as a tool in the evaluation process. Examples of situations in which modeling may be used as a tool include, but are not limited to, the following:

- a. to help identify potential migration pathways on the basis of site-specific conditions;
- b. to estimate potential exposures when field samples cannot be collected (e.g., access to collect the samples is denied or buildings have not yet been constructed over the subsurface contamination); and
- c. to identify a preferred order for sampling buildings by predicting expected indoor air concentrations within each of the buildings if there are numerous buildings overlying the subsurface contamination.

Use of any model at a site should be discussed with the agencies prior to the model's development and application. If a model is used, it should incorporate site-specific parameters (e.g., attenuation factors, soil conditions, concentrations of volatile chemicals, depth to subsurface source, characteristics of subsurface source, and foundation slab thickness) as much as possible. Furthermore, both the limitations of the model (e.g., exclusion of preferential migration pathways) and the sensitivity of the variables in the model should be understood and identified with the modeling results.

### Section 3: Data Evaluation and Recommendations for Action

Section 3 describes the process by which data obtained during the investigation are evaluated. The goals of the evaluation are as follows:

- a. to determine what volatile chemicals, if any, are present in the investigated media;
- b. to identify the likely cause(s) of their presence; and
- c. to identify completed and potential human exposures whether actions to address exposures should be taken.

Also discussed are actions typically recommended based on the evaluation. Actions to remediate the source(s) of soil vapor contamination, such as soil excavation or air-spargers/soil vapor extraction systems, are beyond the scope of this guidance and are not included.

#### 3.1 Data quality

Before the data are evaluated, their representativeness and reliability should be verified. To assess analytical errors and the usability of the data, a qualified person should review the analytical data package and all associated QA/QC information to make sure that

- a. the data package is complete;
- b. holding times have been met;
- c. the QC data fall within the protocol limits and specifications;
- d. the data have been generated using established and agreed upon analytical protocols;
- e. the raw data confirm the results provided in the data summary sheets and QC verification forms; and
- f. correct data qualifiers have been used.

As discussed in Section 2.8, for sites in an environmental remediation program (e.g., State Superfund), a DUSR or equivalent report should be generated in accordance with NYSDEC guidance and should be submitted for regulatory review and approval.

If the investigation was not completed in accordance with the guidelines set forth in Section 2, additional investigation may be appropriate to either replace or complement the existing data. For example, product inventories [Section 2.11.2] filled out incompletely or incorrectly may need to be redone (and in some cases with additional air sampling) so that likely sources of volatile chemicals in the indoor air can be identified and appropriate actions to mitigate exposures can be recommended.

#### 3.2 Overview

The results of individual soil vapor, sub-slab vapor, indoor air and outdoor air samples are not reviewed in isolation. Rather, they are evaluated with the consideration of several additional factors, which include the following:

- a. the nature and extent of contamination in *all* environmental media;
- b. factors that affect vapor migration and intrusion;

- c. completed or proposed remedial actions;
- d. sources of volatile chemicals;
- e. background levels of volatile chemicals in air;
- f. relevant standards, criteria and guidance values; and
- g. past, current and future land uses.

These factors are described in detail in this subsection.

#### 3.2.1 Nature and extent of contamination in all environmental media

The type of volatile chemicals present and the extent of contamination in all environmental media — including soil, groundwater, subsurface vapors, indoor air and outdoor air — is considered when evaluating the data. Trends in environmental data (e.g., groundwater monitoring results show concentrations of volatile chemicals are decreasing) are also considered. This information is used to identify possible sources of contamination and migration pathways, as well as to recommend appropriate actions to address exposures.

#### 3.2.2 Factors that affect vapor migration and intrusion

As discussed in Section 1.3, there are numerous site-specific environmental factors [Table 1.1] and building factors [Table 1.2] that can affect soil vapor migration and intrusion. This information is used to identify possible sources of contamination and migration pathways, as well as to recommend appropriate actions to address exposures.

#### 3.2.3 Sources of volatile chemicals

An understanding of the likely sources of the chemicals is crucial for determining appropriate actions to address exposure, as well as identifying the parties responsible for implementing the actions. Volatile chemicals that are not site-related may be present in the investigated media for reasons such as the following:

- a. *subsurface vapors* — misuse, misapplication, or improper disposal of the chemicals to the subsurface, unidentified subsurface sources of vapor contamination, presence of septic systems (where products, such as cleaning agents or degreasers, may be disposed), biodegradation of natural organic matter in soil, infiltration into the subsurface from a building under positive pressure in which the chemicals are heavily used (i.e., reverse process from soil vapor intrusion), etc.;
- b. *indoor air* — use and storage (current or historic) of volatile chemical-containing products, off-gassing from building materials or new furnishings, use of contaminated groundwater during private well usage, infiltration of outdoor air containing volatile chemicals, etc. [Table 1.3]; and
- c. *outdoor air* — emissions from automobiles, lawn mowers, oil storage tanks, gasoline stations, dry cleaners or other commercial/industrial facilities, etc. [Table 1.3].

Site-related chemicals may also be present for these same reasons. Information about household products and their ingredients are available on web sites, such as the National Institute of Health's site at <http://householdproducts.nlm.nih.gov>.

### 3.2.4 Background levels of volatile chemicals in air

Chemicals are part of our everyday life [Section 1.4]. As such, they are found in the indoor air of buildings not affected by intrusion of contaminated soil vapor. They are also found in the outdoor air that enters a home or place of business. Commonly found concentrations of these chemicals in indoor and outdoor air are referred to as "background levels." Background levels of volatile chemicals are one of the factors considered when evaluating sampling results at a site [Section 3.3.2 – 3.3.4]. Estimates of background levels come from studies where air samples were collected in homes, offices and outdoor areas.

Several studies have been conducted, both nationally and in the State of New York, to provide information on indoor and outdoor air background levels in a variety of settings (e.g., residential or commercial buildings). Each of these studies offers useful information and has its own limitations. Each database provides statistical measures of background levels and the criteria used to select sampling locations. The criteria in some of the studies required that sampling locations not be located near known sources of volatile chemicals (for example, not near a chemical spill, hazardous waste site, dry-cleaner, or factory). The criteria may also have included checking containers of volatile chemicals in or near the building to make sure they are tightly closed or removing those products before samples are taken. Depending on the criteria for site selection and sampling conditions, statistical measures of background levels in a given study may differ from what would be expected if indoor air were sampled in randomly selected homes.

The background databases that are used for evaluating indoor and outdoor air data are introduced below. A more detailed description of each database along with statistical measures of background levels are provided in Appendix C.

- a. *NYSDOH 2003: Study of Volatile Organic Chemicals in Air of Fuel Oil Heated Homes*  
Results of indoor and outdoor air samples collected from 104 single-family fuel oil heated homes throughout New York State. Samples collected in evacuated canisters and analyzed for 69 aromatic, aliphatic, and halogenated hydrocarbons, and ketones by modified EPA Method TO-15. Limitations: only fuel oil heated homes were included, homes were not randomly selected, and five boroughs of New York City were excluded.
- b. *EPA 2001: Building Assessment and Survey Evaluation (BASE) Database*  
Study of measured concentrations of volatile organic compounds from 100 randomly selected public and commercial office buildings. Samples collected by evacuated canisters and/or tube methodologies. Limitations: only represents office settings, two methodologies used for sampling and analysis that are not completely overlapping and do not show agreement in results in some cases.
- c. *NYSDOH 1997: Control Home Database*  
Indoor and outdoor air samples compiled from 53 residences in New York State that were considered "control homes" with neighborhood, construction, and occupancy similar to potentially impacted homes that were being investigated at the time. Limitations: multiple methodologies for sampling and analysis, small sample size, and varying detection limits often higher than current background levels.
- d. *EPA 1988: National Ambient Volatile Organic Compounds (VOCs) Data Base Update*  
Published and unpublished air data compiled by the EPA in 1988. The document includes data from studies between 1970 to 1987. The database covers more than

300 chemicals in indoor and outdoor settings. Limitations: data are compiled from numerous studies with limitations on selection or screening criteria, data are 20-35 years old, indoor air data include both residential and office spaces, sample size for some analytes is very small (less than 10). Outdoor air data include rural, suburban, urban, source dominated and remote locations.

- e. *Health Effects Institute (HEI) 2005: Relationship of Indoor, Outdoor, and Personal Air (RIOPA)*

Indoor, outdoor and personal air concentrations of 18 VOCs, 10 carbonyl compounds and particulate matter (PM<sub>2.5</sub>) were measured in 100 homes in each of 3 cities between the summer of 1999 and the spring of 2001. Limitations: limited numbers of VOCs, passive organic vapor badge method is subject to sampling bias in stationary versus mobile locations, the passive organic vapor badge method is only approved for tetrachloroethene in New York State.

Among the databases, the Upper Fence (see \*NOTE below) values from the NYSDOH Fuel Oil Study data may be used as initial benchmarks when evaluating residential indoor air (see Appendix C.1) and the 90th percentile values from the EPA BASE data for indoor air in office and commercial buildings (see Appendix C.2). These initial benchmark values should be considered along with the overall distribution of results in the background database to characterize sampling results from a single building or from multiple buildings in a community. The Health Effects Institute 2005 database and the older NYSDOH and EPA databases can also provide useful information on the range of concentrations found in air. The database or combination of databases that best represents site-specific conditions should be used as the basis for comparison. State agency personnel should review and have the opportunity to comment on the proposed use of other databases or subsets of data within a database for evaluating test results.

\*NOTE: The Upper Fence is calculated as 1.5 times the interquartile range (difference between the 25th and 75th percentile values) above the 75th percentile value. It is a boundary estimate used to account for outliers in the data.

### 3.2.5 Relevant standards, criteria and guidance values

- a. *Subsurface vapors*

The State of New York does not have any standards, criteria or guidance values for concentrations of volatile chemicals in subsurface vapors (either soil vapor or sub-slab vapor).

- b. *Indoor and outdoor air*

The NYSDOH has developed several guidelines for chemicals in air. The development process is initiated for specific situations. For example, in New York State, particularly in New York City, dry cleaners are often located in apartment buildings. Because air in buildings mixes to some extent and the dry cleaning chemical tetrachloroethene (PCE) is volatile, it may migrate to residential apartments. When the NYSDOH became aware of this problem and how widespread it is, the NYSDOH developed an air guideline for PCE of 100 micrograms per cubic meter (mcg/m<sup>3</sup>). In addition to PCE, the NYSDOH has developed guidelines for methylene chloride (also referred to as dichloromethane) and trichloroethene (TCE) in air, as well as dioxin and polychlorinated biphenyls (PCBs) in indoor air. Each guideline went through a peer review process, in which expert scientists outside of the NYSDOH reviewed the technical documentation that describes

the scientific basis for the guidance value. The peer reviewers provided technical comments on the data and methods used to derive the guidelines, each of which were addressed by the NYSDOH. Upon completion of the reviews and responses to comments, the guidelines were finalized.

Air guideline values derived by the NYSDOH are summarized in Table 3.1. Additional information about these guidelines is provided in the following:

- Appendix D — overview of how the NYSDOH develops air guidelines; and
- Appendix H — copies of fact sheets that discuss the air guidelines for PCE and TCE.

The purpose of a guideline is to help guide decisions about the nature of efforts to reduce exposure to the chemical. Reasonable and practical actions should be taken to reduce exposures when indoor air levels are above background, even when they are below the guideline. The urgency to complete these actions increases with indoor air levels, particularly when air levels are above the guideline, and additional actions taken if the initial actions do not sufficiently reduce levels. In all cases, the specific corrective actions to be taken depend on a case-by-case evaluation of the situation. The goal of the recommended actions is to reduce chemical levels in indoor air to as close to background as practical.

**Table 3.1** Air guideline values derived by the NYSDOH

Chemical		Air Guideline Value (mcg/m <sup>3</sup> )	Reference
methylene chloride (also referred to as dichloromethane)	MeCl	60	1
polychlorinated biphenyls	PCBs	1*	2,3
tetrachlorodibenzo- <i>p</i> -dioxin equivalents	TCDD	0.00001*	3,4
tetrachloroethene	PCE	100	5
trichloroethene	TCE	5	6,7

\*The guideline is specific to indoor air.

References:

- [1] NYSDOH. 1988. Letter from N. Kim to T. Allen, Division of Air, New York State Department of Environmental Conservation. November 28, 1988.
- [2] NYSDOH. 1985. Binghamton State Office Building (BSOB) Re-Entry Guidelines: PCBs. Document 1330P. Albany, NY: Bureau of Toxic Substance Assessment.
- [3] NYSDOH. 1988. Letter from D. Axelrod to J. Egan, New York State Office of General Services. March 8, 1988.
- [4] NYSDOH. 1984. Re-Entry Guidelines. Binghamton State Office Building. Document 0549P. Albany, NY: Bureau of Toxic Substance Assessment.
- [5] NYSDOH. 1997. Tetrachloroethene Ambient Air Criteria Document. Albany, NY: Bureau of Toxic Substance Assessment.
- [6] NYSDOH. 2003. Letter from N. Kim to D. Desnoyers, Division of Environmental Remediation, New York State Department of Environmental Conservation. October 31, 2003. [Provided in Appendix D.]
- [7] NYSDOH. 2006. Final Report: Trichloroethene (TCE) Air Criteria Document. Center for Environmental Health, Bureau of Toxic Substance Assessment. Troy, NY.

### 3.2.6 Completed or proposed remedial actions

The status and effectiveness of actions taken to remediate environmental contamination (e.g., soil removal, groundwater treatment, soil vapor extraction, etc.) are considered when making decisions pertaining to additional sampling and the selection of mitigation actions. For example,

- a. if a comparison of pre-remediation and post-remediation subsurface vapor sampling results indicates negligible improvement in the quality of subsurface vapors,
  1. additional sampling may be appropriate to document a decreasing trend in subsurface vapor concentrations;
  2. termination of mitigation system operations may not be appropriate without additional sampling; or
  3. additional remedial actions may be appropriate to address contaminated subsurface vapors;
- b. when monitoring a building is appropriate, it may be more cost-effective to install a mitigation system if subsurface contamination is wide-spread and is expected to take many years to remediate; and
- c. if exposures in an on-site building will be addressed concurrently by a method selected to remediate subsurface contamination (e.g., a soil vapor extraction system), installation of a mitigation system may be redundant. However, if the remedial system is not expected to be operational in the immediate future, or if it is not expected to mitigate indoor air levels in a reasonable time frame, a mitigation system may still be appropriate. [Refer to Section 4.1 for a description of the appropriate use of concurrent techniques.]

### 3.2.7 Past, current and future land uses

Past, current and future land uses are considered when evaluating the investigation data and determining appropriate actions for further investigation or measures to address exposures. For example,

- a. if the parcel or buildings were historically used for commercial or industrial purposes (e.g., gasoline station, automotive repair facility, electroplating facility, etc.), but are currently used for residential purposes or commercial or industrial purposes where volatile chemicals are not used in current operations, off-gassing of volatile chemicals from building materials [Table 1.3] or additional subsurface sources should be considered;
- b. subsurface vapor sampling of a parcel that is undeveloped or contains unoccupied buildings may be appropriate based on the data evaluation. However, sampling may be delayed as discussed in Section 2.3;
- c. air sampling of a building may be appropriate based on the data evaluation. However, provisions may be put in place to defer sampling until occupancy of the building is expected; or
- d. if actions should be taken to mitigate exposures related to soil vapor intrusion should the site be developed, the appropriate mitigation method will depend upon the proposed land use — a parking lot, recreational field, single-family home, commercial building, high-rise building with underground parking, occupied or unoccupied building, etc. — since each presents a different exposure scenario.

### 3.3 Sampling results and recommended actions

This subsection describes the process for evaluating sampling results. It also describes actions that may be recommended based on the evaluation. The evaluation procedures and actions described may not be directly applicable to samples collected as part of an emergency response. For guidance on how to proceed in such situations, refer to Section 3.5.

#### 3.3.1 Soil vapor

If soil vapor samples are collected from locations where there are no known sources of volatile chemicals, we do not expect the chemicals to reach detectable levels in the samples. However, concentrations of volatile chemicals in soil vapor are commonly detected. This is likely due to several factors, including infiltration of outdoor air into the subsurface (to a limited extent) and background interferences (similar to indoor and outdoor air [Section 3.2.4]).

New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in soil vapor. Additionally, there are currently no databases available of background levels of volatile chemicals in soil vapor. In the absence of this information, soil vapor sampling results are reviewed "as a whole," in conjunction with the results of other environmental sampling and the site conceptual model, to identify trends and spatial variations in the data [Section 3.2.1]. To put some perspective on the data, soil vapor results might be compared to background outdoor air levels [Section 3.2.4], site-related outdoor air sampling results, or the NYSDOH's guidelines for volatile chemicals in air [Table 3.1].

These comparisons are used to

- identify areas of relatively elevated concentrations of volatile chemicals in soil vapor;
- select buildings for sub-slab vapor, indoor air and outdoor air sampling;
- identify possible sources of subsurface vapor contamination;
- monitor the progress, or verify the completion, of efforts to remediate subsurface vapor contamination (either directly or indirectly); and
- characterize the nature and extent of subsurface vapor contamination.

When determining appropriate actions, the following should also be considered:

- Soil vapor results may not indicate a traditional plume-like pattern of contamination (as is often described for groundwater). Rather, the nature and extent of contamination may follow a "hit and miss" pattern.
- Our experience to date indicates soil vapor results alone typically cannot be relied upon to rule out sampling at nearby buildings. For example, concentrations of volatile chemicals in sub-slab vapor samples have been substantially higher (e.g., by a factor of 100 or more) than concentrations found in nearby soil vapor samples (e.g., collected at 8 feet below grade near the building). This may be due to differences in factors such as soil moisture content and pressure gradients. Therefore, exposures are evaluated primarily based on sub-slab vapor, indoor air and outdoor air sampling results and soil vapor results are primarily used as a tool to guide these investigations.

There are no concentrations of volatile chemicals in soil vapor that automatically trigger action or no further action. Based on the comparisons and considerations described, the following actions may be recommended:

#### a. No further soil vapor sampling

The nature and extent of subsurface vapor contamination has been adequately characterized with respect to addressing exposures and designing measures to remediate subsurface vapor contamination (either directly or indirectly).

Sub-slab vapor samples, rather than soil vapor samples, will be used to identify potential exposures and to characterize the nature and extent of subsurface vapor contamination since soil vapor results are not following a consistent pattern (i.e., hit and miss).

#### b. Additional soil vapor sampling

To characterize the nature and extent of subsurface vapor contamination if soil vapor results are following a consistent pattern (e.g., traditional plume-like pattern).

To identify possible sources of subsurface vapor contamination.

To verify sampling results that appear inconsistent with previous sampling and/or the current understanding of the site [Sections 3.2.1 and 3.2.2].

To resample locations where results may have been invalidated by short-circuiting (outdoor air infiltration), cross contamination, or other problems.

To monitor the progress, or verify the completion, of efforts to remediate subsurface vapor contamination (either directly or indirectly).

#### c. Sub-slab vapor, indoor air and outdoor air sampling

Generally, if soil vapor results are fairly consistent throughout the study area, buildings closest to the site are sampled first. The investigation then proceeds outward, as appropriate, on an areal basis until potential and current human exposures have been adequately addressed. If there is an area of relatively elevated concentrations of volatile chemicals in soil vapor (when looking at the soil vapor results as a whole), then the buildings in this area are also sampled.

#### d. Address exposures related to soil vapor intrusion

Provisions on parcels may be appropriate so that the parcel will not be developed or buildings occupied without addressing exposure concerns [Sections 2.3 and 3.6].

As discussed previously, soil vapor sampling results alone typically do not drive actions to mitigate exposures in existing buildings. Rather, they guide sampling efforts in buildings. However, a "blanket mitigation" approach may be taken provided the nature and extent of soil vapor contamination has been sufficiently characterized. A "blanket mitigation" approach is where an area is defined within which each building may be offered a mitigation system. The offer is made regardless of what actions may be appropriate based on an evaluation of air results (e.g., no further action or monitoring).

## Notes:

- a. The recommended actions may be modified or supported upon consideration of the factors given in Section 3.2.
- b. Additional sampling may become appropriate based on the migration of subsurface contamination (e.g., contaminated groundwater or vapors) or if environmental monitoring indicates a change in chemical constituents (e.g., the production of degradation products that may be more toxic than the parent compounds).

3.3.2 Sub-slab vapor

The goals of collecting sub-slab vapor samples are to identify potential and current (when collected concurrently with indoor and outdoor air samples) exposures associated with soil vapor intrusion and to characterize the nature and extent of subsurface vapor contamination. As discussed in Sections 3.2.5 and 3.3.1, New York State currently does not have any standards, criteria or guidance values for concentrations of compounds in sub-slab vapor. Additionally, there are no databases available of background levels of volatile chemicals in subsurface vapors.

The detection of volatile chemicals in sub-slab vapor samples does not necessarily indicate soil vapor intrusion is occurring or actions should be taken to address exposures. When making these decisions, the State considers the following:

- a. the sampling results — sub-slab vapor, indoor air, outdoor air, soil vapor;
- b. background concentrations of volatile chemicals in indoor air;
- c. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];
- d. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;
- e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations),
- f. the NYSDOH's decision matrices [described in Section 3.4], and
- g. the factors described in Section 3.2.

Based on this evaluation, the following actions may be recommended:

a. *No further action*

When the volatile chemical is not detected in the indoor air and sub-slab sample results are not expected to substantially affect indoor air quality.

b. *Take reasonable and practical actions to identify source(s) and reduce exposures*

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

c. *Resampling*

Resampling may also be recommended when the results are not consistent with the conceptual site model. For example, when the sub-slab vapor results of a building do not indicate a need to take action, but the sub-slab vapor results of adjacent buildings indicate a need to take actions to address exposures related to soil vapor intrusion.

Resampling may be appropriate if samples were collected outside of the heating season. As discussed in Section 2.4.2, results obtained outside of the heating season should not be used to rule out exposures related to soil vapor intrusion.

d. *Monitoring*

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended to determine whether concentrations in indoor air or sub-slab vapor have changed. It is also recommended to determine what affect, if any, active soil and groundwater remediation techniques (e.g., chemical oxidation, air sparging, etc.) may be having on subsurface vapor and indoor air quality. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

e. *Mitigate*

Mitigation may be appropriate to minimize current or potential exposures associated with soil vapor intrusion. Mitigation methods are described in Section 4.

## Notes:

- a. The recommended actions may be modified or supported upon consideration of the factors given in Section 3.2.
- b. Additional sampling may be appropriate based on the migration of subsurface contamination (e.g., contaminated groundwater or vapors) or if environmental monitoring indicates a change in chemical constituents (e.g., the production of degradation products that may be more toxic than the parent compounds).
- c. Monitoring and mitigation measures to address exposures related to soil vapor intrusion are considered interim measures implemented until contaminated environmental media (e.g., soil, groundwater and/or soil vapor) are remediated.
- d. Actions more protective of human health may be proposed. For example, such a decision may be based on a comparison of the costs associated with resampling or monitoring to the costs associated with installation and monitoring of a mitigation system.
- e. Additional sampling associated with post-mitigation testing, operation, maintenance and monitoring activities, and termination of mitigation system operations is described in Section 4.

### 3.3.3 Indoor air

Indoor air samples are used to assess current exposures to volatile chemicals in air. The detection of volatile chemicals in indoor air samples does not necessarily indicate soil vapor intrusion is occurring or actions should be taken to address exposures. When making these decisions, the State considers the following:

- the sampling results — sub-slab vapor, indoor air, outdoor air, soil vapor;
- background concentrations of volatile chemicals in indoor air;
- the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];
- human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;
- attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations), and
- the NYSDOH's decision matrices [described in Section 3.4], and
- the factors described in Section 3.2.

When evaluating indoor air data, the results are compared to background levels of volatile chemicals in indoor air [Section 3.2.4], the NYSDOH's guidelines for volatile chemicals in air [Table 3.1], the NYSDOH's decision matrices [Section 3.4], and human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air. This helps to put the results into perspective and to determine the need for action and the urgency with which actions should be taken. As discussed in Section 3.2.5, the urgency to complete reasonable and practical actions to reduce exposures increases with indoor air levels, particularly when air levels are above a guideline.

Generally, if the results are comparable to background levels, then no further action is needed to address *current* human exposures. However, additional sampling may be appropriate if

- samples were collected at times when vapor intrusion is not expected to have its greatest effect on indoor air quality (typically, samples collected outside of the heating season). As discussed in Section 2.4, these results may not be used to rule out exposures related to soil vapor intrusion;
- the potential for exposures related to soil vapor intrusion should be monitored based on the sub-slab vapor results [Section 3.3.2]; and/or
- subsurface conditions change over time (e.g., due to the migration of contaminated groundwater or vapors).

If the concentrations of volatile chemicals are not consistent with background levels, then the likely cause of the exposure should be determined. Understanding the source is crucial for selecting the best method to address exposures. For example, although a volatile chemical may be detected in the sub-slab vapor sample, the results may indicate that indoor air effects are more likely to be coming from products stored in the building or from outdoor air rather than from contaminated soil vapors. Therefore, a sub-slab depressurization system to minimize exposures associated with soil vapor intrusion may not be appropriate.

As discussed in Sections 1.4 and 3.2.3, volatile chemicals may be present in the indoor air due to any one, or a combination, of the following:

- the indoor environment itself and/or building characteristics;
- off-gassing of volatile chemicals from contaminated water that may enter the building at the tap or shower head, or during flooding events, or contaminated water that rests in a sump or a subsurface drain;
- outdoor sources; and/or
- migration from the subsurface (i.e., soil vapor intrusion).

To determine the likely cause, the following assessment is completed:

- qualitative and quantitative comparisons are made between the types and concentrations of the contaminants found in the indoor air sample(s) and those found in the outdoor air and sub-slab vapor sample;
- qualitative and quantitative comparisons are made between indoor air results obtained in different locations of the building (e.g., different floors or rooms);
- indoor air results are compared to the product inventory to evaluate the extent to which indoor sources are affecting indoor air quality; and
- the indoor air quality questionnaire and building inventory form is reviewed to identify potential preferential pathways for soil vapor intrusion into the building, potential outdoor sources of volatile chemicals to the outdoor air (e.g., gasoline station or dry cleaner), and routes of air distribution within the building (e.g., HVAC system operations, airflow observations, etc.).

If a likely source or multiple sources can be identified from the available information, one or more of the following actions may be recommended given the source:

a. *Indoor source or building characteristics*

Products containing volatile chemicals should be tightly capped. Alternatively, the products can be stored in places where people do not spend much time, such as a garage or outdoor shed. If the products are no longer needed, consideration should be given to disposing of them properly (e.g., hazardous waste cleanup days). The list of products and corresponding readings from field instrumentation provided in the product inventory [Appendix B] can help identify products that may be contributing to the levels that were detected in the indoor air.

If exposures are assumed to be associated with off-gassing of new building materials, paint, etc., resampling may be appropriate to confirm this assumption or to confirm that actions taken to address these exposures have been effective.

b. *Off-gassing from contaminated groundwater within the building*

Measures should be taken to prevent contaminated groundwater from entering the house (e.g., filter on private well supply, sealed sump, etc.).

c. *Outdoor source*

No further action to address exposures related to soil vapor intrusion, unless the evaluation for soil vapor intrusion cannot be completed until outdoor interferences are addressed.

**d. Soil vapor intrusion**

Depending upon the relationship between indoor air concentrations and sub-slab vapor concentrations and the results of environmental sampling in the area, resampling, monitoring or mitigation may be recommended by the State.

1. Resampling, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended when the results are not consistent with the conceptual site model. For example, when indoor air results are comparable or higher than the corresponding sub-slab vapor results and the results do not appear to be due to building characteristics or alternate sources (either indoor or outdoor).
2. Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, may be recommended to determine whether concentrations in indoor air or sub-slab vapor have changed. It is also recommended to determine what affect, if any, active soil and groundwater remediation techniques (e.g., chemical oxidation, air sparging, etc.) may be having on subsurface vapor and indoor air quality. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.
3. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4.

The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

Likely sources may not be evident given the information available. Therefore, the above recommendations cannot be made. This situation most often arises for the following reasons:

- a. Interfering indoor sources are identified. However, the possibility of vapor intrusion cannot be ruled out due to the concentrations of the same volatile chemicals detected in the sub-slab vapor sample. Differentiating the contribution of each source is not possible.
- b. Indoor air samples were collected without concurrent outdoor air and sub-slab vapor samples. Depending upon other information that may be available (e.g., building inventory and well-characterized subsurface vapor contamination), identifying likely sources and recommending appropriate actions may not be possible.

- c. All appropriate air samples are collected. However, the indoor air quality questionnaire and building inventory forms are filled out incompletely or incorrectly. The contribution of indoor sources cannot be evaluated.

When the source(s) of volatile chemicals to indoor air cannot be identified with confidence, resampling is typically recommended with corrections made as appropriate. For example, using the three scenarios presented above:

- a. resampling occurs after interferences are removed;
- b. concurrent indoor air, outdoor air and sub-slab vapor samples are collected; and
- c. an indoor air quality questionnaire and building inventory form is filled out completely and correctly when samples are collected.

Notes: See notes presented in Section 3.3.2.

**3.3.4 Outdoor air**

Outdoor air sampling results are primarily used to evaluate the extent to which outdoor air may be contributing to the levels of volatile chemicals detected in indoor air. However, people are also exposed to the outdoor air and the outdoor air results are indicative of outdoor air conditions. As such, outdoor air results are also reviewed to determine whether outdoor air conditions present a potential concern that requires further investigation.

As discussed in Sections 1.4 and 3.2.3, volatile chemicals may be present in outdoor air due to emissions from automobiles, lawn mowers, oil storage tanks, gasoline stations, and dry cleaners or other commercial and industrial facilities. To determine what extent, if any, outdoor air is affecting indoor air quality, indoor air results are compared to outdoor air results. To determine whether outdoor air conditions present a potential concern that requires further investigation, the State looks at the data set as a whole and considers the following:

- a. background concentrations of volatile chemicals in outdoor air;
- b. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];
- c. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air; and
- d. the factors described in Section 3.2.

**3.4 Decision matrices****3.4.1 Overview**

Decision matrices are risk management tools, developed by the NYSDOH in conjunction with other agencies, to provide guidance on a case-by-case basis about actions that should be taken to address current and potential exposures related to soil vapor intrusion. The matrices are intended to be used when evaluating the results from buildings with full slab foundations. The matrices encapsulate the data evaluation processes and actions recommended to address exposures discussed in Sections 3.3.2 and 3.3.3. The general format of a decision matrix is shown in Table 3.2.

**Table 3.2** General format of a decision matrix

Sub-slab Vapor Concentration of Volatile Chemical (mcg/m <sup>3</sup> )	Indoor Air Concentration of Volatile Chemical (mcg/m <sup>3</sup> )		
	Concentration Range 1	Concentration Range 2	Concentration Range 3
Concentration Range 1	ACTION	ACTION	ACTION
Concentration Range 2	ACTION	ACTION	ACTION
Concentration Range 3	ACTION	ACTION	ACTION

Indoor air and sub-slab vapor concentration ranges in a matrix are selected based on a number of considerations in addition to health risks. For example, factors that are considered when selecting the ranges include, but are not limited to, the following:

- a. human health risks (i.e., cancer and non-cancer health effects) associated with exposure to the volatile chemical in air;
- b. the NYSDOH's guidelines for volatile chemicals in air [Table 3.1];
- c. background concentrations of volatile chemicals in air [Section 3.2.4];
- d. analytical capabilities currently available; and
- e. attenuation factors (i.e., the ratio of indoor air to sub-slab vapor concentrations).

**3.4.2 Matrices**

The NYSDOH has developed two matrices, which are included at the end of Section 3.4, to use as tools in making decisions when soil vapor may be entering buildings. The first decision matrix was originally developed for TCE and the second for PCE. As summarized in Table 3.3, four chemicals have been assigned to the two matrices to date.

**Table 3.3** Volatile chemicals and their decision matrices

Chemical	Soil Vapor/Indoor Air Matrix*
Carbon tetrachloride	Matrix 1
Tetrachloroethene (PCE)	Matrix 2
1,1,1-Trichloroethane (1,1,1-TCA)	Matrix 2
Trichloroethene (TCE)	Matrix 1

\*The decision matrices are available at the end of Section 3.4.

Because the matrices are risk management tools and consider a number of factors, the NYSDOH intends to assign chemicals to one of these two matrices, if possible. For example, if a chemical other than those already assigned to a matrix is identified as a chemical of concern during a soil vapor intrusion investigation, assignment of that chemical into one of the existing decision matrices will be considered by the NYSDOH. Factors that will be considered in assigning a chemical to a matrix include, but are not limited to, the following:

- a. human health risks, including such factors as a chemical's ability to cause cancer, reproductive, developmental, liver, kidney, nervous system, immune system or other effects, in animals and humans and the doses that may cause those effects;
- b. the data gaps in its toxicologic database;
- c. background concentrations of volatile chemicals in indoor air [Section 3.2.4]; and
- d. analytical capabilities currently available.

If the NYSDOH determines that the assignment of the chemical into an existing matrix is inappropriate, then the NYSDOH will either modify an existing matrix or develop a new matrix.

To use the matrices appropriately as a tool in the decision-making process, the following should be considered:

- a. The matrices are generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).
- b. Indoor air concentrations detected in samples collected from the building's basement or, if the building has a slab-on-grade foundation, from the building's lowest occupied living space should be used.
- c. Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.
- d. When current exposures are attributed to sources other than vapor intrusion, the agencies should be provided documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix and to support assessment and follow-up by the agencies.

3.4.3 Description of recommended actions

Actions recommended in the matrix are based on the relationship between sub-slab vapor concentrations and corresponding indoor air concentrations. They are intended to address both potential and current human exposures and include the following:

a. No further action

When the volatile chemical is not detected in the indoor air sample and the concentration detected in the corresponding sub-slab vapor sample is not expected to substantially affect indoor air quality.

b. Take reasonable and practical actions to identify source(s) and reduce exposures

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile chemical-containing products in places where people do not spend much time, such as a garage or shed). Resampling may also be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

d. Monitor

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is appropriate to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be appropriate to determine whether existing building conditions (e.g., positive pressure HVAC systems) are maintaining the desired mitigation endpoint and to determine whether changes are appropriate.

The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions.

e. Mitigate

Mitigation is appropriate to minimize current or potential exposures associated with soil vapor intrusion. Methods to mitigate exposures related to soil vapor intrusion are described in Section 4.

f. Monitor / Mitigate

Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

**Soil Vapor/Indoor Air Matrix 1**  
October 2006

SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )			
	< 0.25	0.25 to < 1	1 to < 5.0	5.0 and above
< 5	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
5 to < 50	5. No further action	6. MONITOR	7. MONITOR	8. MITIGATE
50 to < 250	9. MONITOR	10. MONITOR / MITIGATE	11. MITIGATE	12. MITIGATE
250 and above	13. MITIGATE	14. MITIGATE	15. MITIGATE	16. MITIGATE

**No further action:**  
Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

**Take reasonable and practical actions to identify source(s) and reduce exposures:**  
The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

**MONITOR:**  
Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MITIGATE:**  
Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MONITOR / MITIGATE:**  
Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

MATRIX 1 Page 1 of 2

## ADDITIONAL NOTES FOR MATRIX 1

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

- [1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).
- [2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.
- [3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 0.25 microgram per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended for buildings with full slab foundations, and 1 microgram per cubic meter for buildings with less than a full slab foundation.
- [4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.
- [5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.
- [6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

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## Soil Vapor/Indoor Air Matrix 2

October 2006

SUB-SLAB VAPOR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )	INDOOR AIR CONCENTRATION of COMPOUND (mcg/m <sup>3</sup> )			
	< 3	3 to < 30	30 to < 100	100 and above
< 100	1. No further action	2. Take reasonable and practical actions to identify source(s) and reduce exposures	3. Take reasonable and practical actions to identify source(s) and reduce exposures	4. Take reasonable and practical actions to identify source(s) and reduce exposures
100 to < 1,000	5. MONITOR	6. MONITOR / MITIGATE	7. MITIGATE	8. MITIGATE
1,000 and above	9. MITIGATE	10. MITIGATE	11. MITIGATE	12. MITIGATE

**No further action:**

Given that the compound was not detected in the indoor air sample and that the concentration detected in the sub-slab vapor sample is not expected to significantly affect indoor air quality, no additional actions are needed to address human exposures.

**Take reasonable and practical actions to identify source(s) and reduce exposures:**

The concentration detected in the indoor air sample is likely due to indoor and/or outdoor sources rather than soil vapor intrusion given the concentration detected in the sub-slab vapor sample. Therefore, steps should be taken to identify potential source(s) and to reduce exposures accordingly (e.g., by keeping containers tightly capped or by storing volatile organic compound-containing products in places where people do not spend much time, such as a garage or outdoor shed). Resampling may be recommended to demonstrate the effectiveness of actions taken to reduce exposures.

**MONITOR:**

Monitoring, including sub-slab vapor, basement air, lowest occupied living space air, and outdoor air sampling, is needed to determine whether concentrations in the indoor air or sub-slab vapor have changed. Monitoring may also be needed to determine whether existing building conditions (e.g., positive pressure heating, ventilation and air-conditioning systems) are maintaining the desired mitigation endpoint and to determine whether changes are needed. The type and frequency of monitoring is determined on a site-specific and building-specific basis, taking into account applicable environmental data and building operating conditions. Monitoring is an interim measure required to evaluate exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MITIGATE:**

Mitigation is needed to minimize current or potential exposures associated with soil vapor intrusion. The most common mitigation methods are sealing preferential pathways in conjunction with installing a sub-slab depressurization system, and changing the pressurization of the building in conjunction with monitoring. The type, or combination of types, of mitigation is determined on a building-specific basis, taking into account building construction and operating conditions. Mitigation is considered a temporary measure implemented to address exposures related to soil vapor intrusion until contaminated environmental media are remediated.

**MONITOR / MITIGATE:**

Monitoring or mitigation may be recommended after considering the magnitude of sub-slab vapor and indoor air concentrations along with building- and site-specific conditions.

See additional notes on page 2.

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## ADDITIONAL NOTES FOR MATRIX 2

October 2006

Final NYSDOH CEH BEEI Soil Vapor Intrusion Guidance

This matrix summarizes the minimum actions recommended to address current and potential exposures related to soil vapor intrusion. To use the matrix appropriately as a tool in the decision-making process, the following should be noted:

- [1] The matrix is generic. As such, it may be appropriate to modify a recommended action to accommodate building-specific conditions (e.g., dirt floor in basement, crawl spaces, etc.) and/or factors provided in Section 3.2 of the guidance (e.g., current land use, environmental conditions, etc.). For example, resampling may be recommended when the matrix indicates "no further action" for a particular building, but the results of adjacent buildings (especially sub-slab vapor results) indicate a need to take actions to address exposures related to soil vapor intrusion. Additionally, actions more protective of public health than those specified within the matrix may be proposed at any time. For example, the party implementing the actions may decide to install sub-slab depressurization systems on buildings where the matrix indicates "no further action" or "monitoring." Such an action is usually undertaken for reasons other than public health (e.g., seeking community acceptance, reducing excessive costs, etc.).
- [2] Actions provided in the matrix are specific to addressing human exposures. Implementation of these actions does not preclude investigating possible sources of vapor contamination, nor does it preclude remediating contaminated soil vapors or the source of soil vapor contamination.
- [3] Appropriate care should be taken during all aspects of sample collection to ensure that high quality data are obtained. Since the data are being used in the decision-making process, the laboratory analyzing the environmental samples must have current Environmental Laboratory Approval Program (ELAP) certification for the appropriate analyte and environmental matrix combinations. Furthermore, samples should be analyzed by methods that can achieve a minimum reporting limit of 3 micrograms per cubic meter for indoor and outdoor air samples. For sub-slab vapor samples, a minimum reporting limit of 5 micrograms per cubic meter is recommended.
- [4] Sub-slab vapor and indoor air samples are typically collected when the likelihood of soil vapor intrusion to occur is considered to be the greatest (i.e., worst-case conditions). If samples are collected at other times (typically, samples collected outside of the heating season), then resampling during worst-case conditions may be appropriate to verify that actions taken to address exposures related to soil vapor intrusion are protective of human health.
- [5] When current exposures are attributed to sources other than soil vapor intrusion, the agencies should be given documentation (e.g., applicable environmental data, completed indoor air sampling questionnaire, digital photographs, etc.) to support a proposed action other than that provided in the matrix box and to support agency assessment and follow-up.
- [6] The party responsible for implementing the recommended actions will differ depending upon several factors, including the identified source of the volatile chemicals, the environmental remediation program, and site-specific and building-specific conditions. For example, to the extent that all site data and site conditions demonstrate that soil vapor intrusion is not occurring and that the potential for soil vapor intrusion to occur is not likely, the soil vapor intrusion investigation would be considered complete. In general, if indoor exposures represent a concern due to indoor sources, then the State will provide guidance to the property owner and/or tenant on ways to reduce their exposure. If indoor exposures represent a concern due to outdoor sources, then the NYSDEC will decide who is responsible for further investigation and any necessary remediation. Depending upon the outdoor source, this responsibility may or may not fall upon the party conducting the soil vapor intrusion investigation.

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### 3.5 Emergency response

The NYSDOH's staff are responsible for recommending that residents relocate in cases where there may be health risks resulting from exposure to petroleum spills. These roles and responsibilities are outlined in Environmental Health Manual Technical Reference and Procedural Items BTSA-01. Air sampling is appropriate in some cases for demonstrating that spill cleanup and engineering controls have been effective in reducing indoor air impacts and associated health risks to residents. At a minimum, air samples are collected from the basement, first floor and from outdoors. Whether sub-slab or soil gas samples will be taken is evaluated on a case-by-case basis. Air testing data are sometimes used as the basis for ending emergency relocation financial support. For additional information, please contact the NYSDOH's Bureau of Toxic Substance Assessment by calling 1-800-458-1158.

Emergency actions not related to petroleum spills are handled on a case-by-case basis.

### 3.6 Parcels that are undeveloped or contain unoccupied buildings

If investigation of a parcel that is undeveloped or contains unoccupied buildings is being delayed until the site is being developed or occupied, measures should be in place that assure the State that no development or occupation will occur without addressing the exposures. Institutional controls may be used for this purpose. An institutional control is any non-physical means of enforcing a restriction on the use of real property that

- a. limits human or environmental exposure,
- b. provides notice to potential owners, operators or members of the public, or
- c. prevents actions that would interfere with the effectiveness of remedial actions or with the effectiveness and/or integrity of operation, maintenance or monitoring activities at a site.

An institutional control that is often used is an environmental easement. An environmental easement is an enforced mechanism used for property where the remedial actions leave residual contamination that makes the property suitable for some, but not all uses, or includes engineering controls that must be maintained for the easement to be effective. The purpose of the easement is to ensure that such use restrictions or engineering controls remain in place. An environmental easement

- a. can only be created by the property owner (the *grantor*) through a written instrument recorded in the appropriate county recording office. It can only be granted to the State (the *grantee*) and can only be extinguished or amended by a written instrument executed by the Commissioner of the Department of Environmental Conservation and duly recorded;
- b. is binding upon all subsequent owners and occupants of the property. The deed or deeds for the property (as well as any other written instruments conveying any interest in the property) must contain a prominent notice that it is subject to an environmental easement; and
- c. may be enforced in perpetuity against the *grantor*, subsequent owners of the property, lessees, and any person using the property by its grantor, by the State, or by the municipality in which the property is located.

If these actions cannot be implemented, alternative measures should be in place that assure the State that the parcel will not be developed or buildings occupied without addressing the exposure concerns. For example, arrangements should be made for the town, village or city

to notify the appropriate party when new construction or tenants are proposed for the parcel (e.g., permit applications and grants) or ownership of the parcel changes.

## Section 4: Soil Vapor Intrusion Mitigation

As discussed in Section 1.1, soil vapor can enter a building through cracks or perforations in slabs or basement floors and walls, and through openings around sump pumps or where pipes and electrical wires go through the foundation primarily because of a difference between interior and exterior pressures. This intrusion is similar to how radon gas enters buildings from the subsurface. Fortunately, given this similarity, well-established techniques for mitigating exposures to radon may also be used to mitigate exposures related to soil vapor intrusion.

Once it is determined that steps should be taken to address exposures associated with soil vapor intrusion, they should be implemented with all due expediency. This section provides an overview of:

- a. methods of mitigation,
- b. installation and design of mitigation systems,
- c. post-mitigation testing,
- d. operation, maintenance and monitoring of mitigation systems,
- e. termination of mitigation system operations, and
- f. annual certification.

Mitigation is considered to be an interim measure to address exposures until contaminated environmental media are remediated, or until mitigation is no longer needed to address exposures related to soil vapor intrusion.

### 4.1 Methods of mitigation

The most effective mitigation methods involve sealing infiltration points and actively manipulating the pressure differential between the building's interior and exterior (on a continuous basis). As discussed in the following subsections, the appropriate method to use will largely depend upon the building's foundation design. Furthermore, buildings having more than one foundation design feature (e.g., a basement under one portion of the house and a crawl space beneath the remainder) may require a combination of mitigation methods. This section describes methods of mitigation that are expected to be the most reliable options under a wide range of circumstances. Occasionally, there are site-specific or building-specific conditions under which alternative methods (such as HVAC modification, sealing, room pressurization, passive ventilation systems, or vapor barriers) may be more appropriate. Such mitigation proposals may be considered on a case-by-case basis.

#### 4.1.1 Buildings with a basement slab or slab-on-grade foundation

In conjunction with sealing potential subsurface vapor entry points, an active *sub-slab depressurization system* (SSD system) is the preferred mitigation method for buildings with a basement slab or slab-on-grade foundation. A SSD system uses a fan-powered vent and piping to draw vapors from the soil beneath the building's slab (i.e., essentially creating a vacuum beneath the slab) and discharge them to the atmosphere. This results in lower sub-slab air pressure relative to indoor air pressure, which prevents the infiltration of sub-slab vapors into the building.

The most common approach to achieving depressurization beneath the slab is to insert the piping through the floor slab into the crushed rock or soil underneath. However, the EPA, in their "Consumer's Guide to Radon Reduction" (EPA 402-K-03-002; revised February 2003), lists the following approaches as ways to reduce radon levels in a building, either in place of the more common sub-slab suction point method or in conjunction with that method:

- a. *Drain tile suction* — Some houses have drain tiles or perforated pipe to direct water away from the foundation of the house. Suction on these tiles or pipes is often effective;
- b. *Sump hole suction* — If the building has a sump pump to remove unwanted water, the sump can be capped so that it can continue to drain water and serve as the location for piping. If the sump is not used as the suction or extraction point, the associated wiring and piping should be sealed and an air-tight cover should be installed to enhance the performance of the SSD system; and
- c. *Block wall suction* — If the building has hollow block foundation walls, the void network within the wall may be depressurized by drawing air from inside the wall and venting it to the outside. This method is often used in combination with sub-slab depressurization.

The depressurization approach, or combination of approaches, selected for a building should be determined on a building-specific basis due to building-specific features that may be conducive to a specific depressurization approach. For example, if the contaminants are entering the building through a block wall, block wall suction in conjunction with traditional sub-slab depressurization may be more effective at minimizing exposures related to soil vapor intrusion rather than sub-slab depressurization alone.

Although sealing is not a reliable mitigation technique on its own, it can significantly improve the effectiveness of a SSD system since it limits the flow of subsurface vapors into the building. All joints, cracks and other penetrations of slabs, floor assemblies and foundation walls below or in contact with the ground surface should be sealed with materials that prevent air leakage.

If the State concurs that a SSD system is not a practicable alternative or that exposures will be mitigated concurrently by a method selected to remediate subsurface contamination, alternative mitigation methods may be considered, such as the following:

- a. *HVAC modification* — a technique where the building's HVAC system is modified to avoid depressurization of the building relative to underlying and surrounding soil (i.e., to maintain a positive pressure within the building); and
- b. *Soil vapor extraction (SVE) system* — a technique used to remediate contaminated subsurface soil vapor. SVE systems use high flow rates, induced vacuum or both to collect and remove contamination, while SSD systems use a minimal flow rate to effect the minimum pressure gradient (see the EPA's technical guidance documents for recommended gradients; Section 4.2.3) needed to reverse air flow across a building's foundation. Depending upon the SVE system's design, the system may also serve to mitigate exposures. For example, the SVE system's radius of influence includes the subsurface beneath affected buildings or horizontal legs of the system will be installed beneath affected buildings. However, complications can arise if the SVE system is no longer effective at remediating contaminated vapors, exposures should still be mitigated due to residual vapor contamination.

#### 4.1.2 Buildings with a crawl space foundation

A *soil vapor retarder with sub-membrane depressurization (SMD) system* is the preferred mitigation method for buildings with a crawl space foundation. A soil vapor retarder is a synthetic membrane or other comparable material that is placed on the ground in the crawl space to retard the flow of soil vapors into the building. A SMD system is similar to a SSD system. It uses a fan-powered vent and piping to draw vapors from beneath the soil vapor retarder and discharge them to the atmosphere. This results in lower air pressure beneath the membrane relative to air pressure in the crawl space, which prevents the infiltration of subsurface vapors into the building.

If the State concurs that a soil vapor retarder with a SMD system is not a practicable alternative or that exposures will be mitigated concurrently by a method selected to remediate subsurface contamination, alternative mitigation methods may be considered, such as the following:

- a. *HVAC modification* — a technique where the building's HVAC system is modified to avoid depressurization of the building relative to the crawl space;
- b. *Crawl space ventilation with sealing* — a technique that uses a fan to draw air out of the crawl space; and
- c. *SVE system* [Section 4.1.1].

#### 4.1.3 Buildings with dirt floor basements

Either a SSD system with a newly poured slab or a SMD system with a soil vapor retarder may be used. However, the former method is preferred.

#### 4.1.4 Buildings with multiple foundation types

Mitigation in a building with a combination of foundations should be achieved by applying the specific methods described previously [Sections 4.1.1 through 4.1.3] to the corresponding foundation segments of the building. Special consideration should be given to the points at which different foundation types join, since additional soil vapor entry routes exist in such locations. Often, the various systems can be installed and connected to a common depressurization system and fan.

#### 4.1.5 Undeveloped parcels

If sampling results indicate a mitigation system is recommended to address exposures in buildings that may be constructed, then a SSD system with sealing, or a SMD system with a soil vapor retarder, or a combination of these methods is recommended, as appropriate to the design of the proposed buildings.

#### 4.1.6 Additional references

The following documents provide additional information on selecting an appropriate mitigation method:

- a. *A Consumer's Guide to Radon Reduction*  
EPA [EPA 402-K-03-002, revised February 2003]

This document provides assistance in selecting a qualified radon mitigation contractor to reduce the radon levels in a home, determining an appropriate radon reduction method, and maintaining a radon reduction system. It is available at the EPA's web site: <http://www.epa.gov/iaq/radon/pubs/index.html>; and

- b. *Reducing Radon in Schools: A Team Approach*  
EPA [EPA 402-R-94-008, April 1994]

This document will provide assistance in determining the best way to reduce elevated radon levels found in a school. It provides guidance on the process of confirming a radon problem, selecting the best mitigation strategy, and directing the efforts of a multidisciplinary team assembled to address elevated radon levels in a way that will contribute to the improvement of the overall indoor air quality of the school. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318.

#### 4.2 Design and installation of mitigation systems

Once a mitigation method is selected, it should be designed and installed. The components of the design and installation of mitigation systems, the procedures for specific mitigation techniques, and references for technical guidance are provided in the following subsections.

##### 4.2.1 General recommendations

Systems should be designed and installed by a professional engineer or environmental professional. In most areas of the state, there are contractors who have met certain requirements and are trained to identify and fix radon problems in buildings. To obtain the names of local contractors, contact the NYSDOH's Radon Program at 1-800-458-1158, extension 27556, or visit the National Radon Safety Board's web site ([www.nrsb.org](http://www.nrsb.org)) or National Environmental Health Association's web site ([www.neha.org](http://www.neha.org)).

Typically, the party responsible for remediating the site is responsible for arranging design and installation activities. If no responsible party is available, the State will arrange for the design and installation of the system. All design and installation activities should be documented and reported to the agencies. Furthermore, once a mitigation system is installed, an information package should be given to the building's owner and tenants, if applicable, to facilitate their understanding of the system's operation, maintenance and monitoring [Section 5.6].

With the exception of SVE systems, the mitigation methods introduced in Section 4.1 are not intended to remediate the source of subsurface vapors (e.g., contaminated groundwater, soil, etc.). Rather, they are designed to minimize the infiltration of subsurface vapors into a building. For consistency in implementing the techniques in residential buildings, mitigation systems should be designed and installed in accordance with the following:

- a. *Standard Practice for Installing Radon Mitigation Systems in Existing Low-rise Residential Buildings* (ASTM E-2121)

- American Society for Testing and Materials (ASTM) International [ASTM E-2121-03, February 10, 2003]

This document applies to existing buildings. The purpose of this document is to provide radon mitigation contractors with uniform standards that will ensure quality and effectiveness in the design, installation, and evaluation of radon mitigation systems in detached and attached residential buildings three stories or less in height. Information on how to obtain a copy of this standard is available in Appendix E; and

- b. *Model Standards and Techniques for Control of Radon in New Residential Buildings*  
EPA [EPA 402-R-94-009, March 1994]

This document applies to new construction and contains information on how to incorporate radon reduction techniques and materials in residential construction. A copy of this document is provided in Appendix F.

##### 4.2.2 System-specific recommendations

Basic design and installation recommendations for mitigation systems follow. These are based upon recommendations and requirements given by the EPA for mitigating exposures related to radon intrusion (for additional information see EPA's web site on radon at <http://www.epa.gov/iaq/radon/pubs/index.html>).

- a. *Sealing* — To improve the effectiveness of depressurization and ventilation systems and to limit the flow of subsurface vapors into the building, materials that prevent air leakage should be used, such as elastomeric joint sealant (as defined in ASTM C920-87), compatible caulks, non-shrink mortar, grouts, expanding foam, "Dranjel" drain seals, or airtight gaskets. Some effective sealants may contain volatile organic compounds; in some situations, this may be a consideration in choosing an appropriate sealing material.
- b. *Soil vapor retarder (membrane)* —
1. To retard the infiltration of subsurface vapors into the building and enhance the performance of a SMD system, a minimum 6 mil (or 3 mil cross-laminated) polyethylene or equivalent flexible sheeting material should be used.
  2. The sheet should cover the entire floor area and be sealed at seams (with at least a 12 inch overlap) and penetrations, around the perimeter of interior piers and to the foundation walls.
  3. Enough of the sheeting should be used so it will not be pulled away from the walls when the depressurization system is turned on and the sheet is drawn down.
  4. If a membrane is installed in areas that may have future foot traffic (e.g., a dirt floor in a basement), consideration should be given to also installing a wearing surface such as sand or stone to protect the integrity of the membrane. Additionally, a layer of fine sand may be prudent beneath the membrane to protect it from penetrations by sharp objects in the dirt floor.

c. *Depressurization systems* —

1. The systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).
2. The systems should be designed to minimize soil vapor intrusion effectively while minimizing excess energy usage, to avoid compromising moisture and temperature controls and other comfort features, and to minimize noise.
3. To evaluate the potential effectiveness of a SSD before it is installed, a diagnostic test (commonly referred to as a "communication" test) should be performed to measure the ability of a suction field and air flow to extend through the material beneath the slab. This test is commonly conducted by applying suction on a centrally located hole drilled through the concrete slab and simultaneously observing the movement of smoke downward into small holes drilled in the slab at locations separated from the central suction hole. A similar quantitative evaluation may also be performed by using a digital micromanometer or comparable instrument. Depending on test results, multiple suction points may be needed to achieve the desired effectiveness of the system.
4. Passive systems (i.e., a SSD system without a vent fan) are not as effective as active systems and their performance varies depending upon ambient temperatures and wind conditions. Therefore, active systems should be used to ensure exposures are being addressed.
5. The vent fan and discharge piping should not be located in or below a livable or occupied area of the building to avoid entry of extracted subsurface vapors into the building in the event of a fan or pipe leak.
6. To avoid entry of extracted subsurface vapors into the building, the vent pipe's exhaust should be
  - i. above the eave of the roof (preferably, above the highest eave of the building at least 12 inches above the surface of the roof),
  - ii. at least 10 feet above ground level,
  - iii. at least 10 feet away from any opening that is less than 2 feet below the exhaust point, and
  - iv. 10 feet from any adjoining or adjacent buildings, or HVAC intakes or supply registers.
7. Rain caps, if used, should be installed so as not to increase the potential for extracted subsurface vapors to enter the building.
8. To avoid accidental changes to the system that could disrupt its function, the depressurization system should be labeled clearly. An example of such labeling is shown in Figure 5.1.
9. A warning device or indicator should be installed to alert building occupants if the active system stops working properly. Examples of system failure warning devices and indicators include the following: a liquid gauge (e.g., a

manometer), a sound alarm, a light indicator, and a dial (needle display) gauge. The warning device or indicator should be placed where it can be easily heard or seen. The party installing the system should verify the warning device or indicator is working properly. Building occupants should be made aware of the warning device or indicator (what it is, where it is located, how it works, how to read/understand it, and what to do if it indicates the system is not working properly).

- d. *HVAC systems* — HVAC systems should be carefully designed, installed and operated to avoid depressurization of basements and other areas in contact with the soil.
- e. *Crawl space ventilation* —
  1. Ventilation systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).
  2. Openings and cracks in floors above the crawl space that would permit conditioned air to pass into or out of the occupied spaces of the building, should be identified, closed and sealed.
- f. *SVE systems designed to also mitigate exposures* —
  1. The systems should be designed to avoid the creation of other health, safety, or environmental hazards to building occupants (e.g., backdrafting of natural draft combustion appliances).
  2. To avoid reentry of soil vapor into the building(s), the exhaust point should be located away from the openings of buildings and HVAC air intakes. Depending upon the concentrations of volatile chemicals in subsurface vapors and the expected mass removal rate, treatment (e.g., via carbon filters) of the SVE system effluent may be appropriate to minimize outdoor air effects.
  3. The SVE system's radius of influence should adequately address buildings requiring mitigation, as well as subsurface sources requiring remediation. If it does not, additional actions may be appropriate. For example, if the radius of influence does not completely extend beneath a building, a complementary air monitoring program may be appropriate to confirm that exposures are being addressed adequately while the SVE system is operating.

4.2.3 Technical guidance

To address exposures effectively in larger buildings, some of the same techniques used in residential buildings can be scaled up in size, number, or performance (e.g., adjustments in the size and air movement capacity of the vent pipe fan, or installation of multiple suction points through the slab instead of a single point). The design of the techniques may also be modified (e.g., installation of horizontal pipes beneath the building instead of a single suction point).

Detailed technical guidance on designing and installing mitigation systems in residential and non-residential buildings is provided in various documents, such as the following, released by the EPA and others:

- a. References provided in ASTM's E-2121 (see Appendix E for information on how to obtain a copy) and the EPA's *Model Standards and Techniques for Control of Radon in New Residential Buildings* (Appendix F);
- b. *Radon Reduction Techniques for Existing Detached Houses: Technical Guidance (Third Edition) for Active Soil Depressurization Systems*  
EPA [EPA 625/R-93-011, October 1993]  
  
This technical guidance document has been prepared to serve as a comprehensive aid in the detailed selection, design, installation, and operation of indoor radon reduction measures for existing houses based on active soil depressurization techniques. It is intended for use by radon mitigation contractors, building contractors, concerned homeowners, state and local officials and other interested persons. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318;
- c. *Protecting Your Home From Radon: A Step-by-Step Manual for Radon Reduction*  
Kladder et al., 1993  
  
This manual is designed to provide sufficient information to a homeowner to make many of the basic repairs that can significantly reduce radon levels in the home;
- d. *Building Radon Out: A Step-by-Step Guide on How to Build Radon-Resistant Homes*  
EPA [EPA 402-K-01-002, April 2001]  
  
This fully illustrated guide contains all the information needed in one place to educate home builders about radon-resistant new construction (RRNC), including the following: basic questions and detailed answers about radon and RRNC, specific planning steps before installing a system, detailed installation instructions with helpful illustrations, tips and tricks when installing a system, marketing know-how when dealing with homebuyers, and architectural drawings. This document is available at the EPA's web site: <http://www.epa.gov/iaq/radon/pubs/index.html>; and
- e. *Radon Prevention in the Design and Construction of Schools and Other Large Buildings*  
EPA [EPA 625-R-92-016, June 1994]  
  
It is typically easier and much less expensive to design and construct a new building with radon-resistant and/or easy-to-mitigate features, than to add these features after the building is completed and occupied. Specific guidelines on how to incorporate radon prevention features in the design and construction of schools and other large buildings are detailed in this manual. Copies can be ordered from the EPA's Indoor Air Quality Information Clearinghouse at 1-800-438-4318. This document is also available on the EPA Office of Research and Development's web site: <http://www.epa.gov/ORD/NRMRL/pubs/625r92016/625r92016.htm>.

#### 4.3 Post-mitigation or confirmation testing

Once a mitigation system is installed, its effectiveness and proper installation should be confirmed. The party that installed the system should conduct post-mitigation testing and for developing a post-mitigation testing plan. Minimum objectives for post-mitigation testing associated with specific mitigation methods are provided in the following

subsections. All post-mitigation testing activities should be documented and reported to the agencies.

##### 4.3.1 SSD systems with sealing

- a. Reasonable and practical actions should be taken to identify and fix leaks. With the depressurization system operating, smoke tubes are used to check for leaks through concrete cracks, floor joints, and at the suction point. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.
- b. Once a depressurization system is installed, its operation may compete with the proper venting of fireplaces, wood stoves and other combustion or vented appliances (e.g., furnaces, clothes dryers, and water heaters), resulting in the accumulation of exhaust gases in the building and the potential for carbon monoxide poisoning. Therefore, in buildings with natural draft combustion appliances, the building should be tested for backdrafting of the appliances. Backdrafting conditions should be corrected before the depressurization system is placed in operation.
- c. The distance that a pressure change is induced in the sub-slab area (i.e., a pressure field extension test) should be conducted. Analogous to a communication test, this test is commonly conducted by operating the depressurization system and simultaneously observing the movement of smoke downward into small holes (e.g., 3/8 inch) drilled through the slab at sufficient locations to demonstrate that a vacuum is being created beneath the entire slab. A similar quantitative evaluation may also be performed by using a digital micromanometer or comparable instrument. If adequate depressurization is not occurring, the reason (e.g., improper fan operation) should be identified and corrected.
- d. Adequate operation of the warning device or indicator should be confirmed.
- e. Except as indicated below, post-mitigation indoor and outdoor air sampling should be conducted in all buildings where pre-mitigation samples were collected and in all buildings where physical data suggest possible impediments to comprehensive sub-slab communication of the depressurization system (i.e., locations with wet or dense sub-slab soils, multiple foundations and footings, minimal pressure differentials between the interior and sub-slab). Generally, indoor and outdoor air sampling locations, protocols and analytical methods should be consistent between pre-mitigation and post-mitigation sampling, where applicable. In buildings with basements, post-mitigation indoor air sampling from the basement alone (i.e., without a concurrent indoor air sample from the first floor) is recommended in most circumstances.

Typically, post-mitigation sampling should be conducted no sooner than 30 days after installing a depressurization system. If the system is installed outside of the heating season or at the end of a season, post-mitigation air sampling may be postponed until the heating season.

In cases of widespread mitigation due to vapor contamination and depending upon the basis of making decisions (e.g., a "blanket mitigation" approach within a specified area of documented vapor contamination [Section 3.3.1]), a representative number of buildings from an identified study area, rather than each building, may be

sampled. Prior to implementation, this type of post-mitigation sampling approach should be approved by State agency personnel.

In newly constructed buildings, a site-specific and building-specific indoor air sampling plan is recommended due to potential interferences caused by the off-gassing of volatile chemicals in new building materials (e.g., paints, carpets, furniture, etc. [Section 1.4]). In these situations, if indoor air sampling is appropriate samples should be

- i. collected while the system is operational but before potentially interfering factors are brought into the building,
- ii. analyzed for a targeted list of volatile chemicals based on previous environmental sampling (e.g., groundwater, soil, soil vapor, etc.), and/or
- iii. collected while the system is operational but after potentially interfering factors have had an opportunity to off-gas.

If post-mitigation sampling results do not indicate a significant decrease in the concentrations of volatile chemicals previously believed to be present in the indoor air due to soil vapor intrusion, the reason (e.g., indoor or outdoor sources, improper operation of the mitigation system, etc.) should be identified and corrected as appropriate.

#### 4.3.2 SMD systems with soil vapor retarder

- a. Reasonable and practical actions should be taken to identify and fix leaks. With the depressurization system operating, smoke tubes are used to check for leaks in the membrane at seams, edge seals and at locations where the sheet was sealed around obstructions. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.
- b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].
- c. Adequate operation of the warning device or indicator should be confirmed.
- d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [as discussed in Section 4.3.1].

#### 4.3.3 HVAC modifications

- a. Check the building for positive pressure conditions (e.g., verify a pressure controller is maintaining the desired pressure differential and/or measure the pressure differential between the sub-slab and indoor air by using field instruments).
- b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].
- c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.
- d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [Section 4.3.1].

#### 4.3.4 Crawl space ventilation and sealing

- a. Reasonable and practical actions should be taken to identify and fix leaks. With the ventilation system operating, smoke tubes are used to check for leaks in openings and cracks in floors above the crawl space that were sealed during installation of the system. Any leaks identified should be resealed until smoke is no longer observed flowing through the opening.
- b. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].
- c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.
- d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [as discussed in Section 4.3.1].

#### 4.3.5 SVE systems designed to also mitigate exposures

- a. Backdrafting conditions should be evaluated and corrected [Section 4.3.1].
- b. The distance that a pressure change is induced in the sub-slab area should be conducted. This may be done by operating the SVE system and simultaneously observing the movement of smoke downward into small holes (e.g., 3/8 inch) drilled through the building's slab at sufficient locations to demonstrate that a vacuum is being created beneath the entire slab.
- c. Adequate operation of the warning device or indicator, if applicable, should be confirmed.
- d. Post-mitigation indoor and outdoor air testing should be conducted in buildings where pre-mitigation samples were collected [Section 4.3.1].

### 4.4 **Operation, maintenance and monitoring of mitigation systems**

When mitigation systems are implemented at a site, the operation, maintenance and monitoring (OM&M) protocols for the systems should be included in a site-specific site management plan (formerly referred to as operation, maintenance and monitoring plan). The party that installed the system should conduct OM&M activities and should develop the site management plan. Recommendations for minimum OM&M activities associated with specific mitigation methods are provided in the following subsections. Also included is a discussion of non-routine maintenance. All routine and non-routine OM&M activities should be documented and reported to the agencies.

#### 4.4.1 SSD and SMD systems

Routine maintenance should commence within 18 months after the system becomes operational, and should occur every 12 to 18 months thereafter. Based upon a demonstration of the system's reliability, the State recommends that, if a different frequency is desired, a petition describing the alternative frequency and the reasons that frequency is preferred be submitted to the State. Any comments the State may have on the petition should be considered before the frequency is altered.

During routine maintenance, the following activities (at a minimum) should be conducted:

- a. a visual inspection of the complete system (e.g., vent fan, piping, warning device or indicator, labeling on systems, soil vapor retarder integrity, etc.),
- b. identification and repair of leaks [Sections 4.3.1 and 4.3.2], and
- c. inspection of the exhaust or discharge point to verify no air intakes have been located nearby.

As appropriate preventative maintenance (e.g., replacing vent fans), repairs and/or adjustments should be made to the system to ensure its continued effectiveness at mitigating exposures related to soil vapor intrusion. The need for preventative maintenance will depend upon the life expectancy and warranty for the specific part, as well as visual observations over time. The need for repairs and/or adjustments will depend upon the results of a specific activity compared to that obtained when system operations were initiated.

If significant changes are made to the system or when the system's performance is unacceptable, the system may need to be redesigned and restarted. Many, if not all, of the post-mitigation testing activities, as described in Sections 4.3.1 and/or 4.3, may be appropriate. The extent of such activities will primarily depend upon the reason for the changes and the documentation of sub-slab depressurization.

Generally, air monitoring is not recommended if the system has been installed properly and is maintaining a vacuum beneath the entire slab.

In addition to the routine OM&M activities described here, the building's owner and tenants are given information packages that explains the system's operation, maintenance and monitoring [Section 5.6]. Therefore, at any time during the system's operation, the building's owner or tenants may check that the system is operating properly.

#### 4.4.2 Other mitigation systems

For other mitigation systems (e.g., HVAC modifications, crawl space ventilation, etc.), routine maintenance activities are generally comparable to post-mitigation testing activities [Section 4.3]. Activities typically include a visual inspection of the complete system, and identification and repair of leaks. System performance checks, such as air stream velocity measurements of ventilation systems, also should be performed.

As appropriate, preventative maintenance (e.g., replacing filters, cleaning lines, etc.), repairs and/or adjustments should be made to the system to ensure its continued effectiveness at mitigating exposures related to soil vapor intrusion. If significant changes are made to the system or when the system's performance is unacceptable, redesigning and restarting the system may be appropriate [Section 4.4.1].

Air monitoring, such as periodic sub-slab vapor, indoor air and outdoor air sampling, may be appropriate to determine whether existing building conditions are maintaining the desired mitigation endpoint and to determine whether changes are appropriate. The type and frequency of monitoring is determined based upon site-specific and building-specific conditions, taking into account applicable environmental data, building operating conditions, and the mitigation method employed.

#### 4.4.3 Non-routine maintenance

Non-routine maintenance may also be appropriate during the operation of a mitigation system. Examples of such situations include the following:

- a. the building's owners or occupants report that the warning device or indicator indicates the mitigation system is not operating properly;
- b. the mitigation system becomes damaged; or
- c. the building has undergone renovations that may reduce the effectiveness of the mitigation system.

Activities conducted during non-routine maintenance visits will vary depending upon the reason for the visit. In general, building-related activities may include examining the building for structural or HVAC system changes, or other changes that may affect the performance of the depressurization system (e.g., new combustion appliances, deterioration of the concrete slab, or significant changes to any of the building factors listed in Table 1.2). Depressurization system-related activities may include examining the operation of the warning device or indicator and the vent fan, or the extent of sub-slab depressurization. Repairs or adjustments should be made to the system as appropriate. If appropriate, the system should be redesigned and restarted [Section 4.4.1].

#### 4.5 Termination of mitigation system operations

Mitigation systems should not be turned off, until the State receives, and has had the opportunity to comment on, a proposal to turn off mitigation systems. The party seeking to turn off the mitigation systems should consider any comments the State may have on the proposal, except in emergency situations. Systems should remain in place and operational until they are no longer needed to address current or potential exposures related to soil vapor intrusion. This determination should be based upon several factors, including the following:

- a. subsurface sources (e.g., groundwater, soil, etc.) of volatile chemical contamination in subsurface vapors have been remediated based upon an evaluation of appropriate post-remedial sampling results;
- b. residual contamination, if any, in subsurface vapors is not expected to affect indoor air quality significantly based upon soil vapor and/or sub-slab vapor sampling results;
- c. residual contamination, if any, in subsurface vapors is not affecting indoor air quality when active mitigation systems are turned off based upon indoor air, outdoor air and sub-slab vapor sampling results at a representative number of buildings; and
- d. there is no "rebound" effect for which additional mitigation efforts would be appropriate observed when the mitigation system is turned off for prolonged periods of time. This determination should be based upon indoor air, outdoor air and/or sub-slab vapor sampling from the building over a time period, determined by site-specific conditions.

Given the prevalence of radon throughout the State of New York, consideration should be given to leaving the system in place and operating to address exposures related to radon intrusion after concurrence is reached that the system is no longer needed to mitigate exposures related to soil vapor intrusion. This action should be done only with permission of the property owner and after the property owner is aware of their responsibilities in

operating, monitoring and maintaining the system for this specific purpose. If the property owner declines the offer, the system should be shut down and, if requested, removed in a timely manner.

#### 4.6 Annual certification and notification recommendations

Mitigation systems are considered engineering controls, defined as any physical barrier or method employed to

1. actively or passively contain, stabilize, or monitor hazardous waste or petroleum,
2. restrict the movement of hazardous waste or petroleum to ensure the long-term effectiveness of remedial actions, or
3. eliminate potential exposure pathways to hazardous waste or petroleum.

Therefore, depending upon the remedial program, submission of an annual certification to the State may be required. This certification must be prepared and submitted by a professional engineer or environmental professional and affirm that the engineering controls are in place, are performing properly and remain effective. This requirement of certification remains in effect until the State provides notification, in writing, that this certification is no longer needed.

If a property owner declines a mitigation system, the party responsible for arranging the design and installation of the system should renew the offer on an annual basis, unless they demonstrate environmental conditions have changed such that a system is no longer needed.

## Section 5: Community Outreach

While community outreach is an essential component of the investigation and remediation of any site, it is particularly critical when evaluating soil vapor intrusion at a site due to the following:

- a. a heightened awareness by environmental professionals and the general public (both nationally and state-wide) for the importance of soil vapor intrusion;
- b. the relatively complicated nature of the exposure pathway (e.g., chemicals in groundwater or soil ending up in the indoor air of buildings versus contaminated groundwater entering the house through the use of a private well);
- c. the unknowns associated with the evolving science of investigating, evaluating, and mitigating exposures related to soil vapor intrusion; and
- d. the relatively complicated nature of mitigating the exposure pathway (e.g., the design, installation and operation of a sub-slab depressurization system in a home versus an immediate switch from using private well water to using bottled water).

When people have been or may be exposed to contamination, providing them with accurate and timely information about those exposures is extremely important. This information should include details about the types of chemicals, the levels of exposure, and possible health effects from those exposures. In addition, information should include details about the planning and progress of the investigation and remediation efforts. Techniques commonly used to inform the community about soil vapor intrusion issues are described in this section. The type, or types, of techniques selected for a site will vary depending upon the community's needs, site-specific conditions and remedial program-specific requirements.

### 5.1 Site contact list

A contact list contains names, addresses and telephone numbers of individuals and organizations with interest or involvement in a site. They may be affected by or interested in the site, or have information that staff needs to make effective remedial decisions. Contact lists typically include residents near the site, elected officials, appropriate federal, state, and local government contacts, local media, organized environmental groups and the responsible party, as well as local businesses, civic and recreational groups, religious facilities, school district officials, and all staff (NYSDEC, NYSDOH, county health department, EPA, etc.) involved in the site. The checklist provided in Appendix G.1 will help to identify who should be included in a particular site's contact list.

With respect to soil vapor intrusion, the site contact list is often used to

- a. send a fact sheet announcing a proposed investigation in the area, a major project decision or proposal, the project's status or progress, a public meeting or availability session, or the availability of documents in the repositories;
- b. contact building owners and tenants to arrange sampling dates and times and to transmit sampling results (in written form and/or verbally); and
- c. provide community members with verbal updates on the project's status or progress.

The member of the project team (defined as the NYSDEC, NYSDOH, responsible party, etc.) that develops and maintains the site contact list is determined on a site-specific and/or

program-specific basis. Development and revision of the contact list are ongoing activities throughout the site's investigation and remediation. Guidance on how to create a site contact list is provided in Appendix G.1.

### 5.2 Project staff contact sheet

As implied by the name, this is a summary of the contact information for staff working on the site that can be handed out to the community. Often included on the sheet are the name, title, affiliation, role or area of expertise, address, telephone number, email address, facsimile number for each staff member. The contact sheet provides the community with a quick reference on whom to call with questions, comments or concerns about the site. Project staff may also use the site contact sheet to direct inquiries to the most appropriate person. This is particularly useful when there are many agencies working on the site and many issues, such as site investigation, health studies, medical outreach, etc., being addressed.

The site contact sheet should be handed out at public meetings or availability sessions, when door-to-door visits and sampling are conducted, and in conjunction with other appropriate outreach activities. The sheet should be developed early on in the process and kept up-to-date. The member of the project team that develops and maintains the staff contact sheet is determined on a site-specific and/or program-specific basis.

### 5.3 Fact sheets

A fact sheet is a written summary of important information about a site. It presents information in clear and concise terms for the community. Fact sheets aid consistent distribution of information and citizens' understanding of significant issues associated with site-related activities. With respect to soil vapor intrusion, fact sheets are often used to

- a. announce a proposed soil vapor intrusion investigation in the area, either as a stand-alone activity or in conjunction with the site's overall investigation;
- b. summarize the results of an investigation and the anticipated next steps in the process;
- c. invite the public to a meeting or availability session to discuss the proposed investigation, the results of a recently completed investigation, the anticipated next steps, etc.; and
- d. provide additional information on topics associated with soil vapor intrusion, such as specific air guidelines for volatile chemicals.

The member of the project team that plans, develops and distributes the fact sheet is determined on a site-specific and/or program-specific basis. Factors to consider when designating the lead include the site's remedial program, the expected content of the fact sheet, and the relationship of various team members with the community. For example, if the community strongly distrusts the responsible party and wants to know how the state is determining that their actions are appropriate, the state should be the lead. A combination of team members may also be suitable.

All team members should be included in reviewing and finalizing the fact sheet. Once the state approves the fact sheet, it may be released to the public. Timely distribution of the fact sheet is important. Sufficient time should be allowed in the development and review

schedule to ensure that the fact sheet is distributed — *and that it is received* — before the critical activity takes place. Specific timeframes for release include the following:

- a. 2 weeks prior to a public meeting or availability session, or commencement of field activities;
- b. within 24 hours of receiving a specific request for an available fact sheet from the community (e.g., members of the community that did not receive a copy of the fact sheet in the mail);
- c. if applicable, before a comment period begins (otherwise a 30-day comment period becomes, in reality, a 25-day comment period); and
- d. if appropriate, concurrently with letters to the community explaining sampling results.

Copies of fact sheets commonly used to supplement discussions related to soil vapor intrusion are provided in Appendix H. They are also available from the NYSDOH's soil vapor intrusion web page: [http://www.health.state.ny.us/environmental/indoors/vapor\\_intrusion/](http://www.health.state.ny.us/environmental/indoors/vapor_intrusion/). Additional guidance on how to plan, develop and distribute fact sheets is provided in Appendix G.2.

### 5.4 Public gatherings

The following are several types of public gatherings where project staff can meet with the community:

- a. **Traditional Public Meetings:** Project staff generally present information and answer questions. Citizens are encouraged to ask questions and provide comments;
- b. **Public Availability Sessions:** The session is held in a casual setting, without a formal agenda and presentation. Staff generally conduct an availability session about a specific aspect of a site, which is publicized ahead of time. The format promotes detailed individual or small group discussion between staff and the public. An availability session may be targeted to a specific subgroup of the overall community. For example, a session may be held where project staff meet with building owners and tenants to discuss their individual sampling results;
- c. **Public Forum:** The forum is held in a casual setting, without a formal presentation. Typically, the format is one of "question and answer" — a panel of project staff (or, if applicable, outside experts) answer questions asked by community members in an open discussion; and
- d. **Other:** Project staff may be invited to give presentations or to make themselves available for questions at community group meetings, such as community or neighborhood board meetings, school board meetings, etc.

If appropriate, a combination of the above may be used. The type, or combination of types, of gathering (if any) selected should be decided based on site-specific, program requirements and community-specific conditions, such as the following:

- a. Is the investigation limited to on-site buildings, to a localized area of off-site buildings, or to the off-site neighborhood surrounding the site?;
- b. Is the soil vapor investigation being performed as part of ongoing site investigation activities (and consequently ongoing outreach activities), or is this issue being revisited at a site where remediation was considered "complete?";

- c. What type of outreach has the community favored in the past?;
- d. What are the objectives of the meeting? Can one meeting type accomplish each of the objectives or are different meeting types needed on successive days (e.g., public meeting followed by an availability session)?; and
- e. Who is the desired audience? Should the meeting be held in the afternoon to accommodate an elderly population and repeated in the evening for people who work during normal business hours?

The member of the project team that coordinates and implements the gathering is determined on a site-specific and/or program-specific basis. Factors to consider when designating the lead include the site's remedial program, the expected subject of the meeting, and the relationship of various team members with the community. A combination of team members may also be appropriate.

Additional guidance on how to plan and conduct a public meeting and an availability session is provided in Appendices G.3 and G.4.

#### 5.5 Letters transmitting results

When indoor air and/or sub-slab vapor samples are collected from within or beneath a building, a letter providing the sampling results and the conclusions drawn from the data evaluation should be transmitted to the building's owner. If the building is a rental property, the transmittal letter should be sent to the tenants residing in the areas where the samples were collected and a copy to the property owner/landlord. In some cases where responsible parties are carrying out indoor air sampling, access agreements are commonly executed between such a party and the property owner. Consequently, the transmittal letter may be sent to the property owner, and where feasible by prior arrangement with the property owner and/or tenant, with a copy to the tenant.

A transmittal letter should include the following (as applicable):

- a. the address of the building sampled;
- b. the date samples were collected;
- c. the type of samples collected (e.g., sub-slab vapor, indoor air and outdoor air);
- d. indoor air sampling locations (e.g., basement, crawl space, first floor living room, etc.);
- e. who collected the samples (e.g., the state, or [Consultant Name] on behalf of [Responsible Party name], etc.);
- f. why samples were collected (e.g., to evaluate the potential for exposures associated with soil vapor intrusion);
- g. the site name and number (usually included in the subject line);
- h. the compound(s) or group of compounds of concern (e.g., trichloroethene or volatile organic compounds);
- i. an overview of the sampling results (e.g., a table summarizing compounds detected in each sample and/or a figure illustrating sampling locations and corresponding results);

- j. copies of the laboratory sheets for each sample collected and the completed building questionnaire/inventory;
- k. a statement of the conclusions drawn and the next steps (e.g., soil vapor intrusion appears to be the likely source of volatile chemicals in your indoor air and we would like to install a sub-slab depressurization system to minimize exposures);
- i. if applicable, what information should be shared with employees and/or patrons of the facility (e.g., the transmittal letter and enclosed fact sheets, a situation-specific fact sheet and cover memorandum, etc.);
- m. contact information for project staff; and
- n. fact sheets that supplement information provided in the letter.

The member of the project team that transmits the letter is typically the member that conducted the investigation. A representative of each member should be copied on each transmittal. For example, for investigations conducted by the state, letters are transmitted by the NYSDOH; state and local agencies, as well as a representative for the responsible party (or other non-agency project staff), should be copied. For investigations conducted by the responsible party, the responsible party should transmit letters that have been reviewed and approved by the state, and copy state and local agency representatives.

The level of detail provided in the letter will depend upon who transmits the letter. For example, letters written by the NYSDOH may recommend actions to reduce exposures to indoor sources (i.e., not site-related sources) of volatile chemicals, or address expected risks associated with an identified exposure. Letters transmitted by a responsible party generally focus on site-related contamination and their identified next steps. These letters generally refer the recipients to the state for questions regarding non-site-related compounds and health concerns. For additional guidance on the content of the transmittal letters, contact the NYSDOH's Bureau of Environmental Exposure Investigation at 1-800-458-1158, extension 27850.

Timely distribution of the transmittal letter is important. Generally, final (i.e., verified) sampling results from the laboratory are available 6 to 8 weeks after the samples are submitted. As soon as they are available, final results should be forwarded to the team member that is transmitting them. Sufficient time should be allowed in the development and review schedule to ensure that the letter is transmitted within 2 weeks after final results are available.

If there is significant community interest in the sampling results, reasonable attempts should be made to inform the building owners and tenants of their results verbally in addition to sending a transmittal letter. Other interested community members, such as residents, press and elected officials, may be given an overview of the investigation results and the conclusions drawn *after* each building owner and tenant has been notified.

#### 5.6 Soil vapor intrusion mitigation information

Once a mitigation system (e.g., sub-slab depressurization system) is installed in a building, an information package should be given to the building's owner and tenants, if applicable, to facilitate their understanding of the system's operation, maintenance and monitoring. This package should include the following:

- a. a description of the mitigation system installed and its basic operating principles;

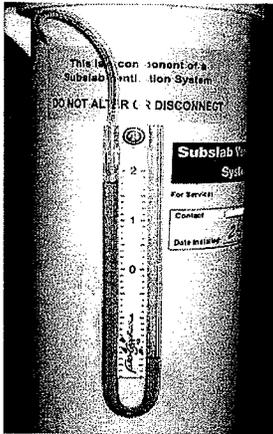
- b. how the owner or tenant can check that the system is operating properly;
- c. how the system will be maintained and monitored and by whom;
- d. a list of appropriate actions for the owner or tenant to take if the system's warning device or indicator (e.g., pressure gauge, alarm, etc.) indicates system degradation or failure; and
- e. contact information (e.g., names, telephone numbers, etc.) if the owner or tenant has questions, comments or concerns.

The building's owner should also receive the following information:

- a. any building permits required by local codes;
- b. copies of contracts and warranties; and
- c. a description of the proper operating procedures of any mechanical or electrical system installed, including manufacturer's operation and maintenance instructions and warranties.

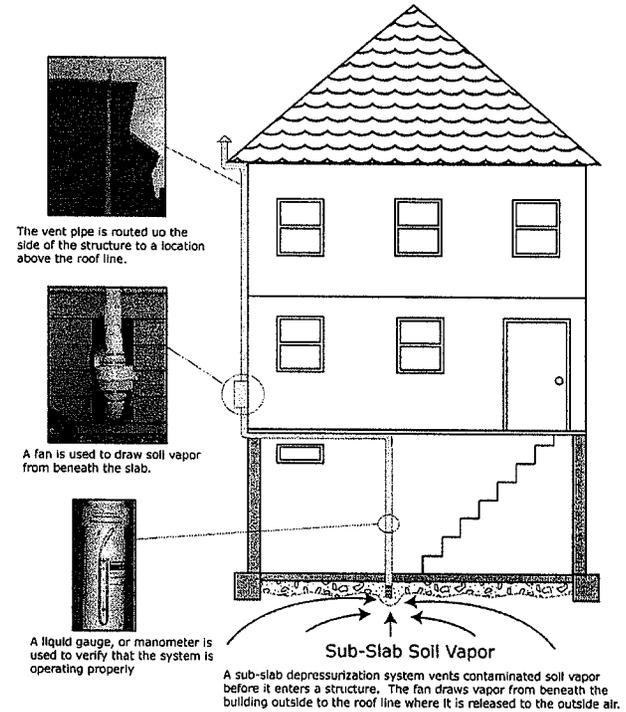
Wherever possible, illustrations should be provided. For example, pictures of a manometer under normal operating conditions [Figure 5.1], as well as drawings or schematics showing the system at work [Figure 5.2].

The member of the project team who provides this information is the member who installed the mitigation system.



**Figure 5.1**  
Manometer indicating the SSD system is operating properly.

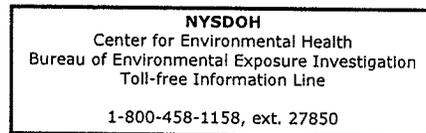
**Sub-Slab Depressurization System**  
(commonly called a radon mitigation system)



**Figure 5.2**  
Example of an illustration showing how a SSD system works.

### 5.7 Toll-free "800" numbers

Toll-free information numbers provide quick, easy access for people who have questions, comments or concerns about a site. At a minimum, the NYSDOH site project manager's name and the following "800" number should be shared with the community in fact sheets and transmittal letters, at public gatherings, when samples are collected, and with other outreach techniques for their use if they have health-related questions, concerns or comments related to soil vapor intrusion at the site.



Note: The "800" number is an *information* line — not a "*hotline*" — because callers may not receive immediate response, such as on nights or weekends.

Similarly, applicable toll-free numbers setup and maintained by other project team members should also be shared with the community whenever appropriate. Additional information on the use of toll-free "800" numbers as an outreach tool is provided in Appendix G.5.

### 5.8 Door-to-door visits

Door-to-door visits involve gathering or distributing site information by meeting individuals at their residences or businesses. Typically, this outreach technique is used to supplement other communication, such as telephone calls and letters. With respect to soil vapor intrusion, project staff may visit residents near a site to provide information, answer questions, or obtain permission for activities on private properties. All team members should be aware of the specifics of the door-to-door visits (e.g., who will be conducting the visits, the reason, the dates, etc.).

Additional information on conducting door-to-door visits is provided in Appendix G.6.

### 5.9 Document repositories

A document repository is a collection of documents and other information developed during the investigation and remediation of a site. It is located in a convenient, public facility, such as a library, so that affected and interested members of the public can easily access and review important information about the site. A repository is maintained through the site's operation and maintenance phase, or until its release from the applicable remedial program.

A site document repository helps the public review

- a. documents about which the state is seeking public comment;
- b. studies, reports and other information; and
- c. complete versions of documents summarized in fact sheets, meeting presentations or media releases (summaries should note the locations of local repositories where the complete documents are available).

The member of the project team that establishes and maintains the document repository is determined on a site-specific and/or program-specific basis. Additional guidance on how to establish and maintain a document repository is provided in Appendix G.7.

### 5.10 Medical community outreach

Outreach to the medical community is an activity or combination of activities undertaken to assist local health care providers in caring for people who have concerns about site-specific environmental exposures. The goal of this type of outreach is to assist the individual provider by giving him/her much of the site-specific information related to the contaminants and to provide information about the site itself. This type of outreach is undertaken whenever the NYSDOH and/or other health agencies determine that the site-specific contaminants may be unfamiliar to the local medical community. Conversely, this outreach can be undertaken when community members express the concern that their health care providers may be unfamiliar with potential adverse health effects related to contaminants at the site.

The targeted audience for this type of outreach consists of specific groups of health care providers most likely to treat people with concerns about potential environmental exposures. Some examples of targeted groups of specialists could include any combination of the following: Family Practice, Internal Medicine, Preventive Medicine, Oncology, Neurology, Allergy, Pediatrics, Obstetrics, Dermatology and Emergency Medicine. Likewise, materials can be sent to medical and nursing schools, residency programs, and medical libraries if they are located nearby. Developing the targeted list of health-care providers is a cooperative effort between local and state departments of health, with input from the community as well.

The NYSDOH, in partnership with the Agency for Toxic Substance and Disease Registry (ATSDR) and the local health department, can conduct these activities, which could include any one or a combination of the following:

- a. announcements made at public meetings that the NYSDOH Center for Environmental Health will mail out information packets to individual physicians at the request of any concerned citizen;
- b. an article placed in a local newspaper, or, if applicable, in a newsletter periodically sent to residents, stating that the NYSDOH Center for Environmental Health will mail out packets to individual physicians at the request of any concerned citizen. The NYSDOH "800" number and two NYSDOH contact names would be given;
- c. an article submitted to the newsletter of the local county medical society, stating that the NYSDOH and the ATSDR have information to help providers with questions about site-related contamination in the area of the site. The NYSDOH "800" number and two NYSDOH contact names would be given; and
- d. materials sent to medical and nursing schools, residency programs, and medical libraries if they are located nearby.

Local and state departments of health, and ATSDR, have developed appropriate outreach materials. The information packets should contain a letter to the physician, site-specific fact sheets, brochures, and booklets about potential exposures and about the contaminants in the area of the site. As an example, here is a list of fact sheets and pamphlets that an information packet for a site with PCE and TCE as contaminants of concern might contain:

- a. a letter of explanation to the provider, including the NYSDOH "800" number to call for access to more information, as well as two NYSDOH contacts with whom to speak initially;
- b. a site-specific fact sheet written for the community, explaining various site-related issues;
- c. a compact disc of ATSDR case studies in environmental medicine (CSEMs), with opportunities for earning many free continuing medical education (CME) credits through the Centers for Disease Control and Prevention;
- d. a hard copy of both the "Trichloroethylene (TCE) Toxicity" and "Taking an Environmental Exposure History" case studies;
- e. two small "quick reference guides" produced by ATSDR about evaluating environmental exposures and doing an exposure history;
- f. a NYSDOH fact sheet on Trichloroethene (TCE) in indoor and outdoor air;
- g. an ATSDR fact sheet on Trichloroethylene (TCE);
- h. a NYSDOH fact sheet on Tetrachloroethene (PERC) in indoor and outdoor air; and
- i. an ATSDR fact sheet on Tetrachloroethylene (PERC).

For additional information on this outreach tool, please contact the NYSDOH Center for Environmental Health's Outreach and Education Unit at 1-800-458-1158, extension 27530.

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## **Appendix 2**



DARAMEND-M® is a specially formulated version of Adventus' controlled-release, integrated carbon and zero valent iron (ZVI) technology for in situ chemical reduction. Similar to EHC-M® ([http://www.adventusgroup.com/products/ehc\\_m.shtml](http://www.adventusgroup.com/products/ehc_m.shtml)), new DARAMEND-M encourages the precipitation and adsorption of arsenic and other dissolved metals (such as chromium, lead and mercury) to limit their mobility.

This new product from Adventus is capable of reducing the amount of metals that can leach from metal-impacted soil, in particular the amount of leachable metal in samples analyzed using the TCLP; Toxicity Characteristic Leaching Procedure

(<http://www.ehso.com/cssepa/TCLP.htm>). Many regulatory jurisdictions have TCLP limits for a variety of metals whereby if a metal exceeds a certain TCLP value, it must be disposed of at a facility that is designed to handle that type of soil. This will often be much more expensive than disposal of soils that do not exceed the TCLP values. Pre-treatment of soil using DARAMEND-M may reduce the leachable metal concentrations, thus allowing for much more cost effective disposal. There may be other circumstances whereby soils can be treated and left in-place should they not exceed the TCLP values, in which case the economic benefit of applying the treatment will be even greater.

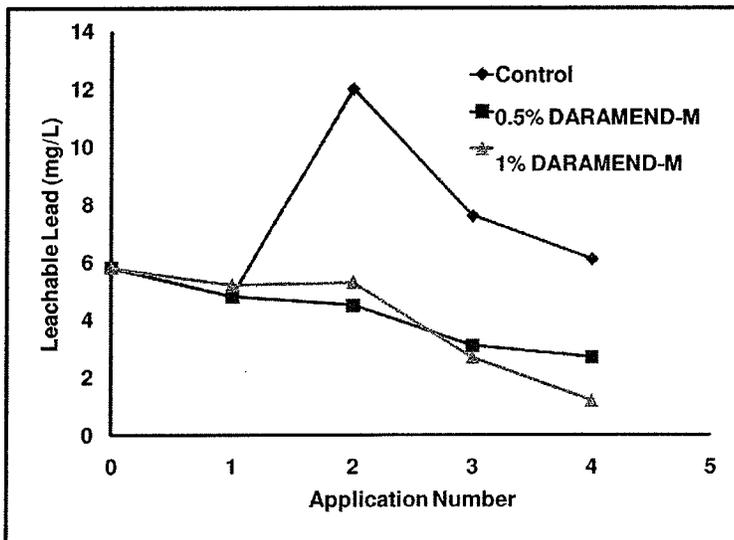


Figure 1. Influence of DARAMEND-M Application on Leachable Lead from Soil.

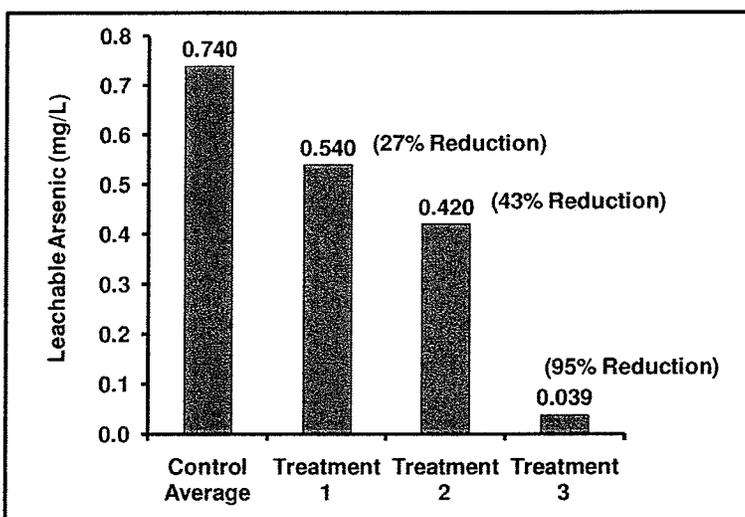


Figure 2. Influence of DARAMEND-M Treatment Methods on Leachable Arsenic from soil.

The technology has been demonstrated to be effective. Figure 1 above illustrates how the amount of lead that is leachable decreases with each additional application of DARAMEND-M. In this case application of the technology was able to reduce the amount of leachable lead to below the TCLP standard. Other results of laboratory treatability testing performed to develop the DARAMEND-M product, are shown in Figure 2. In these tests, the most effective treatment method reduced the amount of leachable arsenic by 95%, using an application rate of 3% weight of DARAMEND-M by dry weight of soil.