



Public Health Assessment for

**HUDSON TECHNOLOGIES, INC.
HILLBURN, ROCKLAND COUNTY, NEW YORK
EPA FACILITY ID: NY0001392463
SEPTEMBER 30, 2006**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE**

Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Agency for Toxic Substances & Disease Registry Julie L. Gerberding, M.D., M.P.H., Administrator
Howard Frumkin, M.D., Dr.P.H., Director

Division of Health Assessment and Consultation..... William Cibulas, Jr., Ph.D., Director
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Health Promotion and Community Involvement BranchSusan J. Robinson, M.S., Chief

Exposure Investigations and Consultation Branch.....Susan M. Moore, Ph.D., Chief

Federal Facilities Assessment Branch Sandra G. Isaacs, B.S., Chief

Superfund and Program Assessment BranchRichard E. Gillig, M.C.P., Chief

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PUBLIC HEALTH ASSESSMENT

HUDSON TECHNOLOGIES INC.

HILLBURN, ROCKLAND COUNTY, NEW YORK

EPA FACILITY ID: NY0001392463

Prepared by:

New York State Department of Health
Center for Environmental Health
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation

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SUMMARY

The Hudson Technologies Inc. (HTI) site is in a suburban area on the outskirts of the Village of Hillburn, in the Ramapo River Valley, in Rockland County, New York. The HTI facility is a 20,500 square foot single story building that has been occupied by several commercial businesses since construction in 1962. HTI reclaims chlorofluorocarbons (also known as CFCs) from commercial air conditioning and cooling systems and either returns them to the customer or buys and resells them.

United Water New York (UWNY) owns and operates the public water supply wells in the area. Some of the public water supply wells near the site were contaminated with the CFC trichlorofluoromethane (also known as refrigerant Freon-11, or R-11), and people using the public water were most likely exposed to R-11 in their water. Contamination was discovered in one well in May 1995 during UWNY's routine compliance monitoring of the public water supply wells. This well and another were shut down two weeks later when re-samples confirmed the contamination. Previous samples, including one taken in January 1995, were tested for CFCs and none were detected. The highest level of contamination detected prior to the wells being shut down was 100 micrograms per liter (mcg/L). The wells were subsequently put back into service when testing showed that water quality was acceptable. An on-site spill in 1999 resulted in recontamination of the same wells, and they were again shut down. The maximum period of time for which people were likely exposed to R-11 in the drinking water at levels above the drinking water standard was about six months. During this time the levels were likely less than 100 mcg/L because the water supplied to the public is actually a mixture of water from any of 10 wells that feed into a reservoir before distribution. UWNY installed two air strippers in 2001 at the public water supply pumping station to remove contamination from the groundwater pumped for drinking water.

Rockland County Department of Health (RCDOH) referred the HTI site to New York State Department of Environmental Conservation (NYS DEC) for an investigation of the contamination under the State Superfund program. The nature of the contaminant of concern at the site did not meet the state definition of a hazardous waste, as defined in Part 371 of the State environmental regulations. Thus, NYS DEC requested that United States Environmental Protection Agency (US EPA) nominate this site to the National Priorities List (NPL). This site was proposed by US EPA for listing on the NPL on May 11, 2000. However, US EPA has not made a final decision about placing the site on the NPL. HTI has voluntarily entered into an Administrative Order with NYS DEC and has conducted remedial activities at the site since May 1999 because R-11 was detected in the sediments of HTI's septic tank. HTI connected to the public sewer system and terminated the use of its on-site septic system in 1998. They also installed an air stripper in 1999 to remove Freon-11 contamination from the groundwater. There has been limited expression of community health concerns associated with the site. While no public meetings have been held, numerous newspaper articles have resulted in a few inquiries to RCDOH.

New York State Department of Health (NYS DOH) and Agency for Toxic Substances and Disease Registry (ATSDR) have no information that indicates people have been exposed to site-related contaminants at levels that may cause adverse health effects. Therefore, based upon ATSDR's public health hazard category classification (see Appendix D), the HTI site poses no apparent public health hazard based on current and past exposures. However, public health actions were needed to reduce exposures. Actions were needed to reduce exposures to R-11 from contaminated drinking water because levels were above the New York State drinking water standard and may have increased or continued had these measures not been taken. However, recovery efforts have halted the migration of the contaminant plume from the site and the presence of Freon-11 in the UWNYS's public water supply wells has not occurred since 2003. Weekly sampling of the Village of Suffern wells began in February 2000, then monthly 2002 until June 2004, and no evidence of impacts due to Freon-11 were noted.

The possibility that children or developing fetuses may have increased sensitivity to R-11 was taken into consideration when evaluating the potential health risks associated with the HTI site. However, no studies were found in the toxicological literature that evaluate the reproductive or developmental health effects of R-11 in animals or humans, and thus a comparison of the estimated R-11 exposures at the site to exposure levels that cause these effects cannot be made.

NYS DOH and ATSDR recommend that public water supplies continue to be monitored and treated to remove contaminants, that groundwater continues to be monitored, that on- and off-site surveillance is conducted to track any contaminant migration from the site and that the possibility that soil gas contaminated with R-11 may intrude into the indoor air at nearby buildings be evaluated.

PURPOSE AND HEALTH ISSUES

The purpose of this public health assessment (PHA) is to evaluate the public health implications of human exposure to contaminants at the Hudson Technologies, Inc. (HTI) site. This site was proposed for addition to the National Priorities List (NPL) on May 11, 2000. This public health assessment will focus primarily on exposure to volatile organic compounds (VOCs), and specifically chlorofluorocarbons (CFCs) in public drinking water, the only documented exposure pathway at the site.

BACKGROUND

A. Site Description and History

The HTI property is at the base of the Ramapo Mountains, about 500 feet east of the Ramapo River on Torne Valley Road in the Village of Hillburn in Rockland County, New York (Appendix A, Figure 1). Hillburn is in the southeastern portion of New York State, near the New York / New Jersey border. The site is near the Town of Ramapo Landfill to the north and is bordered to the west by the Erie Railroad. The site is 3.01 acres and is zoned light industrial. Immediately around the site, the average elevation is approximately 320 feet above mean sea level. The HTI facility is a 20,500 square foot single story building and has been occupied by several commercial businesses since construction in 1962 (Environmental Products and Services, 1996). The facility contains floor drains, a dry well, and a septic system.

HTI began its operations at the Hillburn facility in 1994. HTI reclaims CFCs from commercial air conditioning and cooling systems and either returns them to the customer or buys and resells them. The facility is currently supplied by public water; HTI had an on-site septic system and floor drains that fed into dry wells on-site; the facility has been connected to the public sewer system since 1998 (US EPA, 2000).

United Water New York (UWNY) owns and maintains over 60 public water supply wells in Rockland County. Ten of these are located in the Ramapo River Valley. All of these wells draw from the Ramapo Mahwah Aquifer, a sole source, primary aquifer. The water from these 10 wells is plumbed via two main lines to a pumping station. Three supply wells tie together and the other seven wells tie together at the pump station. Four of the wells are very high yielding wells, supplying 60% of the water pumped from the Ramapo River Valley well field. The well field produces approximately ten million gallons of water per day; therefore, the four high-production wells collectively produce six million gallons of water per day. Water from this well field can be distributed not only locally, but also throughout Rockland County. Two UWNY wells are approximately 500 feet south and southwest (respectively), downgradient from HTI.

The New York State Thruway (I-87), Route 17 and Route 287 all pass nearby, within an eighth of a mile of the HTI site, as do railroad freight and passenger lines. An inactive hazardous waste site, the Town of Ramapo Landfill, is just under a quarter of a mile north of HTI on Torne Valley Road. Two auto body shops (Jan's, and Frank's), the Statewide Window Company, and the Doane Pet Care Company site, being managed in the Voluntary Cleanup Program (Site No.V00235-3), are all within one-half mile of public water supply wells.

Routine sampling of the wells began in 1980. Samples, including one taken in January 1995, were tested for CFCs, and none were detected. In late May 1995, during routine monitoring of their wells, UWNY detected the CFC trichlorofluoromethane (also known as the refrigerant Freon-11 or R-11) in well 85 at 12 micrograms per liter (mcg/L). In June of 1995, UWNY resampled twice and detected R-11 in both wells 84 (3.7 mcg/L) and 85 (100 mcg/L and 28 mcg/L). UWNY immediately shut down both wells, temporarily, pending further investigation. The public drinking water from UWNY is a mixture of water from several wells, so the actual concentration of R-11 in the water reaching the distribution system would be less than 100 mcg/L. Wells 84, 85, and 99 were sampled about weekly thereafter and, based on the sampling results, were either pumped to waste or blended with water from well 100 to assure that public water continued to meet drinking water standards.

While there are several possible sources of the contamination, R-11 was detected in the septic tank sediments of HTI in August 1995. In 1996, HTI hired a consultant to conduct a subsurface investigation to evaluate the impact resulting from the former operation of the septic tank/leachfield system, as well as the drywell. During this investigation, seven monitoring wells were installed and sampled. R-11 was detected in six of the wells, ranging in concentrations from 18.4 mcg/L to 294 mcg/L. The highest concentration was detected in the deep monitoring well adjacent to the facility's septic tank.

In April 1999, HTI documented a spill of approximately 4,000 pounds of R-11 onto the ground. A failed connection hose to one of HTI's outdoor storage tanks and an unintentionally opened valve on the secondary containment vessel resulted in the spill. Elevated levels of the R-11 were soon detected at levels as high as 210,000 mcg/L in the surrounding monitoring wells. Over a 10-day period following this spill, approximately 400 to 500 cubic yards of contaminated soil were excavated from the area. Analytical results from soil samples collected from the excavation on April 2 and April 7, 1999, indicated R-11 at concentrations up to 0.87 milligrams per kilogram (mg/kg). A final round of soil samples collected on April 12, 1999 indicated that R-11 was not present above the detection level of 0.026 mg/kg.

For the public water supply wells, samples collected earlier in 1999 and a sample collected from well 85 on April 2, 1999 did not contain any detectable R-11. R-11 from this spill was first detected in well 85 on April 14, 1999 and in well 84 six days later. Since the public drinking water from UWNY is a mixture of water from several wells, the actual concentration of R-11 served to the public would be less than the highest detected (in well 85 at 243 mcg/L). Although we don't know the exact date, UWNY likely took wells 84 and 85 off-line when R-11 from the

spill was first detected. They then pumped the water to waste in an effort to contain the R-11 plume. A crude aeration system, which pumped the wells to waste, was installed in May 1999 along the Ramapo River bank near wells 84, 85 and 99. Water samples were collected for compliance of a State Pollution Discharge Elimination System (SPDES) permit for this system. The highest level of R-11 in the public water supply wells was 785 mcg/L in well 84, sampled on June 11, 1999 while the well was off-line.

In July of 1999, at the request of NYS DEC, HTI installed a groundwater extraction and treatment system utilizing an air-stripping tower in an effort to remediate the R-11 contamination. Analytical tests on samples from the influent of this system indicated an R-11 concentration of 6,000 mcg/L. The remedial system effluent levels were found to be below 2 mcg/L. The effluent was discharged upgradient of the facility in order to circulate the treated groundwater water back into the remedial system.

In January 2001, HTI installed an additional monitoring well (MW-7) at the request of US EPA. Levels of R-11 in MW-7 increased from 27,000 mcg/L in February 2001 to 63,000 mcg/L in May 2001. As a result, HTI and NYS DEC signed a Modified Order of Consent in May 2001, requiring HTI to install an extraction well near MW-7. The Order also provides for the installation of a sentinel well between UWNY wells 99 and 100.

The crude aeration system on the public water supply was abandoned after the construction of the air stripper system at the pumping station adjacent to public water supply wells 84 and 85 in March 2001. On March 17, 2001, the public water supply wells were put back on-line. These wells are monitored for VOCs (including CFCs) on a weekly basis. Weekly samples of wells during 2001 contained R-11 at levels ranging: 0.6 mcg/L to 5.5 mcg/L in well 84 and 7.4 mcg/L to 20.2 mcg/L in well 99, while there were no detections in well 85. R-11 was not detected in well 100 in 2001 until September, when it was found at 0.6 mcg/L. Similar levels were detected in every weekly sample until the end of January 2003. These levels of R-11 are the levels found in water from the wells before treatment and do not represent the levels in the water after treatment.

In early summer 2001, under the supervision of US EPA, an extraction well was installed on-site to extract contaminated groundwater from the subsurface. A geophysical survey identified a potential "pocket" of contamination. Groundwater samples collected from the extraction well contained elevated levels of R-11 ranging up to 49,000 mcg/L.

HTI has voluntarily conducted and continues to conduct, remedial activities on-site with NYS DEC, US EPA, and Rockland County Department of Health (RCDOH) supervision under the auspices of the Order of Consent with NYS DEC. NYS DEC requested that US EPA add this site to the NPL. The HTI site was nominated to the NPL on May 11, 2000. However, US EPA has not made a final decision about placing the site on the NPL.

B. Site Visit

Staff from NYS DOH visited the site on April 4, 2001. Staff drove the full length of Torne Valley Road (approximately 1 mile), which passes by the inactive Town of Ramapo Landfill and dead ends at a trash compaction and transfer facility owned and operated by the Town of Ramapo. Directly across from HTI on Torne Valley Road are railroad tracks, an overpass, public water supply wells, and a pumping station. Monitoring wells were present both on- and off-site. Cars were parked at the HTI facility, and the site is currently used for warehouse and storage purposes, pending the sale of the property. The HTI site is unfenced. An air-stripper is on-site, attached to the south end of the building. The pump station has two air stripping towers attached to the building.

C. Demographics

NYS DOH estimated from the 2000 Census that 16,295 people live within area most likely to have received contaminated water. This area includes the Villages of Hillburn and Sloatsburg and ZIP code 10901 excluding the Village of Suffern. The age distribution of the area is similar to that of the rest of Rockland County as well as New York State, excluding New York City (NYC). There were approximately 3,000 females of reproductive age (ages 15-44) within the area. The area most likely to have received contaminated water is somewhat less ethnically diverse than the rest of the County or State (excluding NYC). Based on the 2000 Census, a lower percentage of the population is living below the poverty level, while the median household income is about 45% higher than the rest of the county and 77% higher than the State (excluding NYC). These comparisons are provided in the following table. In addition, there are nine schools and one nursing home within the area.

2000 Census Demographics	New York State excluding NYC	Rockland County	Hillburn, Sloatsburg, ZIP code 10901 (part)
Age Distribution			
<6	8%	9%	9%
6-19	20%	21%	22%
20-64	58%	58%	56%
>64	14%	12%	14%
Race Distribution			
White	85%	77%	90%
Black	8%	11%	4%
Native American	<1%	<1%	1%
Asian	2%	6%	3%
Pacific Islander	<1%	0%	<1%
Other	2%	4%	1%
Multi-Racial	2%	3%	2%
Percent Minority*	18%	28%	14%
Ethnicity Distribution			
Percent Hispanic	6%	10%	4%
1999 Median Income	\$47,517	\$57,850	\$83,924
% Below Poverty Level	10%	10%	4%

* Minority includes Hispanics, African-Americans, Asian-Americans, Pacific Islanders and Native Americans.

DISCUSSION

A. Environmental Contamination

On-Site Contamination

After learning of the contamination in the UWNY drinking water supply wells in May 1995, samples were collected from HTI's septic system in August 1995. The results showed the presence of R-11 in the sediments. No other volatile organic compounds have been detected above New York State drinking water standards.

In early 1996, HTI retained Environmental Products and Services, Inc. to conduct a subsurface investigation. The purpose of the subsurface investigation was to evaluate contamination in the septic tank/leachfield system and drywell at the HTI facility. Six monitoring wells set in clusters of two (shallow and deep) were installed during February and March of 1996. A seventh monitoring well was installed in April 1996. Groundwater samples were collected and analyzed for volatile organic compounds using US EPA method 601/602. All groundwater samples contained R-11. The results are summarized below.

Monitoring Well #	R-11 Concentration micrograms per liter (mcg/L)
MW-1S	dry*
MW-1D	294
MW-2S	21.7
MW-2D	38.8
MW-3S	18.4
MW-3D	20.4
MW-4	41.8

* No water was collected for analysis because the monitoring well was dry.

In January 2001, HTI installed an additional monitoring well (MW-7) on site at the request of US EPA. Levels of R-11 in MW-7 have increased from 27,000 mcg/L in February 2001 to 63,000 mcg/L in May 2001. As a result, HTI and NYS DEC signed a Modified Order of Consent in May 2001, requiring HTI to install an extraction well in the vicinity of MW-7. The Order also provides for the installation of a sentinel well between UWNY wells 99 and 100.

Off-site Contamination

UWNY has been conducting quarterly monitoring sampling of the four wells of concern (84, 85, 99, 100) since 1984, and biannual sampling was conducted as early as 1980. The frequent (weekly) monitoring schedule was in response to concerns about the potential for contamination by another New York State inactive hazardous waste disposal site (Tempcon), also upgradient of the public water supply wells.

Low levels of R-11 were detected in UWNY well 84 and well 85 as early as 1995, and in well 99 as early as 1996. More recently, weekly sampling of these wells during 2001 showed detections of 0.6 mcg/L to 5.5 mcg/L in well 84, no detections in well 85, and 7.4 mcg/L to 20.2 mcg/L in well 99. In September 2001, water from well 100 contained 0.6 mcg/L of R-11. Similar levels have been detected in every weekly sample since then. Well 100 is approximately 0.6 miles (~3,200 feet) downgradient from HTI. The Village of Suffern water supply wells are approximately 1 mile downgradient of the HTI site. Due to the detection of R-11 in Well 100, the RCDOH requested that additional monitoring wells be installed between well 100 and the Village of Suffern's public water supply.

B. Pathways Analysis

This section of the PHA identifies completed and potential exposure pathways associated with past, present and future releases of hazardous substances at the site. An exposure pathway is the route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism

(such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

The source of contamination is the source of contaminant release to the environment (any waste disposal area or point of discharge); if the original source is unknown, it is the environmental media (soil, air, biota, water) which are contaminated at the point of exposure. Environmental media and transport mechanisms “carry” contaminants from the source to points where human exposure may occur. 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 (i.e., ingestion, inhalation, dermal absorption). The receptor population is people who are exposed or may be exposed to contaminants at a point of exposure.

Completed Exposure Pathways

For the HTI site there is currently only one completed exposure pathway; that is, exposure to R-11 in public drinking water in the past. Exposure to contaminants in drinking water supplies can occur via ingestion, dermal contact and absorption during showering, bathing, or other uses, and inhalation of aerosols and vapors from water.

Sampling results from January 1995 did not detect contamination in any of the public water supply wells. The first detection of contamination was in May 1995. The contaminated wells were shut down shortly thereafter, in mid-June 1995 and managed thereafter to assure that public water supplies met drinking water standards. R-11 from a new spill was also detected in 1999 with a time of about 12 days between when a sample was taken with no detectable R-11 and a sample was collected that contained R-11. Therefore, between the 1995 and 1999 events, residents may have been exposed to R-11 at levels above the drinking water standard for a period of about 6 months.

There are no other known completed exposure pathways at this site at this time; however there are four potential pathways, described below.

Potential Exposure Pathways

On-site Soils

One potential exposure pathway evaluated is exposure to contaminants in on-site soils. The potential for exposure to R-11 in the surface soil is unlikely due to the volatile nature of the contaminant of concern. The spill area is inaccessible because it is below the building. In addition, the site is an industrial area and not frequented by the general public. The majority of the site is paved or covered with vegetation, limiting contact with surface soils. Because of the limited potential for exposure, this exposure pathway is not considered further.

Ambient Air and River Water

Other potential exposure pathways are exposure to contaminants in air and river water from on- and off-site air stripping activities conducted to remediate groundwater contamination. Prior to the construction of the air strippers at the public water supply pump station, a crude aeration system was set up along the river bank to aerate contaminated groundwater from the HTI site. People who engaged in recreational activities along the river (e.g. fishing, swimming) may have been exposed to contaminated air and river water. River water samples collected approximately one-half mile downstream of the HTI site were tested for volatile organic contaminants (VOCs). The only contaminant detected was R-11 and the highest level detected was 3.14 mcg/L in a sample collected on May 17, 1999. This value is below the drinking water standard of 5 mcg/L.

While there are no direct air sampling results from the air strippers, RCDOH estimated that approximately one pound per hour of R-11 was emitted from the on-site air stripper system, based on effluent concentrations and flow rates of the system. Remediation using the crude aerator occurred between May 1999 and March 2001, and the newly constructed air stripper began operation in March 2001 and continues to be in operation.

Past exposure to R-11 via air and river water is difficult to characterize as the exposure periods were likely to be intermittent, periodic, and of unknown duration by transient populations. In addition, the highest concentration of R-11 found in river water was below the drinking water standard and the estimated amount released to the air from the air stripper system was low.

For the on-site remediation, a report documenting the site operations found that, on average, about 0.18 gal/day, or less than one (1) lb/day of R-11 was being released to the atmosphere. NYS DOH estimated potential air concentrations associated with R-11 emissions from the groundwater pump and treat system. We estimated worst-case ambient impacts using a screening model. We used the available stack information for the groundwater pump and treat system. The dispersion model calculated air concentrations for a variety of meteorological conditions, including periods of atmospheric inversions, to determine the highest estimated air concentrations. Our estimated maximum air concentration is well below health comparison values for R-11 in air. These pathways, therefore, are not considered further.

Indoor Air

Soil gas contaminated with R-11 may be present and could intrude into the indoor air of buildings in the area. No data have been collected to evaluate this potential exposure pathway. This PHA recommends that US EPA evaluate the possibility that soil gas contaminated with R-11 may intrude into the indoor air at nearby buildings.

C. Public Health Implications

Toxicological and epidemiological evaluation

To evaluate the potential health risks of R-11 associated with the human exposure pathway identified for the HTI site, NYS DOH assessed the risks for cancer and noncancer health effects. The risks for adverse health effects are related to contaminant concentration, exposure pathway, exposure frequency and exposure duration. Exposure to chemicals in drinking water is possible by ingestion, dermal contact and inhalation from water uses such as showering, bathing and cooking. Additional information on NYS DOH procedures for assessing health risks is presented in Appendix C.

Past ingestion, dermal and inhalation exposure to R-11 in public water supply wells

For an undetermined period of time, possibly about six months, residents may have been exposed to R-11 in drinking water at levels above the drinking water standards. The highest level of R-11 (100 mcg/L in 1995 and 243 mcg/L in 1999) while the public water supply wells were in use exceeds the current New York State public drinking water standard of 5 mcg/L (Appendix B, Table 1). However, the public drinking water from UWNY is a mixture of water from several wells, so the actual concentration of R-11 distributed to the public would be less than 100 mcg/L.

Toxicological data are inadequate to assess the carcinogenic potential of R-11 in humans (US EPA, 1989). Information on noncancer health effects from exposure to R-11 is limited. People who accidentally breathed high amounts of R-11 had effects on the heart (irregular or rapid heartbeat) and central nervous system (stupor, unconsciousness). One person who accidentally ingested a small amount of pure R-11 had damage to the stomach and liver. Exposure to large amounts of R-11 by inhalation damages the heart, central nervous system and respiratory system of laboratory animals (ACGIH, 2001). Although the risks of noncarcinogenic effects from past exposures in drinking water are not completely understood, the existing data suggest that they would be minimal for people exposed to the highest detected level of R-11 (100 mcg/L in 1995 and 243 mcg/L in 1999) in drinking water supply wells. The public drinking water from UWNY is a mixture of water from several wells, so the actual concentration of R-11 to which residents were exposed would have been less than 100 mcg/L. The estimated exposure to the highest level of R-11 in drinking water near the HTI site (100 mcg/L) is at least 17,000 times lower than the exposures known to cause adverse noncancer effects in animals and is 20 times lower than the US EPA Lifetime Health Advisory (LTHA) for R-11 in drinking water.

D. ATSDR Child Health Considerations

The ATSDR Child Health Considerations emphasizes the on-going examination of relevant child health issues in all of the agency's activities, including evaluating child-focused concerns through its mandated public health assessment activities. ATSDR and NYS DOH consider children when evaluating exposure pathways and potential health effects from environmental

contaminants. Children are of special concern because of their greater potential for exposure from play and other behavior patterns. Children sometimes differ from adults in their susceptibility to hazardous chemicals, but whether there is a difference depends on the chemical. Children may be more or less susceptible than adults to health effects, and the relationship may change with developmental age.

The possibility that children or developing fetuses may have increased sensitivity to R-11 was considered when evaluating the potential health risks associated with the Hudson Technologies, Inc. site. However, no studies were located in the toxicological literature that evaluate the reproductive or developmental health effects of R-11 in animals or humans, and thus a comparison of the estimated R-11 exposures at the site to exposure levels that cause these effects cannot be made.

E. Health Outcome Data Evaluation

NYS DOH has not evaluated health outcome data specifically for the HTI site. NYS DOH maintains several health outcome databases, which could be used to generate site-specific data, if warranted. These databases include the cancer registry, the congenital malformations registry, vital records (birth and death certificates) and hospital discharge information.

In 1999, NYS DOH established the New York State VOC Exposure Registry, a registry of individuals in the state who have been exposed to VOCs. Because the level and duration of exposure are limited, residents supplied by public water affected by contamination from HTI site are not being considered for inclusion in the VOC Exposure Registry at this time.

COMMUNITY HEALTH CONCERNS

Since the discovery of the contamination in May 1995, there has been some expression of community health concerns associated with the site. The Village of Suffern has had multiple meetings with NYS DOH, NYS DEC, US EPA and representatives of Hudson Technologies. The Village has sent correspondence expressing concern over potential impacts to the Village's water supply. They have also reviewed and commented on several documents regarding remediation of this site. In addition, there have been numerous newspaper articles regarding the site over the past several years. RCDOH states that there have been two inquiries made by public water supply customers (to RCDOH) regarding this site and less than ten inquiries made by private well owners who live several miles from the site. The site does not affect these private wells because they are upgradient and several miles from the site. No specific health concerns were identified as a result of these inquiries.

The public was invited to review the draft Public Health Assessment during the public comment period, which ran from June 21, 2002 to July 22, 2002. A summary of the comments is provided in Appendix E.

CONCLUSIONS

Based on the ATSDR's public health hazard category classification (Appendix D), the Hudson Technologies Inc. site poses no apparent public health hazard currently and in the past because NYS DOH and ATSDR have no information that indicates persons have been exposed to site-related contaminants at levels that may cause adverse health effects.

However, public health actions were needed to reduce possible exposures to R-11 from contaminated drinking water because levels were above the New York State drinking water standard and may have increased or continued had these measures not been taken. Human exposures to R-11 may have occurred via ingestion, inhalation, and dermal contact, and the exposure may have continued for about six months. Treatment was installed at the UWNY public supply wells to remove contamination. There are no other known completed exposure pathways at this site.

The groundwater contaminant plume has not reached the Village of Suffern's water supply wells as documented through historical sampling and monitoring activities.

RECOMMENDATIONS

1. Continue actions to reduce exposures to people from drinking water that exceeds drinking water standards. These actions include treatment of the drinking water by the air strippers.
2. Continue periodic sampling of the public water supply wells and monitoring wells to monitor contaminant levels. This information will be used to minimize possible exposures until the groundwater meets New York State public drinking water standards.
3. Continue monitoring on- and off-site groundwater contamination. This can provide a basis for future remedial activities, if needed.
4. Evaluate the possibility that soil gas contaminated with R-11 may intrude into the indoor air at nearby buildings.

PUBLIC HEALTH ACTION PLAN

The Public Health Action Plan (PHAP) for the Hudson Technologies Inc. site contains a description of actions to be taken by ATSDR and/or the NYS DOH following completion of this public health assessment. For those actions already taken at the site, please refer to the

Background section of this public health assessment. The purpose of the PHAP is to ensure that this public health assessment identifies public health hazards and provides a plan of action designed to mitigate and prevent adverse human health effects resulting from the past, present and/or future exposures to hazardous substances at or near the site. Included is a commitment on the part of ATSDR and/or NYS DOH to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and/or NYS DOH are as follows:

1. NYS DOH will coordinate with the appropriate agencies to develop a plan to implement the recommendations contained in this public health assessment.
2. NYS DOH and RCDOH will continue to review monitoring data to make sure any additional contamination is detected early and exposures are minimized.

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PREPARERS OF THE REPORT

New York State Department of Health Authors

Kim Evans
Public Health Specialist II
Bureau of Water Supply Protection

Scarlett Messier
Research Scientist
Bureau of Environmental Exposure Investigation

Sharlin Liu
Assistant Research Scientist
Bureau of Toxic Substance Assessment

Thomas Johnson, Ph.D.
Research Scientist
Bureau of Toxic Substance Assessment

Steven P. Forand
Research Scientist
Bureau of Environmental and Occupational Epidemiology

Donald W.R. Miles
ATSDR Grant Coordinator
Bureau of Environmental Exposure Investigation

Agency for Toxic Substances and Disease Registry

Arthur Block
Senior Regional Representative
Region 2
Office of Regional Operations

Gregory V. Ulrich Ph.D.
Environmental Health Engineer
Superfund Site Assessment Branch
Division of Health Assessment and Consultation

Leah Escobar
Regional Representative
Region 2
Office of Regional Operations

CERTIFICATION

The Public Health Assessment for the Hudson Technologies, Inc., site was prepared by the New York State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was initiated. Editorial review was completed by the cooperative agreement partner.



Technical Project Officer, CAT, CAPEB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation, and concurs with its findings.



Team Leader, CAT, CAPEB, DHAC, ATSDR

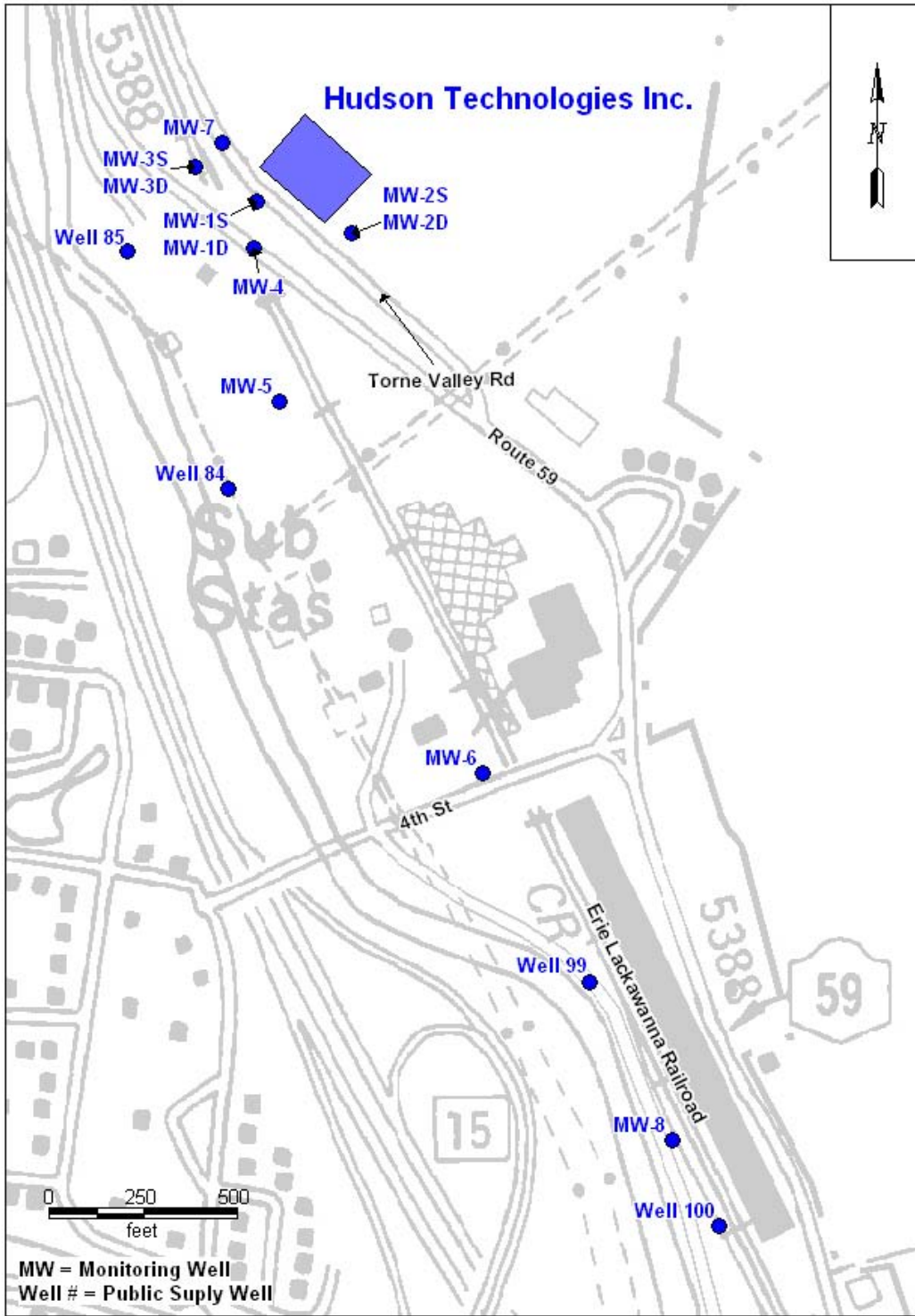
APPENDIX A

Figures

Figure 1: Site Location Map
Hudson Technologies Inc. Village of Hillburn, Rockland County, New York



Figure 2. Monitoring Well and Public Water Supply Well Locations



APPENDIX B

Tables

Table 1
Water Quality Standards/Guidelines and Public Health Assessment
Comparison Values for Trichlorofluoromethane
 [All values in micrograms per liter (mcg/L)]

Contaminant	Water Quality Standards/Guidelines			Comparison Values*					
	New York State			US EPA		Cancer	Basis	Noncancer	Basis**
	Ground Water	Surface Water	Drinking Water	Drinking Water					
trichlorofluoromethane	5	5	5	--	--	--	2000	EPA LTHA	

* Comparison values determined for a 70 kilogram adult who drinks 2 liters of water per day.

** EPA LTHA: Environmental Protection Agency lifetime health advisory.

APPENDIX C

NYS DOH PROCEDURE FOR EVALUATING POTENTIAL HEALTH RISKS
FOR CONTAMINANTS OF CONCERN

NYS DOH PROCEDURE FOR EVALUATING POTENTIAL HEALTH RISKS
FOR CONTAMINANTS OF CONCERN

To evaluate the potential health risks from contaminants of concern associated with the Hudson Technologies Inc. Site, the New York State Department of Health assessed the risks for cancer and noncancer health effects.

Increased cancer risks were estimated by using site-specific information on exposure levels for the contaminant of concern and interpreting them using cancer potency estimates derived for that contaminant by the US EPA or, in some cases, by the NYS DOH. The following qualitative ranking of cancer risk estimates, developed by the NYS DOH, was then used to rank the risk from very low to very high. For example, if the qualitative descriptor was "low", then the excess lifetime cancer risk from that exposure is in the range of greater than one per million to less than one per ten thousand. Other qualitative descriptors are listed below:

Excess Lifetime Cancer Risk

<u>Risk Ratio</u>	<u>Qualitative Descriptor</u>
equal to or less than one per million	very low
greater than one per million to less than one per ten thousand	low
one per ten thousand to less than one per thousand	moderate
one per thousand to less than one per ten	high
equal to or greater than one per ten	very high

An estimated increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is a plausible upper bound estimate of the probability that a person may develop cancer sometime in his or her lifetime following exposure to that contaminant.

There is insufficient knowledge of cancer mechanisms to decide if there exists a level of exposure to a cancer-causing agent below which there is no risk of getting cancer, namely, a threshold level. Therefore, every exposure, no matter how low, to a cancer-causing compound is assumed to be associated with some increased risk. As the dose of a carcinogen decreases, the chance of developing cancer decreases, but each exposure is accompanied by some increased risk.

There is general consensus among the scientific and regulatory communities on what level of estimated excess cancer risk is acceptable. An increased lifetime cancer risk of one in one million or less is generally not considered a significant public health concern.

For noncarcinogenic health risks, the contaminant intake was estimated using exposure assumptions for the site conditions. This dose was then compared to a risk reference dose (estimated daily intake of a chemical that is likely to be without an appreciable risk of health effects) developed by the US EPA, ATSDR and/or NYS DOH. The resulting ratio was then compared to the following qualitative scale of health risk:

Qualitative Descriptions for
Noncarcinogenic Health Risks

<u>Ratio of Estimated Contaminant Intake to Risk Reference Dose</u>	<u>Qualitative Descriptor</u>
equal to or less than the risk reference dose	minimal
greater than one to five times the risk reference dose	low
greater than five to ten times the risk reference dose	moderate
greater than ten times the risk reference dose	high

Noncarcinogenic effects unlike carcinogenic effects are believed to have a threshold, that is, a dose below which adverse effects will not occur. As a result, the current practice is to identify, usually from animal toxicology experiments, a no-observed-effect-level (NOEL). This is the experimental exposure level in animals at which no adverse toxic effect is observed. The NOEL is then divided by an uncertainty factor to yield the risk reference dose. The uncertainty factor is a number which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor takes into consideration various factors such as sensitive subpopulations (for example, children or the elderly), extrapolation from animals to humans, and the incompleteness of available data. Thus, the risk reference dose is not expected to cause health effects because it is selected to be much lower than dosages that do not cause adverse health effects in laboratory animals.

The measure used to describe the potential for noncancer health effects to occur in an individual is expressed as a ratio of estimated contaminant intake to the risk reference dose. A ratio equal to or less than one is generally not considered a significant public health concern. If exposure to the contaminant exceeds the risk reference dose, there may be concern for potential noncancer health effects because the margin of protection is less than that afforded by the reference dose. As a rule, the greater the ratio of the estimated contaminant intake to the risk reference dose, the greater the level of concern. This level of concern depends upon an evaluation of a number of factors such as the actual potential for exposure, background exposure, and the strength of the toxicologic data.

APPENDIX D
PUBLIC HEALTH HAZARD CATEGORIES

INTERIM PUBLIC HEALTH HAZARD CATEGORIES

CATEGORY / DEFINITION	DATA SUFFICIENCY	CRITERIA
<p>A. Urgent Public Health Hazard</p> <p>This category is used for sites where short-term exposures (< 1 yr) to hazardous substances or conditions could result in adverse health effects that require rapid intervention.</p>	<p>This determination represents a professional judgement based on critical data which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information* indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse impact on human health that requires immediate action or intervention. Such site-specific conditions or exposures may include the presence of serious physical or safety hazards.</p>
<p>B. Public Health Hazard</p> <p>This category is used for sites that pose a public health hazard due to the existence of long-term exposures (> 1 yr) to hazardous substance or conditions that could result in adverse health effects.</p>	<p>This determination represents a professional judgement based on critical data, which ATSDR has judged sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information* suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse impact on human health that requires one or more public health interventions. Such site-specific exposures may include the presence of serious physical or safety hazards.</p>
<p>C. Indeterminate Public Health Hazard</p> <p>This category is used for sites in which “critical” data are <i>insufficient</i> with regard to extent of exposure and/or toxicologic properties at estimated exposure levels.</p>	<p>This determination represents a professional judgement that critical data are missing and ATSDR has judged the data are insufficient to support a decision. This does not necessarily imply all data are incomplete; but that some additional data are required to support a decision.</p>	<p>The health assessor must determine, using professional judgement, the “criticality” of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision.</p>
<p>D. No Apparent Public Health Hazard</p> <p>This category is used for sites where human exposure to contaminated media may be occurring, may have occurred in the past, and/or may occur in the future, but the exposure is not expected to cause any adverse health effects.</p>	<p>This determination represents a professional judgement based on critical data that ATSDR considers sufficient to support a decision. This does not necessarily imply that the available data are complete; in some cases additional data may be required to confirm or further support the decision made.</p>	<p>Evaluation of available relevant information* indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse impact on human health.</p>
<p>E: No Public Health Hazard</p> <p>This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard.</p>	<p>Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future</p>	

*Such as environmental and demographic data; health outcome data; exposure data; community health concerns information; toxicologic, medical, and epidemiologic data; monitoring and management plans.

APPENDIX E

Summary of Public Comments and Responses

Summary of Public Comments and Responses

This summary was prepared to address comments and questions on the public comment draft of the Hudson Technologies Public Health Assessment. The public was invited to review the draft during the public comment period which ran from June 21 to July 22, 2002. Similar comments may be consolidated or grouped together and some statements reworded to clarify the comment. If you have any questions about this summary, you may contact New York State Department of Health (NYS DOH) at the toll-free number: 1-800-458-1158.

Comment #1 - A consultant for the Village of Suffern questioned the validity of the statement that there had been limited expression of public health concerns and no public meetings. The Village of Suffern has had at least six meetings with NYS DOH, NYS DEC, US EPA and representatives of Hudson Technologies. The Village has sent correspondence expressing concern over potential impacts to the Village's water supply. They have also reviewed and commented on numerous documents regarding remediation of this site. Does this not represent strong community concerns?

Response #1 - We revised the discussion in the community health concerns section to reflect the concerns identified by the commentor.

Comment #2 - A resident states that the public is not aware of the potential health risks and that is the reason for the limited concern.

Response #2 - The potential public health implications of the contamination from the site are discussed in this document, which was distributed to the public for their information and comment. Some additional concerns were brought to our attention and are summarized in this final version of the public health assessment.

Comment #3 - A consultant from the Village of Suffern stated that, contrary to what was stated in the draft public health assessment, the Village water system has not been treated for the removal of VOCs for the past 10 years.

Response #3 - We revised the document to reflect the concerns identified by the commentor. (Deleted last sentence on page 2, page 5, and page 14)

Comment #4 - A resident questioned why the state approval process didn't take Hudson Technologies' septic system into consideration as a potential environmental risk factor.

Response #4 - An investigation of all sources of groundwater contamination was conducted which resulted in the discovery of the septic system as the most likely source. Following discovery, all investigation and remediation activities focused on the septic system.

Comment #5 - A resident questioned why HTI was allowed to continue operation after the first wells were contaminated.

Response #5 - After discovery of the septic field as the likely source of groundwater contamination, the Rockland County Department of Health required HTI to cease using the field and install a holding tank. All wastewater was pumped from the tank and taken for disposal to an acceptable wastewater treatment facility. Available information indicated that the source of the contamination was stopped and, therefore, the agencies had no reason to stop normal business operations at the site.

Comment #6 - A resident questioned the use of an air stripper to clean the water. The area is subject to severe air inversions making the freon not easily dispersed.

Response #6 - The Public Comment Draft public health assessment (page 11, par. 1) provided an estimate from the Rockland County DOH that as much as one (1) lb/hr of Freon 11 recovered from the Remediation Well 1 (RW-1) at the HTI site would be released to ambient air. Since the release of the public comment draft report, a second well has been commissioned (RW-2). A report documenting the site operations found that, on average, about 0.18 gal/day, or less than one (1) lb/day of R-11 was being released to the atmosphere. NYS DOH estimated potential air concentrations associated with R-11 emissions from the groundwater pump and treat system. We estimated worst-case ambient impacts using a screening model. We used the available stack information for the groundwater pump and treat system. The dispersion model calculated air concentrations for a variety of meteorological conditions, including periods of atmospheric inversions, to determine the highest estimated air concentrations. Our estimated maximum air concentration is well below health comparison values for R-11 in air.

Comment #7 - A resident questions the possible contamination of the Hillburn/Sloatsburg area where there is currently no sewer or treatment system.

Response #7 – Contamination from this site affects a limited area and does not reach residential areas of Hillburn or Sloatsburg.

Comment #8 - A resident wonders whether the continued ingestion of R-11 is cumulative and questions the length of time that residents could have been exposed given that the first contamination was in May of 1995 and the last in May of 1999.

Response #8 - There is limited information on how R-11 is absorbed, changed and excreted following oral exposure. There is no scientific evidence to suggest that large amounts of R-11 accumulate in the body.

Concerning the length of time people may have been exposed, the first contamination of public water supply wells was discovered in May, 1995. Sampling by United Water New York in January 1995 did not detect any R-11, and R-11 was not detected in previous sampling dating back to 1980. The contaminated wells were shut down in June, 1995. R-11 from a new spill was also detected in 1999 with a time of about 12 days between when a sample was taken with no

detectable R-11 and a sample was collected that contained R-11. Therefore, residents may have been exposed to R-11 for a period of about 6 months.

Comment #9 - A resident requests that a public meeting be held.

Response #9 –We believe that the public has had opportunities to learn about the site and have input on the investigation and cleanup. The Rockland County Health Department presented information about the site to many public organizations including the Rockland County Legislature, local environment groups and the media. The County and NYS DOH continue to be available for questions. The NYS DOH can be reached at the toll-free number 1-800-458-1158.

Comment #10 - A resident wants to know the potential danger to wildlife and vegetation due to R-11 adsorption.

Response #10 -The purpose of this public health assessment (PHA) is to evaluate the public health implications of human exposure to contaminants at the site. Questions regarding the effects of R-11 on wildlife and vegetation should be addressed to the *NYS Department of Environmental Conservation, 625 Broadway Albany NY 12233*.

Comment #11 - A resident questions the State's ability to have full confidence in its standards for allowable contamination when the toxicological data are inadequate to assess the carcinogenic potential of R-11.

Response #11 - The New York State public drinking water standard for R-11 is 5 micrograms per liter (mcg/L) based on its classification as a principal organic contaminant. R-11 is regulated under the state's generic drinking water standards for organic chemicals, which classify contaminants that do not have a chemical-specific standard as either principal organic contaminants (maximum contaminant level = 5 mcg/L) or unspecified organic contaminants (maximum contaminant level = 50 mcg/L). R-11 is designated as a principal organic contaminant because it belongs to one of six chemical classes (specifically, chlorinated alkanes) whose chemical structure is generally associated with a greater degree of toxicity and carcinogenic potential than other organic chemicals. The intent of the generic standards is to provide a means to limit exposure to organic chemicals whose toxicity has not been well-studied and for which no federal drinking water standard exists (such as R-11).

Comment #12 - A resident feels that the aquifer should be more strongly protected before the drinking water is contaminated.

Response #12 - The geographical features that make this area a high yielding water supply are the same features that allow contaminants to easily enter the aquifer, and have historically attracted development as a high usage industrial and transportation corridor. As a result, it is prone to contamination and is exposed to a wide range of potential contaminants. The local health department has been looking at legislative means of limiting exposure (e.g., drafting aquifer protection legislation) and has also been considering further

outreach efforts to inform both the public and planners of the potential for contamination of the aquifer. For more information, please contact the Rockland County Health Department.

The County Legislature is currently holding a series of water forums to gather facts and listen to ideas with the goal of making recommendations to protect the County's drinking water supply in general, and the Ramapo/Mahwah aquifer in particular. The Rockland County Department of Health, Division of Environmental Health, Bureau of Hazardous Materials has begun a new series of inspections within the boundary of the aquifer, looking for underground injection control points with the assistance of a grant from US EPA, and performing expanded Petroleum Bulk Storage inspections. In addition, there are local interest groups involved with numerous actions focusing on protection of the aquifer, as well as the Ramapo River. Due to the aquifer's valuable water resource potential and contamination potential, there will always be the need to be prepared for the possibility of contamination.

Comment #13 - A resident requests a cancer study of the Hillburn area. (Direct quote "Give priority to a cancer study of Hillburn Area").

Response #13 - NYS DOH has no plans at this time to conduct a cancer study of the Hillburn area. There was limited exposure to R-11. Although levels at the contaminated wells were above NYS drinking water standards, substantial mixing of the water within the drinking water system from 10 other supply wells is known to have taken place thus the levels of R-11 in the distribution system were much lower than those observed at the well head. In addition, the time period of possible exposure was limited to about 6 months and may have been shorter. While there is inadequate toxicological information to assess the carcinogenicity of R-11, we would not expect there to be a significant increase in cancer risk due to the relatively short duration of exposure. Most cancers may take up to 20 years to develop after exposure to cancer causing chemicals. Therefore, even if the site were thought to have posed a risk to the community, these effects would not be seen for at least 10 to 15 years.

Comment #14 - A resident wonders if the risks to children as a result of breast feeding were evaluated.

Response #14 - Risks to infants via breast-feeding were not specifically evaluated. Our evaluation of the health risks for exposure to R-11 is based on the most sensitive known effect of the chemical in the most sensitive species. The estimated level of exposure to R-11 at the highest level found in public drinking water is at least 17,000 times lower than the levels of R-11 exposure that cause health effects in animals. We therefore estimate that the risk for adverse health effects, including those to nursing infants, is minimal.

Comment #15 - A consultant for HTI states that the generic maximum contaminant level of 5 mcg/L is not based on chemical specific toxicological information on R-11 and therefore, exceeding the 5 mcg/L does not indicate a health hazard, or the need to take action to protect public health.

Response #15 - The standard is a regulatory level aimed at minimizing public exposure to drinking water contaminants to the greatest extent practical. Since the standard is set at a level that provides a reasonable margin of protection against adverse health effects, it therefore follows that exposure at the level of the standard is associated with a relatively low risk of adverse health effects for most chemicals. However, while exceedance of the standard may not indicate a health hazard, it does indicate that public health actions should be taken to minimize long-term exposure to the chemical. This is especially important for chemicals like R-11, whose toxicological database is limited and whose health effects and effect levels have not been as well characterized as those for other chemicals.

Comment #16 - A consultant for HTI states that the US EPA has not classified R-11 as a potential human carcinogen so the increase in breast cancer noted in the PHA can not be attributed to HTI and should be removed from the document.

Response #16 - The commenter is correct in that US EPA has not classified R-11 as a potential human carcinogen. The health assessment did not attempt to relate the significantly higher than expected incidence of breast cancer to any specific chemical or risk factor, as the comment implies, however, the section has been removed from the document.

Comment #17 - A consultant for HTI states that NYS DOH has not demonstrated that the site could have posed a significant public health hazard had actions not been taken to reduce exposures. The PHA does not include any analysis of potential concentrations in drinking water if cleanup measures had not been taken at the site.

Response #17 - NYS DOH believes that public health actions were needed because a public drinking water supply was contaminated at levels above drinking water standards. We have removed the phrase “public health hazard” from this paragraph.

Comment #18 - A lawyer for HTI states that the contaminated plume has been controlled citing reports prepared by Miller Environmental Group.

Response #18 - HTI has installed groundwater treatment systems for on-site contamination. The HTI environmental consultant, Miller Environmental Group, reported that the contaminant plume is controlled by these systems. Area groundwater flows are heavily influenced by United Water, which pumps groundwater at high volumes. The groundwater contaminant plume has not reached the Village of Suffern’s water supply wells as documented through historical sampling and monitoring activities

Comment #19 - A representative of United Water feels that there is no definitive knowledge that an exposure occurred so the wording of the PHA should not state exposure only the possibility of exposure.

Response #19 - While people were probably exposed to HTI site-related contaminants in public drinking water since public water is composed of a mixture from several wells (many of which

were contaminated), there is a possibility that some residents were not exposed to these chemicals. The document has been changed to indicate that residents “were likely exposed” as opposed to “were exposed.”

Comment #20 - A representative of United Water states that the last sentence of paragraph one on page 12 should be changed from Rockland County to Ramapo Valley Well Field.

Response #20 - The correct name is Ramapo Valley Well Field.

Comment #21 - A representative of United Water states that any potential exposure was not at the highest concentration because the water was altered physically, by virtue of pumping to a clearwell and exposure to the atmosphere, then treated. It was also blended with water not containing R-11.

Response #21 - We agree with the commentor’s remark, which is stated in the Public Health Assessment, page 1, second paragraph, last sentence.

APPENDIX F
ATSDR Glossary of Terms

ATSDR Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-422-8737.

General Terms

Absorption - The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute - Occurring over a short time [compare with chronic].

Acute exposure - Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect - A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect - A change in body function or cell structure that might lead to disease or health problems.

Aerobic - Requiring oxygen [compare with anaerobic].

Ambient - Surrounding (for example, *ambient* air).

Anaerobic - Requiring the absence of oxygen [compare with aerobic].

Analyte - A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study - A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect - A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level - An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Biodegradation - Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi).

Biologic indicators of exposure study - A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring - Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake - The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing - Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota - Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden - The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

Cancer - Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk - A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen - A substance that causes cancer.

Case study - A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study - A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number - A unique number assigned to a substance by the American Chemical Society Abstracts Service.

Central nervous system - The part of the nervous system that consists of the brain and the spinal cord.

CERCLA - [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980].

Chronic - Occurring over a long time [compare with acute].

Chronic exposure - Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation - A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP) - A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV) - Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway - [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) - CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration - The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant - A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect - A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal - Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact - Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology - The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit - The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention - Measures used to prevent a disease or reduce its severity.

Disease registry - A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD - United States Department of Defense.

DOE - United States Department of Energy.

Dose (for chemicals that are not radioactive) - The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals) - The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship - The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media - Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism - Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA - United States Environmental Protection Agency.

Epidemiologic surveillance - [see Public health surveillance].

Epidemiology - The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure - Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment - The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction - A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation - The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway - The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or

touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry - A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study - A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS) - A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds - Training sessions for physicians and other health care providers about health topics.

Groundwater - Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t_{1/2}$) - The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard - A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat) - The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste - Potentially harmful substances that have been released or discarded into the environment.

Health consultation - A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education - Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation - The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence

and exposure to hazardous substances.

Health promotion - The process of enabling people to increase control over, and to improve, their health.

Health statistics review - The analysis of existing health information (e.g., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard - The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence - The number of new cases of disease in a defined population over a specific time period.

Ingestion - The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation - The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure - Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro - In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with *in vivo*].

In vivo - Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with *in vitro*].

Lowest-observed-adverse-effect level (LOAEL) - The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring - A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism - The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite - Any product of metabolism.

mg/kg - Milligram per kilogram.

mg/cm² - Milligram per square centimeter (of a surface).

mg/m³ - Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration - Moving from one location to another.

Minimal risk level (MRL) - An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral)

over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity - State of being ill or diseased, the occurrence of a disease or condition that alters health and quality of life.

Mortality - Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen - A substance that causes mutations (genetic damage).

Mutation - A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL) - EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP) - Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard - A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL) - The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard - A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL - [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model) - A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica - A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume - A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure - The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population - A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP) - A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb - Parts per billion.

ppm - Parts per million.

Prevalence - The number of existing disease cases in a defined population during a specific time period.

Prevalence survey - The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention - Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session - An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period - An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action - A list of steps to protect public health.

Public health advisory - A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA) - An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard - A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories - Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement - The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance - The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting - A public forum with community members for communication about a site.

Radioisotope - An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide - Any radioactive isotope (form) of any element.

RCRA - [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population - People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD) - An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry - A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation - The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA) - This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA - RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD - [see reference dose]

Risk - The probability that something will cause injury or harm.

Risk reduction - Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication - The exchange of information to increase understanding of health risks.

Route of exposure - The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor - [see uncertainty factor]

SARA - [see Superfund Amendments and Reauthorization Act]

Sample - A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size - The number of units chosen from a population or an environment.

Solvent - A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination - The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations - People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder - A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics - A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance - A chemical.

Substance-specific applied research - A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund - [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA) - In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water - Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance - [see public health surveillance]

Survey - A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect - A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen - A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent - Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile - An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology -The study of the harmful effects of substances on humans or animals.

Tumor - An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor - Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard - A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs) - Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:

Environmental Protection Agency - <http://www.epa.gov/OCEPAterms/>

National Library of Medicine (NIH) -

<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>

For more information on the work of ATSDR, please contact
NCEH/ATSDR Office of Communication, Information Services Center
1600 Clifton Road, N.E. (MS E-29)
Atlanta, GA 30333
Telephone: 1-888-422-8737