

Health Consultation

TOPS 'N' TOWN CLEANERS SITE

ENGLISHTOWN, MONMOUTH COUNTY, NEW JERSEY

EPA FACILITY ID: NJR000008193

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES

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Agency for Toxic Substances and Disease Registry

Division of Health Assessment and Consultation

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Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation 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.

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HEALTH CONSULTATION

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EPA FACILITY ID: NJR000008193

Prepared By:

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Public Health Protection and Emergency Preparedness
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Hazardous Site Health Evaluation Program

Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

Table of Contents

	Page Number
Summary	1
Statement of Issues	3
Background	3
Site Description.....	3
Site History.....	4
Site Visit.....	5
Demographics.....	6
Environmental Contamination	6
Environmental Guideline Comparison.....	6
Indoor Air.....	7
Groundwater.....	8
Soil Gas.....	8
Contaminants of Concern.....	9
Discussion	9
Assessment Methodology.....	9
Completed Pathways.....	9
Eliminated Pathways.....	10
Public Health Implications	10
Non-Cancer Health Effects.....	10
Cancer Health Effects.....	12
Child Health Considerations	14
Conclusions	15
Recommendations	16
Public Health Action Plan	16
Public Health Actions Taken.....	16
Public Health Actions Planned.....	17
References	18

Preparers of Report..... 20

Certification..... 21

Tables

Figures

Photographs

Appendix A: Toxicological Summary

Appendix B: Indoor Air Summary Additional Contaminants of Concern

**Appendix C: Lifetime Excess Cancer Risk Evaluation: Present and Historic
Businesses**

Appendix D: Summary of ATSDR Conclusion Categories

Appendix E: ATSDR Glossary of Terms

Summary

As part of an October 2002 remedial investigation of a leaking underground storage tank at a Mobil gas station located on Route 9, Manalapan Township, Monmouth County, New Jersey, environmental samples were collected from the adjacent Gordon's Corner Shopping Center. Tops 'N' Town Cleaners was one of the businesses located in the shopping center, and tetrachloroethylene was used in its daily dry cleaning operation. Elevated tetrachloroethylene concentrations were detected in the basement at the northern end of the shopping center; subsequent environmental sampling results indicated elevated tetrachloroethylene concentrations in ambient and indoor air, soil gas, and groundwater. Monthly sampling of shopping center businesses was initiated in January 2003, with results indicating continued elevated tetrachloroethylene concentrations in the indoor air.

Tetrachloroethylene concentrations detected in the indoor air of Gordon's Corner Shopping Center businesses during October 2002 through April 2005 exceeded the chronic comparison value, and some businesses had tetrachloroethylene concentrations above the acute comparison value. Maximum and average tetrachloroethylene concentrations detected at three businesses were used to assess non-cancer and cancer health effects for employees and patrons (including children). The likelihood of non-cancer adverse health effects associated with acute and chronic tetrachloroethylene exposures to employees of all businesses is low; non-cancer adverse health effects to patrons, including children, are not expected. It should be noted that the most sensitive endpoint for non-cancer health effects is based on an adult population; therefore, this endpoint may not be sufficiently conservative in all cases, especially for children with developing nervous systems.

Based on the maximum concentration detected in the indoor air, lifetime excess cancer risks for employees were estimated to be approximately one in 1,000 (Tops Tuxedo 'N' Tailoring), one in 1,000 (Tops 'N' Town Cleaners), and two in 10,000 (Panda House Restaurant). Based on the average concentration detected in the indoor air (the more likely exposure scenario), lifetime excess cancer risks for employees were estimated to be approximately three in 10,000 (Tops Tuxedo 'N' Tailoring and Tops 'N' Town Cleaners) and three in 100,000 (Panda House Restaurant). Lifetime excess cancer risks calculated for employees of past businesses operating at the shopping center during the period from 1983 to 2005 were as high as eight in 10,000. As such, past inhalation exposures to tetrachloroethylene for employees are considered a **Public Health Hazard** particularly in the businesses adjacent to the dry cleaners. For patron populations, the excess cancer risk from inhalation of tetrachloroethylene vapors is estimated to be very low when compared to background cancer risk. As such, there is **No Apparent Public Health Hazard** for past inhalation exposures to tetrachloroethylene for patrons.

On May 11, 2005, the New Jersey Department of Health and Senior Services provided a letter of technical assistance to the Manalapan Township Department of Health which recommended that necessary actions be taken to immediately end or prevent exposures from indoor air tetrachloroethylene to employees and patrons of businesses located at Gordon's Corner shopping center.

In May 2005, dry cleaning operations at the Tops 'N' Town Cleaners ceased, and the business space was cleaned. Results of tetrachloroethylene July 2005 indoor air samples collected from all of the businesses show that indoor air tetrachloroethylene concentrations were significantly reduced. Tetrachloroethylene concentrations remaining in eight of the 11 businesses may be associated with either vapor intrusion or residual tetrachloroethylene from the dry cleaners. No additional data was available to review in determining potential tetrachloroethylene fluctuations common with change in season. Since high tetrachloroethylene soil gas concentrations remain at the site and only one indoor air sampling round has been conducted subsequent to the eviction of the dry cleaners, present and future inhalation exposures to tetrachloroethylene are considered an ***Indeterminate Public Health Hazard*** to employees. For patron populations, the excess cancer risk from inhalation of PCE vapors is estimated to be very low when compared to background cancer risk. There is ***No Apparent Public Health Hazard*** for present and future inhalation exposures to PCE for patrons.

Recommendations include continued indoor air monitoring at the businesses to ensure the effectiveness of the positive pressure and soil venting systems, delineation of tetrachloroethylene contamination at the property so that a permanent remedy can be implemented, the examination by the NJDEP of its dry cleaning industry regulations and policies, and further investigation of volatile organic compounds detected in the indoor air. The New Jersey Department of Health and Senior Services is available to review and evaluate future indoor air tetrachloroethylene data in order that the Indeterminate Public Health Hazard category can be reevaluated; the Department is also available to review future indoor air data associated with the adjacent gasoline station site.

Statement of Issues

As part of an October 2002 remedial investigation of a leaking underground storage tank at a Mobil gas station located on Route 9, Manalapan Township, Monmouth County, environmental samples were collected from the adjacent Gordon's Corner Shopping Center. Tops 'N' Town Cleaners was one of the businesses located in the shopping center, and tetrachloroethylene, also known as perchloroethylene or PCE, was used in its daily dry cleaning operation. Elevated PCE concentrations were detected in the basement at the northern end of the shopping center; subsequent environmental sampling results indicated elevated PCE concentrations in ambient and indoor air, soil gas, and groundwater. Monthly sampling of shopping center businesses was initiated in January 2003, with results indicating continued elevated PCE concentrations in the indoor air.

The New Jersey Department of Environmental Protection (NJDEP) and the Manalapan Township Department of Health requested assistance in determining if PCE concentrations detected in the indoor air of shopping center businesses presented a public health hazard. In response to this request and through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the New Jersey Department of Health and Senior Services (NJDHSS) prepared the following health consultation. The health consultation focuses on exposures associated with elevated PCE concentrations detected in the indoor air of shopping center businesses during the time frame October 2002 through April 2005.

Background

Site Description

Tops 'N' Town Cleaners was located in the Gordon's Corner Shopping Center at 354-358 Route 9, Manalapan Township, Monmouth County (see Figure 1, Photograph 1). Tops 'N' Town cleaners, owned by DFM, Inc.¹, operated at this location from 1983 until May 2005. In addition to Tops 'N' Town Cleaners, there are 10 other retail businesses located in the shopping center (see Figure 2). Manalapan 9, LLC, is the shopping center property owner. The shopping center building was constructed in three separate phases (1968, 1974, and 1979). There is a basement under the 1968 portion of the building while the 1974 and 1979 additions were



Figure 1: Location of Tops 'N' Town Cleaners

¹ DFM, Inc. also owned Tops Tuxedos 'N' Tailoring which was located at the same shopping center.

constructed on concrete slab. During the years 1979 through 1983, another dry cleaners operated at the current location of Carlo's Pizza.

Site History

During an October 2002 remedial investigation of a leaking underground storage tank at a Mobil Gas Station located at Route 9, Manalapan Township, Monmouth County, environmental samples were collected from the adjacent Gordon's Corner Shopping Center. Elevated PCE concentrations were detected in the basement at the northern end of the shopping center. The results of subsequent environmental sampling indicated elevated PCE concentrations in ambient and indoor air, soil gas, and groundwater. A Field Directive and Notice to Insurers was issued by the NJDEP to Manalapan 9, LLC and DFM, Inc. requiring a Preliminary Assessment/Site Investigation (PA/SI). The purpose of the PA/SI was to document past property use and investigate site environmental contamination (Whitman 2004).

Based on widespread PCE contamination as determined by the PA/SI, the NJDEP directed Manalapan 9, LLC and DFM, Inc. to perform a remedial investigation to identify the source(s) of PCE contaminated subsurface soil², delineate the contaminated groundwater plume, and implement monthly indoor air sampling of shopping center businesses (NJDEP 2005).

In mid-2004, efforts to reduce indoor air PCE concentrations in the affected businesses were implemented through the installation of engineering controls. These engineering controls included the installation of positive pressure fresh air systems and a subsurface soil venting system (see Photographs 2 and 3). Results of continued monthly monitoring, however, showed elevated and fluctuating levels of PCE in the indoor air of businesses. On February 9, 2005, the Manalapan Township Department of Health sent letters notifying both DFM, Inc. and Manalapan 9, LLC that the elevated PCE concentrations in the shopping center businesses were contributing to an unhealthy environment. The letters further indicated that DFM, Inc. and Manalapan 9, LLC were to take immediate steps to reduce the levels of PCE in indoor air, and that failure to comply with this directive would result in the Manalapan Township Department of Health seeking an appropriate course of action to correct the problem (Richardson 2005).

On May 12, 2005, Tops 'N' Town Cleaners was evicted due to non-payment of back rent³. Following the eviction, the vacated space was stripped down to the concrete and steel structure and surfaces cleaned to remove residual PCE on all potentially contaminated surfaces. In July 2005, additional indoor air samples were collected; results indicated that PCE concentrations were significantly reduced with only low concentrations remaining for eight of the 11 businesses.

²The Gordon's Corner Shopping center property (parking lot, rear loading area) is paved.

³Tops Tuxedos 'N' Tailoring was also evicted.

Site Visit

On December 10, 2004, a site visit was conducted at the Tops 'N' Town Cleaners site. NJDHSS representatives were Christa Fontecchio and Tariq Ahmed; Arthur Block represented the ATSDR. Also present were representatives of the NJDEP, Manalapan Township Health Department, and the Manalapan 9, LLC.

The Manalapan 9, LLC property manager stated that with the exclusion of Tops 'N' Town Cleaners, Panda House Restaurant, Bus Tickets, and Mixed Greens, rooftop systems had been installed above each business to provide constant positive (fresh) air pressure in an effort to prevent PCE vapor intrusion. Indoor air results from September 2004, however, indicated that elevated indoor air PCE concentrations at these businesses persisted. According to the property manager, this may have been due to tenants and/or ventilation system mechanics unwittingly altering the positive pressure settings of their businesses. During a rooftop inspection, the property manager also surmised that exhaust from the Tops 'N' Town Cleaners was entering fresh air intakes of adjacent businesses. The Manalapan Township Health Department Health Officer requested that the property manager inspect the concrete slab of all businesses for cracks and seal, if necessary, to reduce potential vapor intrusion.

A second site visit of the Tops 'N' Town Cleaners site was conducted on February 16, 2005. Present were Glenn Pulliam, Tariq Ahmed, and Julie Petix of the NJDHSS and Leah Escobar of the ATSDR. Representatives of the NJDEP, Manalapan Township Health Department, Monmouth County Department of Health, Manalapan 9, LLC, and DFM, Inc. were also present during the site visit. The site is bordered by a Mobil gas station to the north, residences to the east, commercial businesses (liquor store, Anthony Sylvan Pools) to the south, and Route 9 to the west.

In addition to Tops 'N' Town Cleaners, Video Home Center, Carlo's Pizza, Bagel World, and Panda House Restaurant are open for business seven days a week. An inspection of the interior of the Tops 'N' Town Cleaners was conducted. The dry cleaning machine used by Tops 'N' Town was a Realstar RS-640 (see Photograph 4 and 5). The machine was not in operation during the site visit, its compressor was allegedly broken by an act of vandalism early that morning. NJDEP indicated this machine is a fourth generation machine which utilizes current state of the art technology. NJDEP air permit PCP000001 was issued to DFM, Inc. for the operation of a four by four foot roof exhaust fan⁴ (see Photograph 6). PCE emissions regulated by this permit were limited to less than 0.1 pound per hour and less than 0.44 ton per year. A service representative of M & L Mechanical Contractors provided a detailed presentation on the Realstar dry cleaning machine and service history. Approximately 19 gallons of PCE were purchased by Tops 'N' Town Cleaners four times per year; no PCE was stored on-site.

Chlorinated solvent odors were noticeable at the rear of the dry cleaning machine where liquid condensate effluent and a muck tank were located; measurements were noted with the use of an organic vapor monitor. A muck tank serves to separate dirty

⁴This permit expired on December 18, 2005.

PCE (lint, sludge) from recyclable PCE. Liquid and solid wastes were stored on-site prior to off-site disposal by National Waste Clean, a licensed waste disposal contractor. The concrete floor between the dry cleaning machine and wall was noted to be stained possibly from PCE spills.

A rooftop inspection of the shopping center was conducted. With the exception of Tops 'N' Town Cleaners, positive pressure, fresh air-handling units were individually mounted for all businesses.

Demographics

Using the 2000 United States Census data, the ATSDR estimates that approximately 1,600 people live within a one-mile radius of the site (see Figure 3).

Environmental Contamination

An evaluation of site-related environmental contamination consists of a two tiered approach: 1) a screening analysis; and 2) a more in-depth analysis to determine public health implications of site-specific exposures. First, maximum concentrations of detected substances are compared to media-specific environmental guideline comparison values (CVs). If concentrations exceed the environmental guideline CV, these substances, referred to as Contaminants of Concern (COC), are selected for further evaluation. Contaminant levels above environmental guideline CVs do not mean that adverse health effects are likely, but that a health guideline comparison is necessary to evaluate site-specific exposures. Once exposure doses are estimated, they are compared with health guideline CVs to determine the likelihood of adverse health effects.

Environmental Guideline Comparison

There are a number of CVs available for the screening environmental contaminants to identify COCs. These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Media Evaluation Guides (RMEGs). EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects. RMEGs represent the concentration in water or soil at which daily human exposure is unlikely to result in adverse noncarcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were also considered as comparison values. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime (70 years). In the absence of an ATSDR CV, other comparison values may be used to evaluate contaminant levels in environmental media. These include New Jersey Maximum Contaminant Levels (NJMCLs) for drinking water; USEPA Region 3 Risk-Based Concentrations (RBCs). RBCs are contaminant concentrations corresponding to a fixed level of risk (i.e., a

Hazard Quotient⁵ of 1, or lifetime excess cancer risk of one in one million, whichever results in a lower contaminant concentration) in water, air, biota, and soil; and NJDEP Indoor Air Screening Levels for air.

Substances exceeding applicable environmental guideline CVs were identified as COCs and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations.

Indoor Air

Between October 2002 and April 2005, indoor air samples were collected from the 11 businesses located at the Gordon's Corner Shopping Center. Ambient air samples were also collected during this time frame. All samples were collected with SUMMA canisters and analyzed for volatile organic compounds (VOCs), including PCE, using USEPA Method TO-15. Indoor air concentrations ranged from non-detect to 12,800 micrograms of PCE per cubic meter of air ($\mu\text{g}/\text{m}^3$); ambient PCE concentrations ranged from non-detect to 170 $\mu\text{g}/\text{m}^3$ (see Table 1). PCE concentrations in indoor air were observed to fluctuate throughout the sample period, including significant fluctuations at the businesses where the concentrations were observed to be elevated as presented in Table 1. Maximum PCE concentrations detected in seven of the 11 businesses exceeded the ATSDR chronic EMEG of 270 $\mu\text{g}/\text{m}^3$. Maximum PCE concentrations detected in the indoor air of Tops 'N' Town Cleaners, Tops Tuxedo 'N' Tailoring, and Panda House Restaurant exceeded the acute EMEG of 1,356 $\mu\text{g}/\text{m}^3$.

In May 2005, dry cleaning operations at the Tops 'N' Town Cleaners ceased, and the business space was cleaned. Results of PCE July 2005 indoor air samples collected from all of the businesses are provided below.

Indoor air PCE concentrations were significantly reduced to below the NJDEP Non-residential Indoor Air Screening Level of 3 $\mu\text{g}/\text{m}^3$ for PCE. The PCE concentrations remaining in indoor air may be associated with either vapor intrusion from contaminated subsurface media or residual PCE from the dry cleaners. No additional data was available to review in determining potential PCE fluctuations common with change in season.

In addition to elevated indoor air PCE concentrations, results indicated the presence of petroleum-related compounds and other VOCs (unrelated to the dry cleaners) above their respective environmental guideline CV (see Appendix A, Table A -1).

⁵The ratio of estimated site-specific exposure to a single chemical from a site over a specified period, to the estimated daily exposure level, at which no adverse health effects are likely to occur.

Results of July 2005 PCE Indoor Air Sampling at the Gordon's Corner Shopping Center		
Business Name	PCE ($\mu\text{g}/\text{m}^3$)*	NJDEP Non-Residential Indoor Air Screening Level ($\mu\text{g}/\text{m}^3$)
Jem Jewelers	ND**	3
Allure Hair & Nails	ND	
Mixed Greens	3.0	
Bus Tickets	ND	
Panda House Restaurant	3.1	
Tops Tuxedo 'N' Tailoring	1.3 J***	
Tops 'N' Town Cleaners	2.5	
Glen's Eye Care	2.4	
Video Home Center	1.2 J	
Bagel World	0.61 J	
Carlo's Pizza	1.1 J	
Ambient Air	1.1 J	

*micrograms of PCE per cubic meter of air; **not detected; ***estimated value

Groundwater

In June, August, and November 2004, groundwater samples were collected at the site. A monitoring well (MW-39) was installed at a downgradient location to delineate the groundwater plume; this well location is believed to represent the groundwater contaminated plume under the shopping center (see Figure 2). Both the average (1,003 micrograms per liter of water or $\mu\text{g}/\text{L}$) and maximum (2,000 $\mu\text{g}/\text{L}$) concentrations exceeded the ATSDR RMEG of 100 $\mu\text{g}/\text{L}$ for children (see Table 2).

In addition to PCE, petroleum-related compounds (unrelated to the dry cleaners) were also detected in the groundwater at concentrations exceeding the ATSDR RMEG for several well locations at the shopping center. These compounds primarily consisted of benzene, toluene, ethylbenzene, and xylene (BTEX), methyl tertiary-butyl ether (MTBE), and tertiary butyl alcohol (TBA).

Soil Gas

Between November 2003 and April 2005, soil gas samples were collected from several shopping center businesses. PCE concentrations ranged from non-detect to 94,300 $\mu\text{g}/\text{m}^3$; the maximum PCE concentration was detected from the Tops 'N' Town Cleaners (see Table 3). Elevated PCE concentrations were also detected in the vicinity of Carlo's Pizza, the former location of another dry cleaner. All PCE soil gas concentrations exceeded the NJDEP Non-Residential Health Based PCE Soil Gas Screening Value of 34 $\mu\text{g}/\text{m}^3$ (NJDEP 2005).

Contaminants of Concern

The contaminant of concern for the Tops 'N' Town site is PCE. A toxicological summary for PCE is provided in Appendix B.

Discussion

The method for assessing whether a health hazard exists to a community is to determine whether there is a completed exposure pathway from a contaminant source to a receptor population and whether exposures to contamination are high enough to be of health concern. Site-specific exposure doses can be calculated and compared with health guideline CVs.

Assessment Methodology

An exposure pathway is a series of steps starting with the release of a contaminant in environmental media and ending at the interface with the human body. A completed exposure pathway consists of five elements:

1. source of contamination;
2. environmental media and transport mechanisms;
3. point of exposure;
4. route of exposure; and a
5. receptor population.

Generally, the ATSDR considers three exposure pathway categories: 1) completed exposure pathways, that is, all five elements of a pathway are present; 2) potential exposure pathways, that is, one or more of the elements may not be present, but information is insufficient to eliminate or exclude the element; and 3) eliminated exposure pathways, that is, one or more of the elements is absent. Exposure pathways are used to evaluate specific ways in which people were, are, or will be exposed to environmental contamination in the past, present, and future.

The exposures pathways are presented in Table 4.

Completed Pathways

Inhalation of PCE in indoor air (past). The source of the elevated PCE concentrations in indoor air may have been associated with Tops 'N' Town dry cleaning operations (e.g., exhaust from the cleaners entering the fresh air intakes of adjacent businesses) and/or vapor intrusion associated with contaminated subsurface media. In the past, there was a completed exposure pathway from indoor air to employees and patrons (children and adults) for the businesses located in the Gordon's Corner Shopping Center.

Inhalation of PCE in indoor air via vapor intrusion (present, future). Results of sampling performed subsequent to the May 2005 eviction and cleaning of the Tops 'N'

Town Cleaners indicated that present and future PCE exposures from indoor air appear to have been significantly interrupted. Indoor air PCE concentrations were significantly reduced to below the NJDEP Non-Residential Indoor Air Screening Level of $3 \mu\text{g}/\text{m}^3$. This value is derived from health-based cancer toxicity data for inhalation of PCE and the analytical practical quantitation limit (NJDEP 2005). PCE concentrations remaining in indoor air may be associated with either vapor intrusion from contaminated subsurface media or residual PCE from the dry cleaners.

Eliminated Pathways

Ingestion of groundwater (past, present, future). According to the NJDEP, there are no domestic potable wells within a one-half mile radius and no public supply wells within one mile hydraulically downgradient of the site, and two public supply wells serving the community are located upgradient of the site. As such, there were no completed exposures via this pathway.

Public Health Implications

Once it has been determined that individuals have or are likely to come in contact with site-related contaminants (i.e., a completed exposure pathway), the next step in the public health assessment process is the calculation of site-specific exposure doses. This is called a health guideline comparison which involves looking more closely at site-specific exposure conditions, the estimation of exposure doses, and the evaluation with health guideline CVs. Health guideline CVs are based on data drawn from the epidemiologic and toxicologic literature and typically include uncertainty or safety factors to ensure that they are amply protective of human health.

Past indoor air PCE exposures at the Gordon's Corner Shopping Center businesses were evaluated based on results of sampling performed during October 2002 through April 2005. Of the 11 businesses located at the shopping center, the maximum indoor air PCE concentration was detected in Tops Tuxedos 'N' Tailoring ($12,800 \mu\text{g}/\text{m}^3$). The next highest indoor air PCE concentration was detected in Tops 'N' Town Cleaners ($5,950 \mu\text{g}/\text{m}^3$). The third highest indoor air PCE concentration was detected in Panda House Restaurant ($4,570 \mu\text{g}/\text{m}^3$). As such, maximum and average PCE concentrations detected at these three businesses were used to assess the risk of non-cancer and cancer health effects for employees and patrons (children and adults) for past exposures. It is important to note that indoor air PCE exposures to patrons of the Gordon's Corner Shopping Center were intermittent, short-term exposures over time.

Non-Cancer Health Effects

To assess non-cancer health effects, ATSDR has developed Minimal Risk Levels (MRLs) for contaminants that are commonly found at hazardous waste sites. An MRL is an estimate of the daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of adverse, non-cancer health effects. MRLs are developed for a route of exposure, i.e., ingestion or inhalation, over a specified time period, e.g., acute (less than 14 days); intermediate (15-364 days); and chronic (365

days or more). MRLs are usually extrapolated doses from observed effect levels in animal toxicological studies or occupational studies, and are adjusted by a series of uncertainty (or safety) factors or through the use of statistical models. In toxicological literature, observed effect levels include:

- no-observed-adverse-effect level (NOAEL); and
- lowest-observed-adverse-effect level (LOAEL).

A NOAEL is the highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or in experimental animals. A LOAEL is the lowest dose of a substance that has been reported to cause harmful (adverse) health effects in people or in experimental animals. In order to provide additional perspective on the potential for adverse health effects, calculated exposure doses may also be compared to the NOAEL or LOAEL. As the exposure dose increases beyond the MRL to the level of the NOAEL and/or LOAEL, the likelihood of adverse health effects increases.

When MRLs for specific contaminants are unavailable, other health based comparison values such as the USEPA's Reference Dose (RfD) are used. The RfD is an estimate of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime of exposure.

Inhalation - Indoor Air

Exposure assumptions for employees were based on business hours of operation (R. Engle, Manalapan 9, LLC, personal communication, 2005); patron exposure assumptions were based on estimated number and duration of weekly visits (see Table 5). Using a time-weighted average (TWA)⁶, maximum and average PCE concentrations were adjusted for the three businesses as follows

$$TWA = \sum C_x \times ET_x / 24$$

where, C = concentration of PCE in indoor air
ET = exposure time (business hours of operation or estimated patron visit)
x = Tops Tuxedos 'N' Tailoring or
Tops 'N' Town Cleaners or
Panda House Restaurant

Employee Exposures (past). The maximum TWA PCE concentration at Tops 'N' Town Cleaners, Tops Tuxedo 'N' Tailoring, and Panda House Restaurant exceeded the PCE acute inhalation MRL⁷ of 1,356 µg/m³ (see Table 6). The acute MRL is based on the NOAEL of approximately 69,000 µg/m³. The MRL incorporates a safety factor of 50 to account for various uncertainties, i.e., human variability (including sensitive

⁶Average estimate of exposure over the business hours of operation based on a 24 hour day.

⁷For air contaminants, the EMEG and MRL are the same.

populations such as children) and intermittent exposures (ATSDR 1997). The NOAEL is based on a human study which evaluated visual evoked potentials (i.e., electrical activity in the brain in response to stimulation of sight). The maximum TWA PCE concentration calculated for these three businesses ranged between 16 to 34 times lower than the NOAEL, and the average TWA PCE concentration (the more likely exposure scenario) for all three businesses were below the acute inhalation MRL. As such, acute non-cancer adverse health effects for exposures to PCE in the indoor air to employees of all 11 businesses at the Gordon's Corner Shopping Center were possible although the likelihood was low.

The average TWA PCE concentration at Tops 'N' Town Cleaners, Tops Tuxedo 'N' Tailoring, and Panda House Restaurant exceeded the chronic inhalation MRL of 270 $\mu\text{g}/\text{m}^3$ (see Table 6). The chronic inhalation MRL is based on the LOAEL of approximately 101,000 $\mu\text{g}/\text{m}^3$. The MRL incorporates a safety factor of 374 to account for various uncertainties, i.e., the use of the LOAEL, human variability (including sensitive populations such as children), and in converting from an occupational exposure to a continuous exposure (ATSDR 1997). The LOAEL is based on neurobehavioral effects in long-term female employees of dry cleaning facilities. The average TWA PCE concentration calculated for these three businesses ranged between 102 to 220 times lower than the LOAEL; as such, the likelihood of non-cancer adverse health effects for exposures to PCE in the indoor air to employees of all 11 businesses at the Gordon's Corner Shopping Center is low.

Patron Exposures (past). Both the maximum and average TWA PCE concentrations at Tops 'N' Town Cleaners, Tops Tuxedo 'N' Tailoring, and Panda House Restaurant were below the chronic inhalation MRL of 270 $\mu\text{g}/\text{m}^3$ (see Table 6). As such, non-cancer adverse health effects from exposures to PCE in the indoor air to patrons of all 11 businesses at the Gordon's Corner Shopping Center are not expected.

Employee and Patron Exposures (present, future). Present and future indoor air PCE exposures were significantly interrupted subsequent to the May 2005 eviction of the Tops 'N' Town Cleaners. Subsequent to the removal of the dry cleaning equipment and the space decontaminated, additional indoor air sampling was conducted (July 2005) throughout the shopping center; results indicated PCE concentrations below both the chronic and acute MRL for all shopping center businesses. As such, non-cancer adverse health effects from exposures to PCE in the indoor to employees and patrons of all 11 businesses at the Gordon's Corner Shopping Center are not expected.

Cancer Health Effects

The site-specific lifetime excess cancer risk (LECR) indicates the potential of contaminants to cause cancer. LECR estimates are usually expressed in terms of excess cancer cases in an exposed population in addition to the background rate of cancer. For perspective, the lifetime risk of being diagnosed with cancer in the United States is 46 per 100 individuals for males, and 38 per 100 for females; the lifetime risk of being diagnosed with any of several common types of cancer ranges between 1 and 10 in 100 (SEER 2005). Typically, health guideline CVs developed for carcinogens are based on

one excess cancer case per 1,000,000 individuals. ATSDR considers estimated cancer risks of less than one additional cancer case among one million persons exposed as insignificant or no increased risk (expressed exponentially as 10^{-6}).

According to the United States Department of Health and Human Services (USDHHS), PCE is reasonably anticipated to be a carcinogen.

Inhalation - Indoor Air

Cancer effects were evaluated for Tops 'N' Town Cleaners, Tops Tuxedo 'N' Tailoring, and Panda House Restaurant as they represented the greatest exposure potential from PCE concentrations in indoor air. Cancer exposure doses were calculated using the following formula:

$$\text{Cancer Exposure Dose (mg/kg/day)} = \frac{\text{TWA} \times \text{IR} \times \text{EF}}{\text{BW}} \times \frac{\text{ED}}{\text{AT}}$$

where TWA = time-weighted average concentration of PCE in air (mg/m^3);
IR = inhalation rate (m^3/hour);
EF = exposure factor representing the site-specific exposure scenario;
ED = exposure duration (year);
BW = body weight (kg); and
AT = averaging time (year).

The assumptions used to calculate site-specific exposure doses were the same as described previously for non-cancer health effects (see Table 5). The LECR for adults was calculated by multiplying the cancer exposure dose by the cancer slope factor (CSF). The CSF is defined as the slope of the dose-response curve obtained from animal and/or human cancer studies and is expressed as the inverse of the daily exposure dose, i.e., $(\text{mg}/\text{kg}/\text{day})^{-1}$. Although PCE exposures to patrons in the past were limited and intermittent (assumed to be no more than a few hours per year, see Table 7) and cancer effects are unexpected, cancer risks for patrons were evaluated nonetheless.

Employee Exposures (past). Based on the maximum TWA PCE concentration detected in the indoor air, LECRs for adults were estimated to be approximately one in 1,000 (Tops Tuxedo 'N' Tailoring), one in 1,000 (Tops 'N' Town Cleaners), and two in 10,000 (Panda House Restaurant) (see Table 7).

Based on the average TWA PCE concentration detected in the indoor air (the more likely exposure scenario), LECRs for adults were estimated to be approximately three in 10,000 (Tops Tuxedo 'N' Tailoring and Tops 'N' Town Cleaners) and three in 100,000 (Panda House Restaurant).

LECRs were also calculated for past businesses operating at the shopping center during the period from 1983 to 2005. Some of these LECRs were as high as eight in 10,000 (see Appendix C, Table C-1). A summary of all historical operators at the

shopping center during this period and their respective LECRs is provided in Appendix C, Table C-2.

Patron Exposures (past). Based on the maximum TWA PCE concentration detected in the indoor air, LECRs for adults were estimated to be approximately one in 10,000,000 (Tops Tuxedo 'N' Tailoring) and five in 1,000,000 (Tops 'N' Town Cleaners); for the Panda House Restaurant, a LECR for children (the most sensitive population likely to visit the restaurant) was estimated to be approximately three in 1,000,000 (see Table 7).

Based on the average TWA PCE concentration detected in the indoor air (the more likely exposure scenario), LECRs for adults were estimated to be approximately two in 10,000,000 (Tops Tuxedo 'N' Tailoring), two in 1,000,000 (Tops 'N' Town Cleaners), and one in 1,000,000 (Panda House Restaurant).

It is important to note that the LECRs estimated for the maximum and average TWA PCE concentrations are based on intermittent, short-term exposures over time.

Employee and Patron Exposures (present, future). In May 2005, dry cleaning operations at the Tops 'N' Town Cleaners ceased, and the business space was cleaned. Results of PCE July 2005 indoor air samples collected from all of the businesses indicated a significant reduction of PCE concentrations in indoor air. Indoor air PCE concentrations were significantly reduced to below the NJDEP Non-residential Indoor Air Screening Level of $3 \mu\text{g}/\text{m}^3$. This value is derived from health-based cancer toxicity data for inhalation of PCE and the analytical practical quantitation limit (NJDEP 2005). The PCE concentrations remaining in indoor air may be associated with either vapor intrusion from contaminated subsurface media or residual PCE from the dry cleaners. No additional data was available to review in determining potential PCE fluctuations common with change in season.

Child Health Considerations

ATSDR's recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination in their environment. Children are at greater risk than adults from certain kinds of exposures to hazardous substances because they eat and breathe more than adults. They also play outdoors and often bring food into contaminated areas. They are shorter than adults, which mean they breathe dust, soil and heavy vapors closer to the ground. Children are also smaller, resulting in higher doses of chemical exposure per body weight. The developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. It should be noted that the most sensitive endpoint for non-cancer health effects is increased reaction time, a less serious neurologic effect, as observed in an adult population working in dry cleaning establishments (ATSDR 1997). The MRL, which is

based on this endpoint, may not be sufficiently conservative in all cases, especially for children with developing nervous systems.

As mentioned previously, the MRL used to evaluate non-cancer health effects was based on adult female workers in an occupational setting (ATSDR 1999). Although uncertainty factors are incorporated into the MRL to protect sensitive populations such as children, toxicological data specific to child exposures to PCE were not available to evaluate adverse health effects in children with developing nervous systems.

Conclusions

PCE concentrations detected in the indoor air of Gordon's Corner Shopping Center businesses during October 2002 through April 2005 exceeded the chronic inhalation EMEG, and some businesses had PCE concentrations above the acute inhalation EMEG. Maximum and average PCE concentrations detected at three businesses with the highest detected PCE concentrations were used to assess non-cancer and cancer health effects for employees and patrons (including children). The likelihood of non-cancer adverse health effects associated with acute and chronic inhalation PCE exposures to employees of all businesses is low; non-cancer adverse health effects to patrons are not expected.

Based on the maximum concentration detected in the indoor air, LECRs for adults were estimated to be approximately one in 1,000 (Tops Tuxedo 'N' Tailoring), one in 1,000 (Tops 'N' Town Cleaners), and two in 10,000 (Panda House Restaurant) (see Table 7). Based on the average TWA PCE concentration detected in the indoor air (the more likely exposure scenario), LECRs for adults were estimated to be approximately three in 10,000 (Tops Tuxedo 'N' Tailoring and Tops 'N' Town Cleaners) and three in 100,000 (Panda House Restaurant). LECRs calculated for past businesses operating at the shopping center during the period from 1983 to 2005 were as high as eight in 10,000. As such, past inhalation exposures to PCE for employees are considered a **Public Health Hazard** particularly in the businesses adjacent to the dry cleaners. For patron populations, the excess cancer risk from inhalation of PCE vapors is estimated to be very low when compared to background cancer risk. As such, there is **No Apparent Public Health Hazard** for past inhalation exposures to PCE for patrons.

In May 2005, dry cleaning operations at the Tops 'N' Town Cleaners ceased, and the business space was cleaned. Results of PCE July 2005 indoor air samples collected from all of the businesses show that indoor air PCE concentrations were significantly reduced and were below the NJDEP PCE Indoor Air Screening Level. PCE concentrations remaining in eight of the 11 businesses may be associated with either vapor intrusion or residual PCE from the dry cleaners. No additional data was available to review in determining potential PCE fluctuations common with change in season. Since high PCE soil gas concentrations remain at the site and only one indoor air sampling round has been conducted subsequent to the eviction of the dry cleaners, present and future inhalation exposures to PCE are considered an **Indeterminate Public Health Hazard** to employees. For patron populations, the excess cancer risk from

inhalation of PCE vapors is estimated to be very low when compared to background cancer risk. There is *No Apparent Public Health Hazard* for present and future inhalation exposures to PCE for patrons.

Recommendations

1. It is recommended that the NJDEP continue indoor air monitoring at the businesses. This will ensure the effectiveness of the positive pressure and soil venting systems in reducing PCE concentrations in the indoor air and will also assist in the evaluation of potential seasonal PCE fluctuations.
2. The delineation of PCE contamination at the site (subsurface soil, groundwater) should be completed by the NJDEP in order that a permanent remedy can be implemented to abate PCE concentrations to levels below the applicable regulatory cleanup criteria.
3. Dry cleaning operations in New Jersey, although in compliance with existing NJDEP emission limits, may present a public health threat to individuals (employees, patrons, nearby residents). This includes sensitive populations such as children and the elderly. As such, the NDJEP should examine its regulations and policies with respect to the New Jersey dry cleaning industry.

Public Health Action Plan (PHAP)

The purpose of a PHAP is to ensure that this Health Consultation not only identifies public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the NJDHSS and ATSDR to follow up on this plan to ensure that it is implemented. The public health actions to be implemented by ATSDR and NJDHSS are as follows:

Public Health Actions Taken

1. This health consultation evaluated the health implications associated with exposures to indoor air PCE to employees and patrons of businesses located at Gordon's Corner shopping center.
2. On May 11, 2005, the NJDHSS provided a letter of technical assistance to the Manalapan Township Department of Health. In this correspondence, the NJDHSS recommended that necessary actions be taken to immediately end or prevent exposures from indoor air PCE to employees and patrons of businesses located at Gordon's Corner shopping center.

Public Health Actions Planned

1. Copies of this health consultation will be provided to Manalapan 9, LLC for distribution to each of the current businesses of the Gordon's Corner shopping center.
2. The NJDHSS and the ATSDR will review and evaluate future indoor air PCE data at the businesses when made available by the NJDEP. This information will be used in the reevaluation of the *Indeterminate Public Health Hazard* category for present and future inhalation PCE exposures.
3. Upon the request of the NJDEP, the NJDHSS, in cooperation with the ATSDR, will review future indoor air data associated with the adjacent gasoline station site.
4. Although not related to Tops 'N' Town Cleaners, elevated levels of acetone were detected in indoor air at Allure Hair & Nails. NJDHSS will work with the local health department to provide educational materials to the operators on methods to reduce exposure to this chemical.

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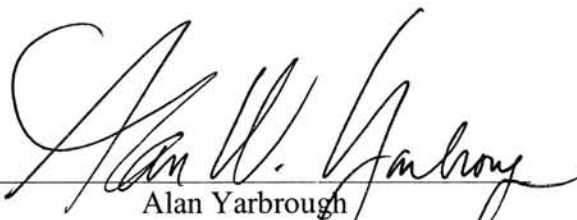
CERTIFICATION

The health consultation for the Tops 'N' Town Cleaners site, Manalapan, Monmouth County, New Jersey was prepared by the New Jersey Department of Health and Senior Services under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. It is in accordance with approved methodology and procedures existing at the time the health consultation was initiated. Editorial review was completed by the cooperative agreement partner,



Gregory V. Ulirsch
Technical Project Officer, CAT, SPAB, DHAC
Agency for Toxic Substances and Disease Registry

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



Alan Yarbrough
Team Leader, CAT, SPAB, DHAC
Agency for Toxic Substances and Disease Registry

Table 1
Tops 'N' Town Cleaners, Manalapan Township, Monmouth County
Comparison of Historical Indoor Air PCE Concentrations With Environmental Guideline Values
Sample Data: October 2002 through April 2005

Sample Location	Number of Samples	Minimum Concentration (ug/m ³) ⁽¹⁾	Maximum Concentration (ug/m ³)	Average Concentration (ug/m ³)	ATSDR ⁽²⁾	
					Chronic EMEG/MRL (ug/m ³)	Acute EMEG/MRL (ug/m ³)
Basement Sump (Allure Hair & Nails/Jem Jewelers)	18	ND	532	124	270	1,356
Basement (Allure Hair & Nails/Jem Jewelers)	27	3	1,060	136		
Jem Jewelers	5	4	54	22		
Allure Hair & Nails	25	ND	787	114		
Mixed Greens	16	2	650	189		
Bus Tickets	4	4	36	15		
Top's Tuxedos 'N' Tailoring	11	19	12,800	2,968		
Panda House Restaurant	14	ND	4,570	1,001		
Carlo's Pizza	16	ND	58	12		
Video Home Center	15	0.8	350	50		
Glen's Eye Care	15	7	1,322	251		
Bagel World	15	0.7	35	7		
Tops 'N' Town Cleaners	11	108	5,950	1,699		
Outside Ambient Air	27	ND	170	19		

Notes:

(1) micrograms of PCE per cubic meter of air

(2) Agency for Toxic Substances and Disease Registry, Environmental Media Evaluation Guide/Minimal Risk Level

ND: not detected

Bold font indicates PCE concentration exceeding the chronic inhalation MRL of 270 ug/m³

Shaded and bold values represent PCE concentration exceeding the acute inhalation MRL of 1,356 ug/m³

Table 2
Tops 'N' Town Cleaners, Manalapan Township, Monmouth County
Historical Groundwater Data - October 2003 Through November 2004

Sample Location	Number of Samples	Maximum PCE Concentration (ug/L) ⁽¹⁾	Average PCE Concentration (ug/L)	ATSDR RMEG Child ⁽²⁾ (ug/L)
MW - 39	3	2,000	1,003	100

Notes:

(1) micrograms of PCE per liter of water

(2) - Agency for Toxic Substances and Disease Registry Reference Media Evaluation Guide for Child Exposure

Bold font represents RMEG exceedance

Table 3
Tops 'N' Town Cleaners, Manalapan Township, Monmouth County
Soil Gas Results

Sample Date	Sample Identification	Sample Location	PCE Concentration (ug/m ³) ⁽¹⁾
3-Nov-03	SG-3	Glen's Eye Care	24,800
3-Nov-03	SG-2	Carlo's Pizza	ND
3-Nov-03	SG-4	Jem Jewelers	18
31-Mar-04	NA	Jem Jewelers	ND
27-May-04	NA	Jem Jewelers	ND
13-Apr-05	Basement	Jem Jewelers	14
3-Nov-03	SG-1	Tops 'N' Town Cleaners	9,700
15-Apr-04	NA	Tops 'N' Town Cleaners	1,610
24-Jun-04	NA	Tops 'N' Town Cleaners	94,300
13-Apr-05	Dry Cleaners	Tops 'N' Town Cleaners	639
3-Nov-03	SG-5	Bagel World	80,000
31-Mar-04	NA	Bagel World	222
27-May-04	NA	Bagel World	3,090
13-Apr-05	Bagel World	Bagel World	81,400

Notes:

Sample collected below floor of indicated businesses.

ND = Not Detected

NA = Not Available

(1) micrograms of PCE per cubic meter of air

Table 4**Tops 'N Town Cleaners, Manalapan Township, Monmouth County****Evaluated Exposure Pathways**

Source	Pathway	Exposure Pathway Elements				Time	Pathway Classification
		Environmental Medium	Point of Exposure	Route of Exposure	Exposed Population		
Dry Cleaning Operations	Rooftop Fresh Air Intakes ⁽¹⁾	Indoor Air	Retail Businesses	Inhalation	Employees, Patrons (including adults & children)	Past	Completed
						Present & Future	Potential
Contaminated Subsurface Media	Soil Gas & Groundwater	Indoor Air Via Vapor Intrusion				Past	Completed
						Present & Future	Potential

(1) This is a potential migration pathway for PCE concentrations to have impacted adjacent businesses within the shopping center.

Table 5
Tops 'N' Town Cleaners Site, Manalapan, New Jersey
Exposure Scenarios For Non-Cancer and Cancer Evaluations
For Businesses Exceeding the Acute MRL ⁽¹⁾

Leasehold	Target Population	Exposure Period	Exposure Duration	Exposure Basis
Tops Tuxedos 'N' Tailoring	Adult Employee	1993 - 2005	12 years at 8 hrs/day	Evaluate exposure risk based on long-term employment.
Tops Tuxedos 'N' Tailoring	Adult Patron	1993 - 2005	12 years at 2 hrs/yr	Evaluate exposure risk based on an estimated average patronage period on a yearly basis.
Tops 'N' Town Cleaners	Adult Employee	1983 - 2005	22 years at 8 hrs/day	Evaluate exposure risk based on long-term employment.
Tops 'N' Town Cleaners	Adult Patron	1983 - 2005	22 years at 15 min/wk	Evaluate exposure risk based on an estimated long-term average patronage period on a weekly basis.
Panda House Restaurant	Adult Employee	2003 - 2005	2 years at 11 hrs/day	Evaluate exposure risk based on current maximum length of occupancy for business and employment
Panda House Restaurant	Adult/Child Patron	2003 - 2005	2 years at 1 hr/wk	Evaluate exposure risk based on an estimated average patronage period on a weekly basis.

Notes:

(1) Agency for Toxic Substance and Disease Registry's acute inhalation Minimal Risk Level of 1,357 (ug/m³) for PCE
Refer to Table 7 for Lifetime Excess Cancer Risks for the above exposure scenarios

Table 6

Tops 'N' Town Cleaners, Manalapan Township, Monmouth County

Comparison of Time-Weighted Average Indoor Air PCE Concentrations With Health Guideline Comparison Values

Sample Data: October 2002 through April 2005

Evaluated Business	Maximum Concentration (ug/m ³) ⁽¹⁾	Average Concentration (ug/m ³)	Daily Estimated Exposure (hours/day)	TWA _m ⁽²⁾ Concentration (ug/m ³)	TWA _a ⁽³⁾ Concentration (ug/m ³)	ATSDR ⁽⁴⁾		NJDEP Non-residential Indoor Air Screening Level (ug/m ³) ⁽⁵⁾
						Chronic MRL (ug/m ³)	Acute MRL (ug/m ³)	
Tops Tuxedos 'N' Tailoring (Employee)	12,800	2,968	8	4,267	989	270	1,356	3
Tops Tuxedos 'N' Tailoring (Patron at 2 hrs/yr)	12,800	2,968	0.005	3	1			
Tops 'N' Town Cleaners (Employee)	5,950	1,699	8	1,983	566			
Tops 'N' Town Cleaners (Patron at 15 min./wk)	5,950	1,699	0.04	9	3			
Panda House Restaurant (Employee)	4,570	1,001	11	2,095	459			
Panda House Restaurant (Patron at 1 hr/wk)	4,570	1,001	0.14	27	6			

Notes:

(1) micrograms of PCE per cubic meter of air

(2) Time-Weighted Average based on maximum PCE concentration

(3) Time-Weighted Average based on average PCE concentration

(4) Agency for Toxic Substances and Disease Registry's Minimal Risk Level for Non-Cancer Effects

(5) New Jersey Department of Environmental Protection

All values under this evaluation exceed the RBC.

Bold font represent PCE concentration exceeding the chronic inhalation MRL of 270 ug/m³ - Chronic exposure timeframe is defined as greater than 365 days.

Shaded and bold font represent PCE concentration exceeding the acute inhalation MRL of 1,356 ug/m³ - Acute exposure timeframe is defined as 1 to 14 days.

Table 7

Tops 'N' Town Cleaners, Manalapan Township, Monmouth County

Calculated Lifetime Excess Cancer Risk (LECR) Based on Time-Weighted Average Indoor Air PCE Concentrations

Sample Data: October 2002 through April 2005

Evaluated Business	Maximum Concentration (ug/m³)⁽¹⁾	Average Concentration (ug/m³)	Daily Exposure (hours/day)	Exposure Duration (years)	TWA_m⁽²⁾ Concentration (ug/m³)	TWA_a⁽³⁾ Concentration (ug/m³)	USEPA CSFi⁽⁴⁾ (mg/kg/day)⁻¹	LECR⁽⁵⁾ TWA_m (TWA_a)
Tops Tuxedos 'N' Tailoring Employee	12,800	2,968	8	12	4,267	989	0.02	1.39 x 10 ⁻³ (3.23 x 10 ⁻⁴)
Tops Tuxedos 'N' Tailoring Patron at 2 hrs/yr	12,800	2,968	0.005	12	3	1		9.58 x 10 ⁻⁷ (2.22 x 10 ⁻⁷)
Tops 'N' Town Cleaners Employee	5,950	1,699	8	22	1,983	566		1.19 x 10 ⁻³ (3.39 x 10 ⁻⁴)
Tops 'N' Town Cleaners Patron at 15 min./wk	5,950	1,699	0.04	22	10	3		5.34 x 10 ⁻⁶ (1.52 x 10 ⁻⁶)
Panda House Restaurant Employee	4,570	1,001	11	2	2,095	459		1.57 x 10 ⁻⁴ (3.43 x 10 ⁻⁵)
Panda House Restaurant Adult Patron at 1 hr/wk	4,570	1,001	0.14	2	27	6		2 x 10 ⁻⁶ (4.37 x 10 ⁻⁷)
Panda House Restaurant Child Patron at 1 hr/wk	4,570	1,001	0.14	2	27	6		3.47 x 10 ⁻⁶ (7.6 x 10 ⁻⁷)

Notes:

- (1) micrograms of PCE per cubic meter in air
- (2) Time-Weighted Average based on maximum PCE concentration
- (3) Time-Weighted Average based on average PCE concentration
- (4) Cancer Slope Factor for inhalation
- (5) LECR TWA_m based on maximum concentration, (TWA_a) based on average concentration

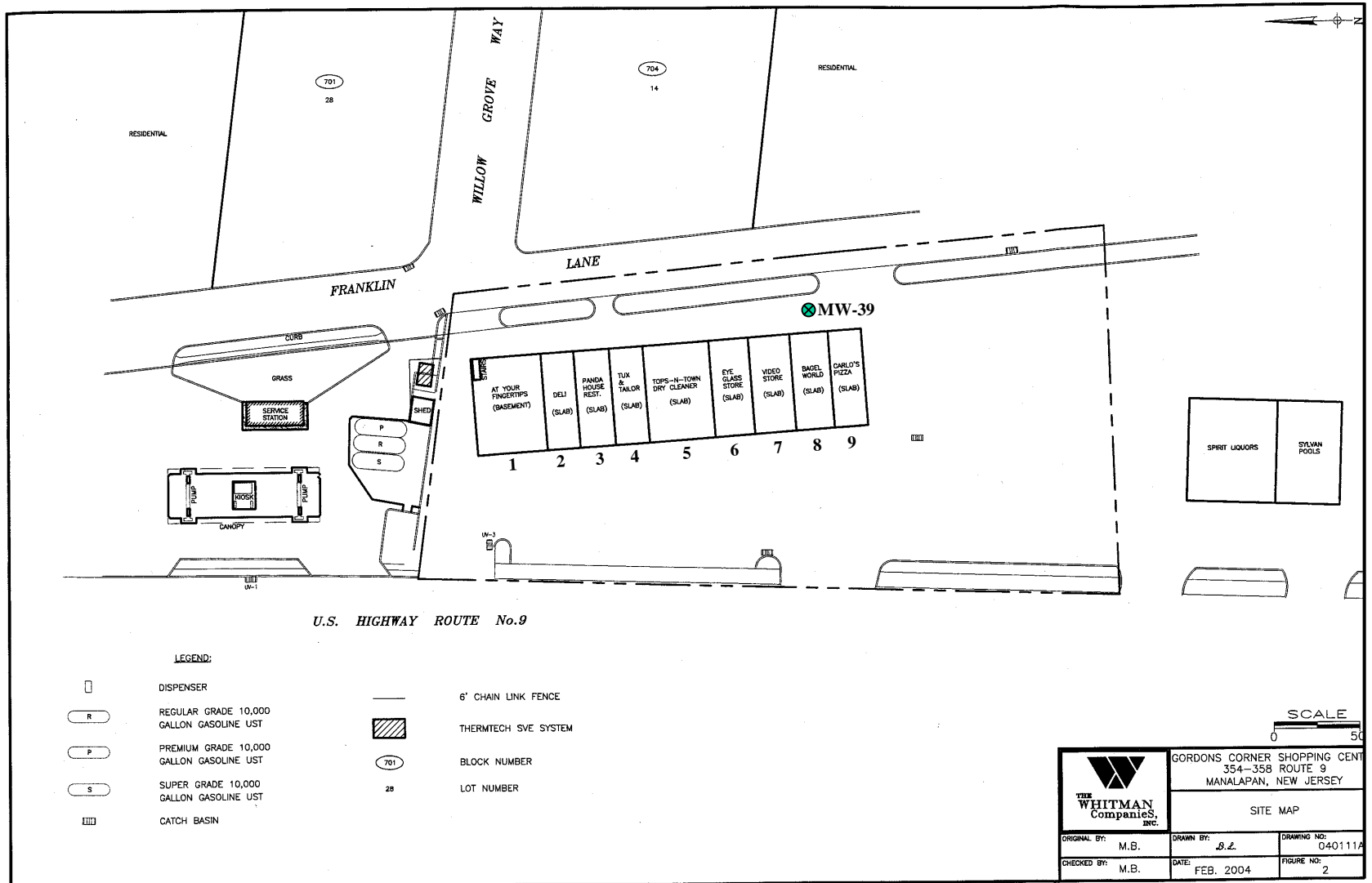


Figure 2: Location of the Gordon's Corner Shopping Center – February 2004

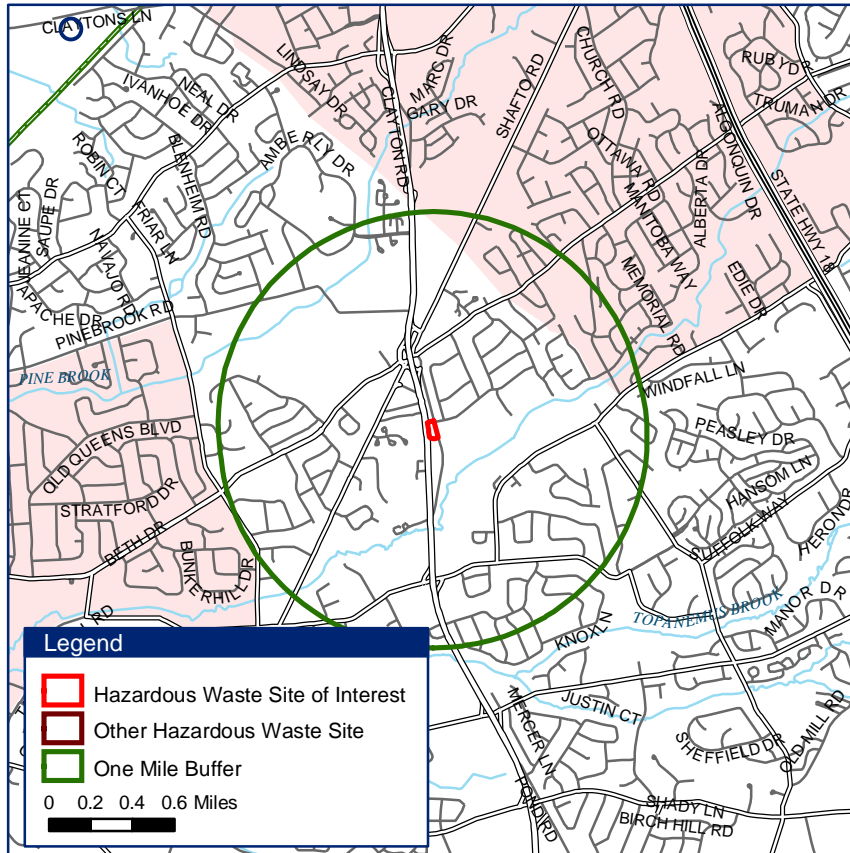
Note: (1) Numbers in front of storefronts represent business identified in Tables 1 and C-1. Businesses as of February 2004 include At Your Fingertips, Gordon's Corner Deli, Panda House Restaurant, Tops Tuxedo 'N' Tailoring, Tops 'N' Town Cleaners, Glen's Eye Care, Video Home Center, Bagel World, and Carlo's Pizza.

(2) At Your Fingertips is the current location of Jem Jewelers and Allure Hair & Nails; Gordon's Corner Deli is currently Mixed Greens and Bus Tickets.

Business Identifier List for Figure 2
Tops 'N' Town Cleaners Site, Manalapan, New Jersey
Operational History

Business Identifier	Tenant	Operational Period
1	Liquor Store	Circa 1979 to circa 1982
	Paper Mates Party Store	1984 to circa 1995
	At Your Finger Tips	1994 to 2004
	Jem Jewelers	2004 to present
	Allure Hair & Nails	2004 to present
2	Gordon's Corner Deli	Circa 1970 to 2004
	US Postal Service	1989 to 2003
	Bus Tickets	2004 to present
	Mixed Greens	2004 to present
3	Hair Salon	Circa 1970 to circa 1990
	Decorating Plus	1991 to 1993
	Wall 2 Wall	1993 to 2003
	Panda House Restaurant	2003 to present
4	Kids for Us Clothing	Circa 1970s to circa 1983
	Hair Studio of NJ	1983 to circa 1990
	Tops Tuxedos 'N' Tailoring	1993 to 2005
5	Kids for Us Clothing	Circa 1970s to circa 1983
	Tops 'N' Town Cleaners	1983 to 2005
6	Collonade Stationers	1979 to circa 1984
	Creations	1984 to circa 1994
	Cards and Gifts	1994 to 2000
	Glen's Eye Care	2000 to present
7	Sam's Fashions	1979 to circa 1984
	Atlantic TV and Video	1984 to circa 1990
	Ain't Just Chicken/Cluck U. Chicken	1990 to 1998
	Electronic Messaging Center	1998 to 1999
	Video Home Center	1999 to present
8	Bagel World	Circa 1979 to present
9	Dry Cleaners	Circa 1979 to circa 1983
	NY Pizza	1983 to circa 2002
	Carlos Gourmet Pizza and Pasta Express	2002 to present

Note: Refer to Figure 2 for business location map as of February 2004.



Site Location: Monmouth County, NJ

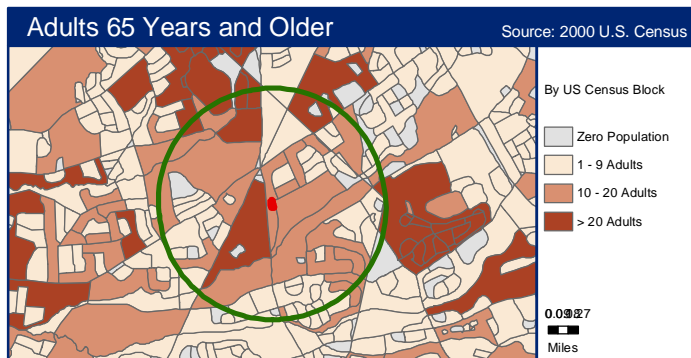
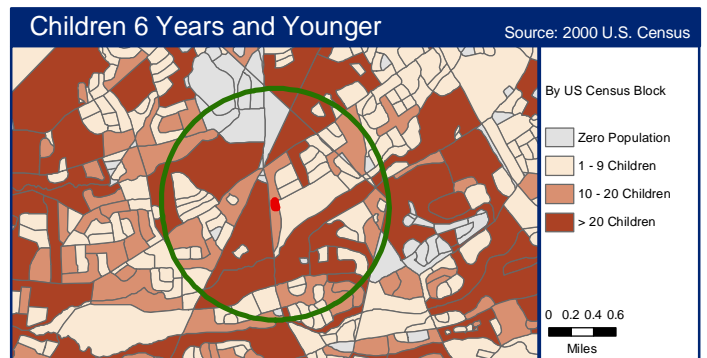
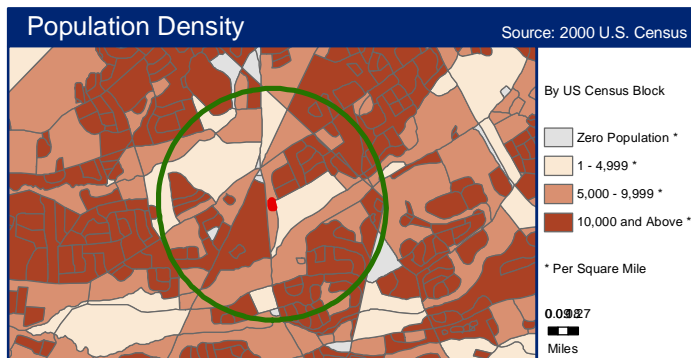


Demographic Statistics

Within Specified Distance of Site*	0.5 mi	1 mi
Total Population	1,578	6,998
White Alone	1,442	6,480
Black Alone	10	92
Am. Indian & Ak Native Alone	1	2
Asian Alone	104	356
Native Hawaiian & Other Pacific Islander Alone	0	1
Some Other Race Alone	4	16
Two or More Races	17	51
Hispanic or Latino**	75	213
Children Aged 6 and Younger	197	661
Adults Aged 65 and Older	128	824
Females Aged 15 to 44	336	1,340
Total Housing Units	508	2,342

Base Map Source: Geographic Data Technology (DYNAMAP 2000), August 2002
 Site Boundary Data Source: ATSDR Public Health GIS Program, August 2002
 Coordinate System (All Panels): NAD 1983 StatePlane New Jersey FIPS 2900 Feet

Demographics Statistics Source: 2000 U.S. Census
 * Calculated using an area-proportion spatial analysis technique
 ** People who identify their origin as Hispanic or Latino may be of any race.



GENERATED: 03-23-2005





**Photograph 1: Gordon's Corner Shopping Center –
Tops 'N' Town Cleaners at mid-point of shopping center.**



**Photograph 2: Positive pressure fresh air intake located on
roof top of shopping center business.**



Photograph 3: Soil venting system located at the south end of the shopping center.



Photograph 4: Realstar RS-640 dry cleaning machine within Tops 'N' Town Cleaners.



Photograph 5: Back of Realstar dry cleaning machine showing cleanout chamber.



Photograph 6: Roof top exhaust vent for Tops 'N' Town Cleaners.

Appendix A

Indoor Air Summary Additional Contaminants of Concern

Table A-1
Selected Indoor Air Results Obtained from the Gordon's Corner Shopping Center
October 2002 through April 2005

Location	Compound	Average Concentration (µg/m³)	Maximum Concentration (µg/m³)	Acute EMEG (µg/m³)	Intermediate EMEG (µg/m³)	Chronic EMEG (µg/m³)
Basement (Storage)	Benzene	7.5	90.4	160	13	NA
	MTBE	147	2,640	7,200	2,500	2,500
	Toluene	146	761	3,800	NA	302
Basement (Sumps)	Acetone	5,209	62,000	62,000	31,000	31,000
	Benzene	1,192	14,000	160	13	NA
	MTBE	15,337	110,000	7,200	2,500	2,500
	Toluene	2,102	33,000	3,800	NA	302
	Total Xylenes	1,222	18,160	4,350	3,050	435
Allure Hair & Nails	Acetone	28,186	55,100	62,000	31,000	31,000
	Toluene	686	1,390	3,800	NA	302

NA = not available

Bold font indicates concentration above respective Environmental Comparison Values

Appendix B
Toxicological Summary

The toxicological summary provided in this appendix is based on ATSDR's ToxFAQs (<http://www.atsdr.cdc.gov/toxfaq.html>). Health effects are summarized in this section for the chemical of concern found in indoor air at the Gordon's Corner Shopping Center. The health effects described in the section are typically known to occur at levels of exposure much higher than those that occur from environmental contamination. The chance that a health effect will occur is dependent on the amount, frequency and duration of exposure, and the individual susceptibility of exposed persons.

PCE PCE is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor. Most people can smell PCE when it is present in the air at a level of approximately 7,000 micrograms per cubic meter or more, although some can smell it at even lower levels. People are commonly exposed to PCE when they bring clothes from the dry cleaners.

High concentrations of PCE can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Irritation may result from repeated or extended skin contact with it. These symptoms occur almost entirely in work (or hobby) environments when people have been exposed to high concentrations. In industry, most workers are exposed to levels lower than those causing obvious nervous system effects, although more subtle neurological effects are possible at the lower levels. The health effects of breathing in air or drinking water with low levels of PCE are not known. Results from some studies suggest that women who work in dry cleaning industries where exposures to PCE can be quite high may have more menstrual problems and spontaneous abortions than women who are not exposed. Results of animal studies, conducted with amounts much higher than those that most people are exposed to, show that PCE can cause liver and kidney damage. Exposure to very high levels of PCE can be toxic to the unborn pups of pregnant rats and mice. Changes in behavior were observed in the offspring of rats that breathed high levels of the chemical while they were pregnant.

The U.S. Department of Health and Human Services (USDHHS) has determined that PCE may reasonably be anticipated to be a carcinogen. PCE has been shown to cause liver tumors in mice and kidney tumors in male rats.

Appendix C

Lifetime Excess Cancer Risk Evaluation: Present and Historic Businesses

Table C-1
Tops 'N' Town Cleaners Site, Manalapan, New Jersey
Lifetime Excess Cancer Risk Evaluation: Pre-May 2005
Present and Historic Businesses
Sample Data: October 2002 through April 2005

Business Exposure Scenario ⁽¹⁾	Business Identifier ⁽²⁾	Years of Operation	Exposure Period (Years)	PCE Concentration ($\mu\text{g}/\text{m}^3$) ⁽³⁾		LECR ⁽⁵⁾	
				TWA _m	TWA _a	TWA _m	TWA _a
Adult Employee - (8 hrs/day) Hair Studio of NJ	4	1983 - 1990	1983 - 1990	4,267	989	8.13×10^{-4}	1.88×10^{-4}
Adult Employee - (8 hrs/day) Wall 2 Wall (former tenant)	3	1993 - 2003	1993 - 2003	1,523	334	4.15×10^{-4}	9.08×10^{-5}
Adult Employee - (8 hrs/day) Decorating Plus	3	1991 - 1993	1991 - 1993	1,523	334	8.29×10^{-5}	1.82×10^{-5}
Adult Employee - (8 hrs/day) Hair Salon	3	1970 - 1990	1983 - 1990	1,523	334	2.9×10^{-4}	6.36×10^{-5}
Adult Employee - (7 hrs/day) Glen's Eye Care	6	2000 - present	2000 - April 2005	386	73	4.59×10^{-5}	8.72×10^{-6}
Adult Patron - (2 hrs/yr) Glen's Eye Care	6	2000 - present	2000 - April 2005	0.30	0.06	2.83×10^{-11}	5.38×10^{-12}
Child Patron - (2 hrs/yr) Glen's Eye Care	6	2000 - present	2000 - April 2005	0.30	0.06	4.93×10^{-11}	9.36×10^{-12}
Adult Employee - (8 hrs/day) Cards and Gifts	6	1994 - 2000	1994 - 2000	441	84	7.19×10^{-5}	1.37×10^{-5}
Adult Employee - (8 hrs/day) Creations	6	1984 - 1994	1984 - 1994	441	84	1.2×10^{-4}	2.28×10^{-5}
Adult Employee - (8 hrs/day) Collonade Stationers	6	1979 - 1984	1983 - 1984	441	84	1.2×10^{-5}	2.28×10^{-6}

Notes:

- (1) A default 8 hrs/day exposure was calculated for prior businesses since actual business hours are unknown.
- (2) See Table C-2 and Figure 2 for leasehold locations
- (3) Time-Weighted Average based on maximum PCE concentration
- (4) Time-Weighted Average based on average PCE concentration
- (5) LECR TWA_m based on maximum concentration, (TWA_a) based on average concentration

Table C-1 (continued)
Tops 'N' Town Cleaners Site, Manalapan, New Jersey
Lifetime Excess Cancer Risk Evaluation: Pre-May 2005
Present and Historic Businesses
Sample Data: October 2002 through April 2005

Business Exposure Scenario ⁽¹⁾	Business Identifier ⁽²⁾	Years of Operation	Exposure Period (Years)	PCE Concentration ($\mu\text{g}/\text{m}^3$) ⁽³⁾		LECR ⁽⁵⁾	
				TWA _m	TWA _a	TWA _m	TWA _a
Adult Employee - (8 hrs/day) Allure Hair & Nails	1	2004 - 2005	2004 - 2005	262	38	7.14×10^{-6}	1.03×10^{-6}
Adult Patron - (1 hr/wk) Allure Hair & Nails	1	2004 - 2005	2004 - 2005	5	1	2.19×10^{-9}	3.17×10^{-10}
Adult Employee - (8 hrs/day) Jem Jewelers	1	2004 - 2005	2004 - 2005	18	7	4.9×10^{-7}	2.0×10^{-7}
Adult Employee - (8 hrs/day) At Your Fingertips	1	1994 - 2004	1994 - 2004	262	38	7.14×10^{-5}	1.03×10^{-5}
Adult Employee - (8 hrs/day) Paper Mates Party Store	1	1984 - 1994	1984 - 1994	262	38	7.14×10^{-5}	1.03×10^{-5}
Adult Employee - (8 hrs/day) Mixed Greens	2	2005 - present	2005 - April 2005	217	63	5.9×10^{-6}	1.71×10^{-6}
Adult Employee - (8 hrs/day) U.S. Postal Service	2	1989 - 2003	1989 - 2003	217	63	8.25×10^{-5}	2.4×10^{-5}
Adult Employee - (8 hrs/day) Gordon's Corner Deli	2	1970 - 2004	1983 - 2004	217	63	1.24×10^{-4}	3.6×10^{-5}
Adult Employee - (8 hrs/day) Bus Tickets	2	2005 - present	2005 - April 2005	12	5	3.27×10^{-7}	1.36×10^{-7}

Notes:

(1) A default 8 hrs/day exposure was calculated for prior businesses since actual business hours are unknown.

(2) See Table C-2 and Figure 2 for leasehold locations

(3) Time-Weighted Average based on maximum PCE concentration

(4) Time-Weighted Average based on average PCE concentration

(5) LECR TWA_m based on maximum concentration, (TWA_a) based on average concentration

Table C-1 (continued)
Tops 'N' Town Cleaners Site, Manalapan, New Jersey
Lifetime Excess Cancer Risk Evaluation: Pre-May 2005
Present and Historic Businesses
Sample Data: October 2002 through April 2005

Business Exposure Scenario ⁽²⁾	Business Identifier ⁽²⁾	Years of Operation	Exposure Period (Years)	PCE Concentration ($\mu\text{g}/\text{m}^3$) ⁽³⁾		LECR ⁽⁵⁾	
				TWA _m	TWA _a	TWA _m	TWA _a
Adult Employee - (13 hrs/day) Video Home Center	7	1999 - 2005	1999 - 2005	190	27	5.03×10^{-5}	7.19×10^{-6}
Adult Employee - (8 hrs/day) Electronic Messaging Center	7	1998 - 1999	1998 - 1999	117	17	3.17×10^{-6}	4.54×10^{-7}
Adult Employee - (8 hrs/day) Cluck U. Chicken	7	1990 - 1998	1990 - 1998	117	17	2.54×10^{-5}	3.63×10^{-6}
Adult Employee - (8 hrs/day) Atlantic TV & Video	7	1984 - 1990	1984 - 1990	117	17	1.9×10^{-5}	2.72×10^{-6}
Adult Employee - (8 hrs/day) Sam's Fashions	7	1979 - 1984	1983 - 1984	117	17	3.17×10^{-6}	4.54×10^{-7}
Adult Employee - (13 hrs/day) Bagel World	8	1979 - present	1983 - April 2005	19	4	1.84×10^{-5}	3.69×10^{-6}
Child Patron - (30 min/day) Bagel World	8	1979 - present	1983 - April 2005	1	0.15	4.75×10^{-8}	9.49×10^{-9}
Adult Employee - (11 hrs/day) Carlos Pizza	9	2002 - present	2002 - April 2005	27	6	2.98×10^{-6}	6.17×10^{-7}
Adult Employee - (8 hrs/day) NY Pizza	9	1983 - 2002	1983 - 2002	19	4	1.0×10^{-5}	2.07×10^{-6}
Child Patron - (30 min/day) NY Pizza	9	1983 - 2002	1983 - 2002	1	0.25	6.79×10^{-8}	1.41×10^{-8}

Notes:

- (1) A default 8 hrs/day exposure was calculated for prior businesses since actual business hours are unknown.
- (2) See Table C-2 and Figure 2 for leasehold locations
- (3) Time-Weighted Average based on maximum PCE concentration
- (4) Time-Weighted Average based on average PCE concentration
- (5) LECR TWA_m based on maximum concentration, (TWA_a) based on average concentration

Appendix D

ATSDR Conclusion Categories

Summary of ATSDR Conclusion Categories

Category	Definition
1: Urgent Public Health Hazard	Applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects and require quick intervention to stop people from being exposed.
2: Public Health Hazard	Applies to sites that have certain physical hazards or evidence of chronic, site-related exposure to hazardous substances that could result in adverse health effects.
3: Indeterminate Public Health Hazard	Applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard.
4: No Apparent Public Health Hazard	Applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels expected to cause adverse health effects.
5: No Public Health Hazard	Applies to sites where no exposure to site-related hazardous substances exists.

Appendix E

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, 1-888-42-ATSDR (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) or other natural physical processes (such as sunlight).

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.

CAP [see Community Assistance Panel.]

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 or mixture 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 chemical 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 (i.e., 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 [contrast with prevalence].

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. Morbidity is 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 [contrast with incidence].

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/OCEPAt/terms/>)

National Center for Environmental Health (CDC)
(<http://www.cdc.gov/nceh/dls/report/glossary.htm>)

National Library of Medicine (NIH)
(<http://www.nlm.nih.gov/medlineplus/mplusdictionary.html>)

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