Health Consultation

THE FORMER INDUSTRIAL CHEMICAL SUPPLY COMPANY SITE
(Evaluates additional soil and groundwater data for the 1529 LaSalle Street Site)

TAMPA, HILLSBOROUGH COUNTY, FLORIDA

EPA FACILITY ID: FLD991304619

AUGUST 20, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

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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Prepared By:
Florida Department of Health
Under Cooperative Agreement with the
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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Summary

The Florida Department of Environmental Protection (DEP) asked the Florida Department of Health, (DOH) to evaluate the public health threat at the former Industrial Chemical Supply Company (ICSC) hazardous waste properties in Tampa. ICSC consists of four non-contiguous properties: one houses a cabinetmaking business, two have unoccupied buildings, and the fourth property is vacant. The ICSC properties are in a mixed industrial/commercial/ residential area about one mile west of the Hillsborough River in downtown Tampa. Previous owners reportedly formulated, stored, and distributed oils, chlorinated solvents, and other chemicals.

Between 2001 and 2006, various agencies tested area soil and groundwater on the presently vacant property. In November 2006, the US Environmental Protection Agency (EPA) removed contaminated soil from an adjacent residential property. In 2007, Florida DOH reviewed soil and groundwater test results from 1529 LaSalle Street and recommended additional testing. Between November 2006 and January 2007, Florida DOH and the Hillsborough County Health Department tested indoor air at two nearby residences but did not find chemicals at levels likely to cause illness.

In July 2007, Florida DEP contractors tested additional soil and groundwater on the ICSC site. Based on current exposures, the ICSC properties are "no apparent public health hazard." Based on 2007 soil tests, incidental ingestion of contaminated soil or inhalation of contaminated dust at the former ICSC properties is not likely to cause illness. Although concentrations of several volatile organic chemicals in the groundwater are above drinking water standards; however, there are no irrigation or drinking water wells in the area. Of the three properties with a potential for vapor intrusion, cabinet construction ventilation equipment in the one building currently occupied would prevent buildup of toxic levels of vapors. The other two buildings are currently unoccupied. Uncertainty in the groundwater flow direction prevents an accurate prediction of the potential for vapor intrusion in these buildings.

If in the future the ICSC site were rezoned from commercial/industrial to residential, exposure to contaminated soil at some properties would be a public health threat. Likewise, if in the future landowners failed to construct vapor resistant buildings, vapor intrusion would be a potential public health threat.

Florida DOH recommends above-grade construction/slab venting or groundwater remediation prior to construction of any building at 1529 West LaSalle Street. If the building ventilation system in use at 1204 N. Rome Avenue ever ceases operation, we recommend groundwater remediation or indoor air testing to confirm the potential for vapor intrusion. We recommend groundwater remediation or indoor air testing to confirm the potential for vapor intrusion before the building at 1301 North Rome Avenue is occupied. For a better prediction of the potential for vapor intrusion, we recommend a more accurate determination of groundwater flow direction. We recommend that soils meet residential standards if the site is ever rezoned residential.

Purpose

The purpose of this health consultation is to evaluate the public health threat from chemicals measured in the soil and groundwater in 2007 on and around the former Industrial Chemical Company Supply (ICSC) site. In three previous reports, Florida DOH reviewed 2006 soil, groundwater, and indoor air test data at one of the ICCS properties (1529 W. LaSalle Street). The

Florida DEP requested this evaluation. Florida DOH prepares health consultations through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia.

Background

The former Industrial Chemical Supply Company (ICSC) site is in a mixed residential/industrial/ commercial area two blocks south of Interstate 275 and one mile west of the Hillsborough River in Tampa, Florida (Figure 1). Carver Junior High School is $^{1}/_{8}$ mile southeast of the site, Dunbar Elementary School is ¼ mile northwest of the site, and several churches are nearby. All area buildings are on public water, and there are no known irrigation wells.

Previous owners of the ICSC site reportedly formulated, stored, and distributed various oils, chlorinated solvents, and other chemicals. Nearby residents reported sloppy housekeeping, chemical powders on the ground, and a green liquid along the north side of W. Arch Street when it rained. They recall a 1991 spill that caused plants to die and damaged the trunk of an oak tree. Nearby residents reported tanks on one property leaked chemicals until they were removed (E&E 2007).

Four non-contiguous properties make up the ICSC site (Figure 2):

- 1529 W. LaSalle Street
- 1204 N. Rome Avenue
- 1301 N. Rome Avenue
- 1533 W. Arch Street

In 2002, the owner of 1529 W. LaSalle Street went bankrupt and the City of Tampa assumed ownership. The building is now vacant. A cabinetmaking firm currently uses the building at 1204 N. Rome Avenue. The commercial building at 1301 N. Rome is vacant. The building at 1533 W. Arch Street was residential but is now vacant. The buildings at 1301 N. Rome and 1533 W. Arch Street share a common wall and a door provides easy access between the two. The Florida Department of Transportation (DOT) is purchasing homes north of LaSalle Street to expand Interstate 275 (E&E, 2007).

Investigational History

In January 2001, Florida DOT contractor Post, Buckley, Shuh, and Jernigan investigated 1529 W. LaSalle Street. They field-screened five soil samples for volatile organic compounds (VOCs) and analyzed one groundwater sample from a shallow monitoring well (6 to 7 feet below the ground surface). They found volatile organic compounds), semi-volatile organic compounds (SVOCs), metals, and petroleum hydrocarbons above Florida drinking water standards.

In October 2003 and January 2005, City of Tampa contractor Gannett Fleming, Inc. also investigated 1529 W. LaSalle Street. They collected 25 soil samples and six groundwater samples (from five shallow wells and one deep monitoring well) and excavated two test pits (38' long, 3 feet wide and 3 feet deep). They found volatile organic chemicals (VOCs), SVOCs, petroleum compounds, and metals in the soil and groundwater. Soil in the test pits was dark-green. The test results indicted that contamination might not be confined to the property.

In early 2006, Florida DEP contractor Ecology & Environment (E&E) tested a number of soil samples from 1529 W. LaSalle Street and nearby properties (E&E 2006a). In May 2006, Florida

DEP hand-delivered test results to residents. Florida DEP cautioned residents to avoid contact with the contaminated soil and to avoid gardening or landscaping in dusty conditions. In August 2006, members of a nearby family had their urine tested for metals; the results were within normal ranges. In November 2006, the EPA removed contaminated soil from these residents's property.

In two reports, Florida DOH assessed the public health threat from the groundwater (ATSDR 2007a) and soil (ATSDR 2007b) at 1529 W. LaSalle Street.

In December 2006 and January 2007, Florida DOH tested indoor air at two nearby residences, for three separate 24-hour periods. These results did not indicate elevated volatile chemicals in either home (ATSDR 2007c).

Florida DEP continues to investigate other area sources of soil and groundwater contamination.

Area Population— In 2000, approximately 1,397 persons lived within a 1/4-mile radius of the ICSC site. Approximately 88% were black, 9% were Latino/Hispanic, and 4% were white. American Indian/Alaska Native, Asian/Pacific Islander, and all other racial/ethnic groups made up less than 1% of the population (US Census Bureau 2000).

Community Health Concerns

Nearby residents are concerned that exposure to chemicals from this site might cause cancer (Hallie Calig 2007).

Discussion

In this health consultation, Florida DOH evaluates the public health threat from chemicals measured in the soil and groundwater in 2007 on and around the former ICCS site. We use a computer model (Risk Assistant 1.1) to estimate exposures from incidental ingestion of soil and inhalation of airborne dust. We use a US EPA computer model to estimate indoor air concentrations from groundwater vapor intrusion. Tables 1a and 1b list completed and potential soil and groundwater exposure pathways.

In July 2007, Florida DEP contractor E&E used a portable monitor to screen soil samples in the field. They then collected soil samples from 10 area locations with the greatest potential for contamination (Figure 3). They analyzed for volatile organic chemicals (VOCs), semi-volatile organic chemicals (SVOCs), and metals (Tables 3a, 3b, and 3c). For the purpose of this health consultation, soil at the former ICSC site has been adequately characterized.

In July 2007, E&E also tested groundwater from 13 existing and 9 new monitoring wells. They analyzed for metals, VOCs, and SVOCs (Figure 4). Groundwater flow direction is unclear. Other area sources of groundwater contamination are possible (Hallie Calig 2007). For the purpose of this health consultation, groundwater has not been adequately characterized. Additional testing is necessary to determine the extent of groundwater contamination and the groundwater flow direction.

Public Health Implications

Soil

Pathways Analysis

We assess the public health threat from exposure to contaminated soil by calculating doses for the incidental ingestion of contaminated soil and inhalation of contaminated dust. Potentially exposed individuals are current or future workers, and future residents, including children and adults. To calculate a dose, we use standard exposure assumptions (EPA 1998) and the highest chemical levels measured in soil.

Evaluation Process

We screen the soil analytical test results using ATSDR comparison values and Florida Soil Target Cleanup Levels (SCTLs). Comparison values are concentrations of chemicals that can reasonably (and conservatively) be regarded as harmless, assuming the most likely conditions of exposure. The comparison values include ample safety factors to ensure protection of sensitive human populations. Therefore, soil concentrations below comparison values are unlikely to cause illness.

For soil concentrations above comparison values, we calculate exposure levels (doses) to compare with minimum risk levels (ATSDR 2007). Because comparison values do not represent thresholds of toxicity, exposure to contaminant concentrations above comparison values will not necessarily lead to illness.

Based on 2007 soil tests, incidental ingestion of contaminated soil or inhalation of contaminated dust at the former ICSC site is not likely to cause illness. In the following sections, we discuss our soil evaluations by parcel. Figure 3 shows the data discussed.

1529 W. LaSalle Street

In a previous report, Florida DOH found that concentrations of chemicals in the soil at 1529 W. LaSalle Street between 2001 and 2006 were not likely to cause illness (ATSDR 2007b).

1204 N. Rome Avenue

None of the chemicals measured in two surface soil samples were above ATSDR screening guidelines or Florida industrial and commercial land use SCTLs. The highest level of tetrachloroethene is unlikely to cause noncancer illness for workers. Tetrachloroethene is a strong smelling, colorless liquid used in the textile industry for dry-cleaning and for processing and finishing cloth. Its industrial uses include cold cleaning and vapor degreasing of metals and fluid heat-exchange.

Tetrachloroethene in one sample is above the Florida residential SCTL. DEP could require remedial actions if the property owners redeveloped this property for residential use in the future. While workers or adult residents are unlikely to have an increased cancer risk, the calculated dose might increase a future child resident's cancer risk to 6 cases in 1 million persons more than the expected level. See Table 5 for a discussion of tetrachloroethene and cancer.

1301 N. Rome Avenue is currently for sale. One of the buildings on the property is in use and the other is for rent. E&E took soil samples at 4 locations. In the future if land use changed to residential, DEP could require soil remediation for PAHs and arsenic.

PAHs—E&E measured TEQ PAHs above the Florida industrial/commercial SCTL at 1 location. Polycyclic aromatic hydrocarbons (PAHs) are a family of molecules with similar ring-shaped structures. They may be natural or manufactured, as they form when organic materials burn. In urban settings, PAHs can be elevated from their presence in tars and asphalt-roofing materials as well as from combustion of gasoline and diesel fuels, coal, oil, wood, and garbage. Individual PAHs are manufacturing components of dyes, plastics and pesticides.

Although the highest measured PAH level is unlikely to cause noncancer illness for workers, or to increase workers' cancer risk significantly (less than 1 case in 1 million persons more than the expected level), DEP could require remedial action or risk-based cleanup assessment for soil under current land use at this location. This and another location had TEQ PAHs above the Florida residential SCTL. The calculated future adult and child residents' dose might increase either's cancer risk, but only to 6 cases in 1 million persons more than the expected level. See Table 5 for a discussion of PAHs and cancer.

Arsenic— Arsenic is a naturally occurring metal. In the past, arsenic was used extensively to produce pressure-treated wood and pesticides. Manufacturing of lead-acid batteries, metal alloys, semiconductors and diodes may still use arsenic.

The measured levels of arsenic in soil are unlikely to cause noncancer illness for workers or future residents or increase workers cancer risk significantly. DEP could require remedial action if the owner redeveloped this property for future residential use. The dose we calculated for adult and child residents might increase either's cancer risk, but only to 4 cases in 1 million persons more than the expected level. See Table 5 for a discussion of arsenic and cancer.

1533 W. Arch Street

The highest measured levels of PAHs in the one surface and subsurface soil sample are unlikely to cause noncancer illness. Although PAHs can cause cancer in people, the increased risk from the highest measured PAH concentration would be extremely small.

Groundwater

Pathways Analysis

In 2007, contractors for Florida DEP measured elevated levels of volatile organic compounds in groundwater from monitoring wells on and around the ICSC site. Although concentrations of several VOCs are above drinking water standards (Figure 4), there are no irrigation or drinking water wells in the area. Vapor intrusion from contaminated groundwater up through cracks in concrete-slab foundations or sealed crawl spaces into buildings, however, is a possible exposure pathway. Previously, Florida DOH evaluated the potential for vapor intrusion at 1529 W. LaSalle Street (ATSDR 2007a) but did not find significant indoor air concentrations in two nearby buildings (ATSDR 2007c). In this report, Florida DOH again evaluates the potential for vapor intrusion based on groundwater testing in 2007.

Evaluation Process

We use EPA's Johnson-Ettinger model[‡] to evaluate the potential for a building to trap vapors from contaminated groundwater. This model calculates potential air concentrations and hazard rankings (HRs). HRs are the modeled concentrations divided by EPA's comparison values (reference doses, RfDs, EPA 2007). Therefore, HRs greater than one are greater than the RfD. Like comparison values, reference doses are concentrations of chemicals that can reasonably (and conservatively) be regarded as harmless, assuming the most likely conditions of exposure. To estimate the relative toxicity of the chemicals having vapor intrusion potential, we added the HRs for the volatile chemicals in each monitoring well (Table 4). This approximation is acceptable[†] because many solvents have similar toxicological endpoints; they affect the nerves, liver, kidneys, and may have developmental effects (Table 6).

Intrusion of vapors from contaminated ground water into buildings in this area is not an immediate health threat. Three properties (outlined in yellow in Figures 5 and 6) had HI of more than 1, indicating a potential for accumulation of ground water vapors. Of the three properties, only 1204 N. Rome Avenue and 1301 N. Rome Avenue are currently occupied. Bay doors and ventilation fans prevent accumulation of vapors in the warehouse at 1301 N. Rome Avenue. Dust- and odor-control equipment prevent accumulation of vapors in the custom cabinetmaking shop at 1204 N. Rome Avenue.

Quality Assurance and Quality Control

The completeness and reliability of the referenced environmental data determine the validity of the analyses and conclusions drawn for this health consultation. Florida DOH used existing environmental data. We assume these data are valid: Florida DEP's contractors have approved comprehensive quality assurance project plans.

Child Health Considerations

At this time, children do not live on the ICSC site. Nonetheless, ATSDR and Florida DOH recognize that the unique vulnerabilities of infants and children demand special attention (ATSDR 2005a). Children are at a greater risk than are adults, for some hazardous substance exposures. Because children are smaller than adults are, their exposures can result in higher exposure concentrations of chemical per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Probably most important, however, is that children depend on adults for risk identification and risk management, hygiene awareness, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly. In recognition of these concerns, ATSDR developed the chemical screening values for children's exposures that Florida DOH used in preparing this report. Likewise, we calculated residential exposure doses for children, using exposure parameters specifically for children, to predict children's future exposure potential should these properties become residential.

[‡] Available on-line at EPA's website: http://www.epa.gov/Athens/learn2model/part-two/onsite/JnE_lite.htm
[†] Risks posed by exposure to multiple chemicals with similar health effects are considered to be additive or "cumulative", meaning the total risk can be approximated by summing the risks posed by each individual chemical.

Other susceptible populations may have different or enhanced responses to toxic chemicals than will most persons exposed to the same levels of that chemical in the environment. Reasons may include genetic makeup, age, health, nutritional status, and exposure to other toxic substances (like cigarette smoke or alcohol). These factors may limit a susceptible person's ability to detoxify or excrete harmful chemicals or may increase the effects of damage to their organs or systems.

Conclusions

Based on our evaluation of data for the current exposure pathways, the former ICSC properties present "no apparent public health hazard." Based on 2007 soil tests, incidental ingestion of contaminated soil or inhalation of contaminated dust at the former ICSC site is not likely to cause illness for industrial or commercial uses. Although concentrations of several volatile organic chemicals in the groundwater are above drinking water standards, there are no irrigation or drinking water wells in the area. Of the three properties with a potential for vapor intrusion, ventilation equipment in the two building currently occupied should prevent buildup of toxic levels of vapors in the air. The other building is currently unoccupied. Uncertainty in the groundwater flow direction prevents an accurate prediction of the potential for vapor intrusion in buildings on 1301 N. Rome Avenue.

If in the future certain parcels that make up the ICSC site were rezoned from commercial/industrial to residential, exposure to contaminated soil could be a public health threat. Likewise, if in the future landowners failed to construct vapor resistant buildings on certain parcels that make up the ICSC site, vapor intrusion could be a potential public health threat.

Recommendations

We recommend the following actions to address identified information gaps and potential exposure pathways:

1. DEP should survey the monitoring wells to determine the groundwater flow direction accurately.
2. DEP should consider requiring groundwater remediation, above-grade construction, or ventilation of any new buildings at 1529 West LaSalle Street.
3. Florida DOH will consider groundwater remediation or indoor air testing at 1204 N. Rome Avenue or 1301 North Rome to confirm the potential for vapor intrusion if current building ventilation systems ever cease operation. Florida DOH will alert current occupants of the potential for vapor intrusion.
4. Ensure soil meets residential standards if the site is ever rezoned residential.

Public Health Action Plan

1. On March 5, 2007, ATSDR published a health consultation report evaluating the public health threat from contaminated groundwater near 1529 W. LaSalle Street.
2. On April 3, 2007, ATSDR published a health consultation report evaluating the public health threat from contaminated soil at 1529 W. LaSalle Street.
3. On May 11, 20007, ATSDR published an exposure investigation report assessing the public health threat from indoor air in two buildings near 1529 W. LaSalle Street.

4. Florida DOH will evaluate additional groundwater, soil, or air data as warranted

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WISR: ***http://wiser.nlm.nih.gov/*** the Wireless Information System for Emergency Responders designed to assist first responders in hazardous material incidents. WISER provides a wide range of information on hazardous substances, including substance identification support, physical characteristics, human health information, and containment and suppression advice.

Appendix A—Figures

Figure 1: Locations of the four properties investigated as the former Industrial Chemical and Supply Site in Tampa, Hillsborough County, Florida

Figure 2: 1999 aerial photograph of the site properties.

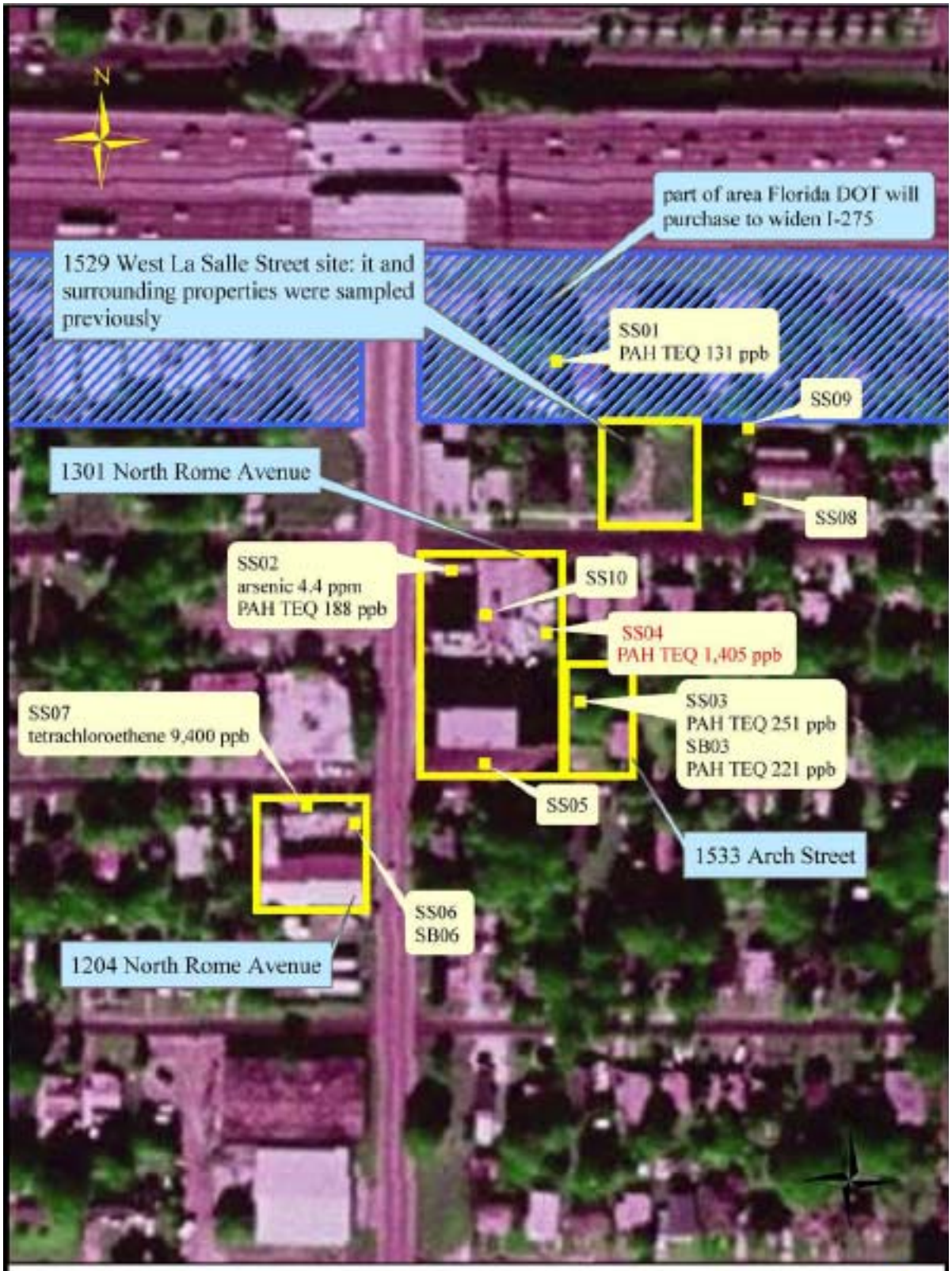

Figure 3: Soil test results that exceed soil target cleanup levels for residential land use. SS04 PAHs were the only chemicals that exceeded the industrial soil target cleaup levels.

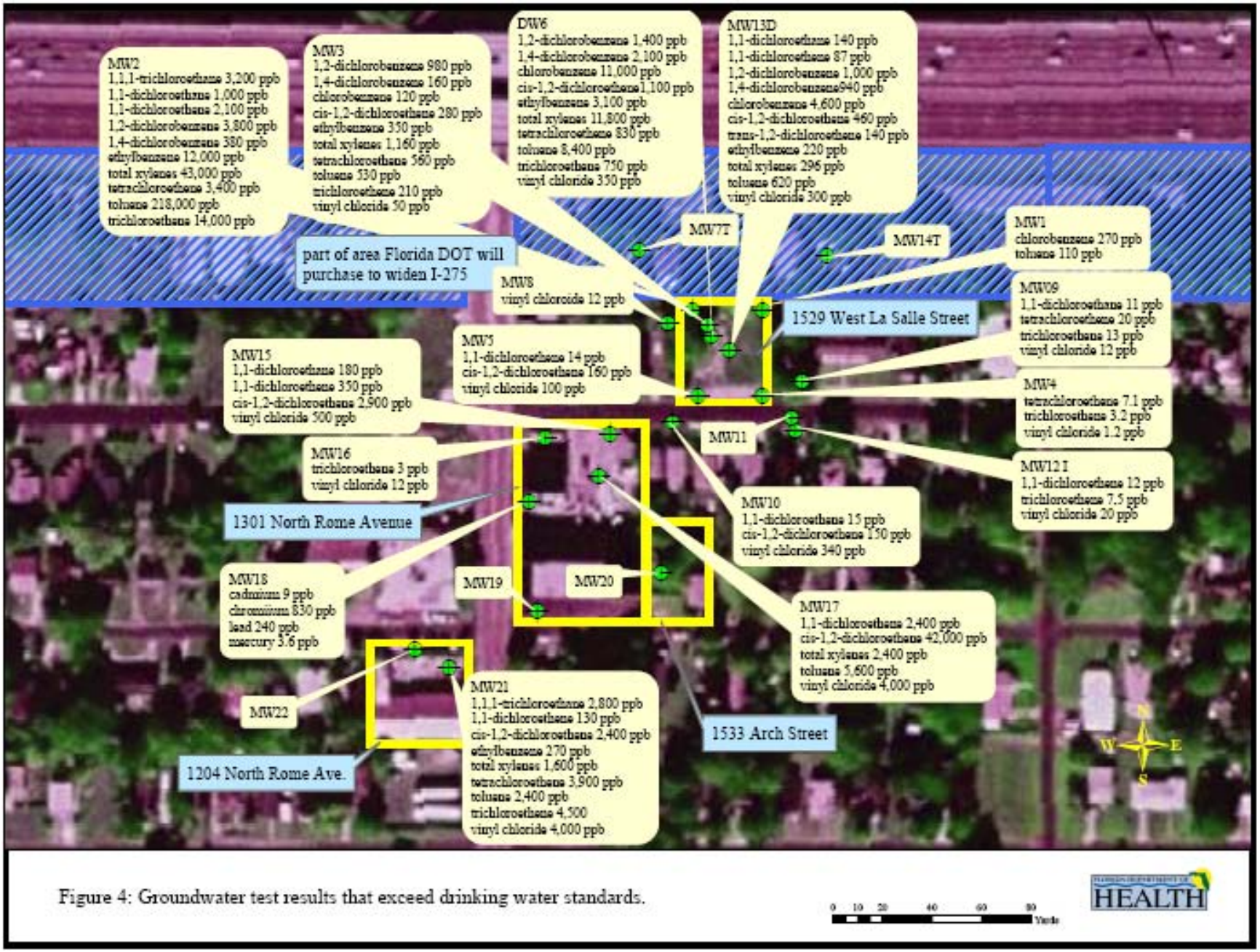

Figure 4: Groundwater test results that exceed drinking water standards.

Figure 5: Hazard Risk totals for vapor intrusion estimated using EPA's Johnson-Ettinger Model for all the chemicals detected in the monitoring wells and adding all the individual Hazard Risk together for the volatile chemicals measured in each well. All the monitoring wells with vapor indices exceeding one are on commercial or vacant property.

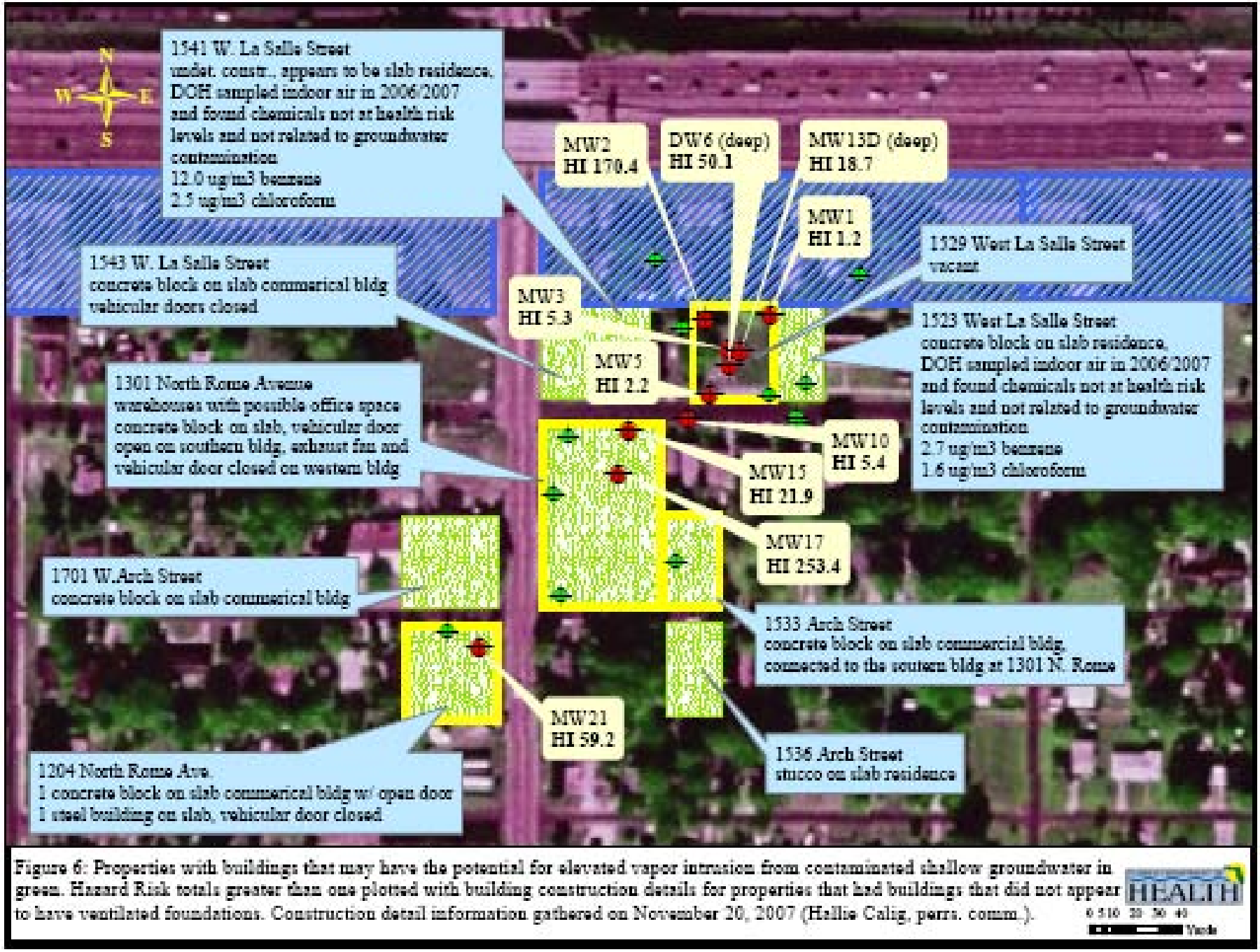

Figure 6: Properties with buildings that may have the potential for elevated vapor intrusion from contaminated shallow groundwater in green. Hazard Risk totals greater than one plotted with building construction details for properties that had buildings that did not appear to have ventilated foundations. Construction detail information gathered on November 20, 2007 (Hallie Calig, perrs. comm.).

Appendix B—Tables

Table 1a. Potential exposure pathways

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental/ Exposure Media	Point of Exposure	Route of Exposure	Exposed Population and land use	
Shallow groundwater	Contaminated groundwater on the site	Shallow groundwater	Vapors inside business or homes constructed on non-vented slabs	Inhalation	Person living or working over the contaminated shallow groundwater plume	Past Current Future

Pathway Name	Exposure Pathway Elements					Time
	Source	Environmental/ Exposure Media	Point of Exposure	Route of Exposure	Exposed Population and land use	
Contaminated on-site surface soil, dust	Soil on tested properties	Wastes, surface and subsurface soil	On-site properties	Incidental ingestion and inhalation	On-site residents/owners, workers	Past Current Future

Table 2. Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in shallow monitoring wells on the sites, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-1	Predicted conc. µg/m^3 ppbv	MW-2	Predicted conc. µg/m^3 ppbv	cancer risk	MW-3	Predicted conc. µg/m^3 ppbv	cancer risk	MW-4	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000				0.97	2100/390		0.0097	21.4/3.9				
1,1,-dichloroethane	-	50,000‡			0.420	210/52		0.19	9.3/2.3		0.001	0.5/0.1	
1,1,-dichloroethene	80				12	2400/603					0.01	2.0/0.5	
1,2,4,-trichlorobenzene	-	-						0.0013	0.3/0.04		0.000083	0.02/0.002	
1,2-dichlorobenzene	-	64,000‡	0.0063	1.3/0.2	1.3	253/42.1		0.33	65.2/10.9		0.057	11.3/1.9	
1,3-dichlorobenzene	-	-						0.013	1.09/0.18		0.11	1.2/0.2	
1,4-dichlorobenzene	100	10†chronic	0.0075	6.0/1.0	0.04	31.9/5.3		0.017	13.4/2.2		0.002	1.6/0.3	
carbon disulfide	900	300†chronic											
chlorobenzene	-	50,000‡	1.1	66.6/14.5				0.27	16.3/3.5		0.0016	0.1/0.02	
cis1,2-dichloroethene	-	-						1.21	42.5/10.7		0.029	1.0/0.3	
trans1,2-dichloroethene	800	200‡									0.0014	0.1/0.02	
ethylbenzene	4,000	1,000‡			0.35	353.5/81.46	$2x10^{-4}$	0.1	103.1/23.76	$4.6x10^{-5}$			
isopropylbenzene	-	-											
methylisobutylketone	3,000	10,000‡											
methylcyclohexane													
methylene chloride	1,000	300†chronic											
xylenes-o	200 total	50†chronic			0.34	2403/554					0.000008	0.06/0.01	
xylenes-m		50†chronic	0.00075	5.3/1.2	1.3	9349/2154		0.035	242.5/55.9				
tetrachloroethene	300	40†chronic				2264/334	$3x10^{-3}$		372.8/55	$4.6x10^{-4}$		4.7/0.7	$5.8x10^{-6}$
toluene	300	80†chronic	0.077	30.8/8.2	12	5044/1051		0.37	148.5/39.44				
trichloroethene	500	100†intermed.			141	5644/1051	$2.6x10^{-1}$	2.12	84.7/15.8	$3.8x10^{-3}$	0.032	1.29/0.24	$5.8x10^{-5}$
vinyl chloride	0.1	30†intermed.						0.67	67/26.22	$2.4x10^{-4}$	0.016	1.6/0.6	$5.8x10^{-6}$
Totals: hazard and cancer risks			1.2		170		$2.7x10^{-1}$	5.34		$4.5x10^{-3}$	0.26		$6.3x10^{-5}$

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3).
Second column = †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 2 (continued). Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in shallow monitoring wells on the sites, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-5	Predicted conc. µg/m^3 ppbv	cancer risk	DW-6	Predicted conc. µg/m^3 ppbv	cancer risk	MW-13D	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000										
1,1,-dichloroethane	-	50,000‡	0.0063	3.2/0.8					0.059	29.43/7.3	
1,1,-dichloroethene	80		0.08	15.9/4.0					0.5	98/25	
1,2,4,-trichlorobenzene	-	-									
1,2-dichlorobenzene	-	64,000‡	0.002	0.4/0.06		0.47	93/16		0.33	67/11	
1,3-dichlorobenzene	-	-							0.053	5.5/0.9	
1,4-dichlorobenzene	100	10†chronic	0.000086	0.07/0.1		0.22	176/29		0.099	79/13	
carbon disulfide	900	300†chronic									
chlorobenzene	-	50,000‡	0.00053	0.03/0.007		25.11	1494/325		10.5	625/136	
cis1,2-dichloroethene	-	-	0.69	24.3/6.1		4.77	167/42		2	70/18	
trans1,2-dichloroethene	800	200‡	0.067	4.7/1.2					0.67	47/12	
ethylbenzene	4,000	1,000‡				0.91	913/210	$4.1x10^{-4}$	0.065	65/15	$2.29x10^{-5}$
isopropyl benzene	-	-									
methylisobutylketone	3,000	10,000‡							0.011	0.9/0.2	
methylcyclohexane											
methylene chloride	1,000	300†chronic									
xylenes-o	200 total	50†chronic				0.091	634/146		0.003	21/5	
xylenes-m		50†chronic				0.37	2600/599		0.0083	58/13	
tetrachloroethene	300	40†chronic					553/82	$6.8x10^{-4}$			
toluene	300	80†chronic				5.89	2354/625		0.43	174/46	
trichloroethene	500	100†intermed.	0.0071	0.3/0.05	$1.3x10^{-5}$	7.56	302/56	$1.4x10^{-2}$			
vinyl chloride	0.1	30†intermed.	1.34	134.0/52.44	$4.8x10^{-4}$	4.69	469/184	1.7x10-3	4.02	402/157	$1.4x10^{-3}$
Totals: hazard and cancer risks			2.2		$4.9x10^{-4}$	50.08		$1.6x10^{-2}$	18.74		1.4x10-3

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3);
Second column †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 2. Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in shallow monitoring wells on the sites, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-15	Predicted conc. µg/m^3 ppbv	cancer risk	MW-16	Predicted conc. µg/m^3 ppbv	cancer risk	MW-17	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000										
1,1,-dichloroethane	-	50,000‡	0.076	37.8/9		0.0019	1.0/0.2				
1,1,-dichloroethene	80		1.99	398/101		0.027	5.5/1.4	13.66	13.66	2731/681	
1,2,4,-trichlorobenzene	-	-									
1,2-dichlorobenzene	-	64,000‡	0.09	18/3		0.0026	0.5/0.08				
1,3-dichlorobenzene	-	-				0.00093	0.1/0.02				
1,4-dichlorobenzene	100	10†chronic	0.0045	4/0.6		0.00018	0.1/0.02				
carbon disulfide	900	300†chronic				0.0014	1/0.3				
chlorobenzene	-	50,000‡				0.003	0.2/0.04				
cis1,2-dichloroethene	-	-	12.58	440/111		0.14	5/1	182.1	182.1	6375/1609	
trans1,2-dichloroethene	800	200‡	0.29	20.24/5.1		0.013	0.8/0.2	0.072	0.072	5.1/1.3	
ethylbenzene	4,000	1,000‡				0.00038	0.4/0.09				
isopropylbenzene	-	-									
methylisobutylketone	3,000	10,000‡									
methylcyclohexane						0.00028	0.8/0.2				
methylene chloride	1,000	300†chronic	0.0014	4.2/1.2	8.1x10^{-7}	0.00003	0.09/0.03				
xylenes-o	200 total	50†chronic				0.000027	0.2/0.04				
xylenes-m		50†chronic				0.000079	0.6/0.1	0.1	0.1	701/162	
tetrachloroethene	300	40†chronic		11/1.7	1.39x10-5		1.7/0.3				
toluene	300	80†chronic				0.0012	0.5/0.1	3.92	3.92	1569/416	
trichloroethene	500	100†intermed.	0.19	7.7/1.4	3.4x10^{-4}	0.03	1.2/0.2				
vinyl chloride	0.1	30†intermed.	6.7	670/262	2.4x10^{-3}	0.16	16/6.3	53.590000	53.59	5359/2098	1.64x10^{-3}
Totals: hazard and cancer risks		2.1970	21.92		2.4x10^{-3}	0.39		253.45	253.45		1.64x10^{-3}

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3);
Second column = †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 2. Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in <u>shallow monitoring wells on the sites</u>, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-18	Predicted conc. µg/m^3 ppbv	MW-19	Predicted conc. µg/m^3 ppbv	cancer risk	MW-20	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000									
1,1,-dichloroethane	-	50,000‡								
1,1,-dichloroethene	80									
1,2,4,-trichlorobenzene	-	-								
1,2-dichlorobenzene	-	64,000‡			0.001	0.2/0.3				
1,3-dichlorobenzene	-	-			0.0003	0.03/0.005				
1,4-dichlorobenzene	100	10†chronic			0.000043	0.03/0.006				
carbon disulfide	900	300†chronic	0.00089	0.6/0.2	0.0007	0.5/0.16				
chlorobenzene	-	50,000‡			0.0022	0.13/0.02				
cis1,2-dichloroethene	-	-			0.0036	0.13/0.03		0.0028	0.09/0.03	
trans1,2-dichloroethene	800	200‡			0.0023	0.16/0.04		0.0038	0.3/0.07	
ethylbenzene	4,000	1,000‡			0.000091	0.09/0.02	4.1x10^{-8}			
isopropylbenzene	-	-								
methylisobutylketone	3,000	10,000‡								
methylcyclohexane										
methylene chloride	1,000	300†chronic								
xylenes-o	200 total	50†chronic			0.000023	0.2/0.04				
xylenes-m		50†chronic			0.000032	0.2/0.05				
tetrachloroethene	300	40†chronic				0.2/.0.3	2.8x10^{-7}		0.2/0.03	2.9x10^{-7}
toluene	300	80†chronic			0.00098	0.4/0.1				
trichloroethene	500	100†intermed.			0.0023	0.09/0.02	4.1x10^{-6}			
vinyl chloride	0.1	30†intermed.						0.0028	0.3/0.1	
Totals: hazard and cancer risks		2.1970	0.0009		0.014		4.4x10-6	0.0094		2.9x10^{-7}

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3);
Second column = †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 2. Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in <u>shallow monitoring wells on the sites</u>, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-21	Predicted conc. µg/m^3 ppbv	cancer risk	MW-22	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000		0.85	1868/342				
1,1,-dichloroethane	-	50,000‡				0.00036	0.2/0.04	
1,1,-dichloroethene	80		0.74	147.9/37				
1,2,4,-trichlorobenzene	-	-						
1,2-dichlorobenzene	-	64,000‡						
1,3-dichlorobenzene	-	-						
1,4-dichlorobenzene	100	10†chronic						
carbon disulfide	900	300†chronic						
chlorobenzene	-	50,000‡						
cis1,2-dichloroethene	-	-	10.41	364/92		0.02	0.7/0.2	
trans1,2-dichloroethene	800	200‡				0.0077	0.5/0.1	
ethylbenzene	4,000	1,000‡	0.08	79.5/18	$3.5x10^{-5}$			
isopropylbenzene	-	-						
methylisobutylketone	3,000	10,000‡						
methylcyclohexane								
methylene chloride	1,000	300†chronic						
xylenes-o	200 total	50†chronic	0.037	262/60				
xylenes-m		50†chronic	0.017	117/27		0.000011	0.08/0.018	
tetrachloroethene	300	40†chronic		2597/383	$3.2x10^{-3}$		1.1/0.2	$1.3x10^{-6}$
toluene	300	80†chronic	1.68	673/179		0.00016	0.06/0.02	
trichloroethene	500	100†intermed.				0.0081	0.3/0.06	$1.5x10^{-5}$
vinyl chloride	0.1	30†intermed.	45.36	1814/338	$8.2x10^{-2}$			
Totals: hazard and cancer risks		2.1970	59.17		$8.5x10^{-2}$	0.036		$1.6x10^{-5}$

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3);
Second column = †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 2. Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in <u>shallow monitoring wells off the sites</u>, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-7T (background)	Predicted conc. µg/m^3 ppbv	cancer risk	MW-8 (residential)	Predicted conc. µg/m^3 ppbv	cancer risk	MW-9 (residential)	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000										
1,1,-dichloroethane	-	50,000‡				0.00076	0.4/0.09		0.0055	2.7/0.7	
1,1,-dichloroethene	80					0.003	0.6/0.2		0.063	12.52/3.2	
1,2,4,-trichlorobenzene	-	-									
1,2-dichlorobenzene	-	64,000‡				0.0027	0.5/0.09		0.11	22/3.7	
1,3-dichlorobenzene	-	-				0.00035	0.04/0.006		0.028	2.9/0.5	
1,4-dichlorobenzene	100	10†chronic				0.00015	0.1/0.02		0.0053	4.2/0.7	
carbon disulfide	900	300†chronic									
chlorobenzene	-	50,000‡				0.00055	0.03/0.007				
cis1,2-dichloroethene	-	-				0.027	0.9/0.2		0.078	2.7/0.7	
trans1,2-dichloroethene	800	200‡				0.0029	0.2/0.05				
ethylbenzene	4,000	1,000‡									
isopropylbenzene	-	-									
methylisobutylketone	3,000	10,000‡									
methylcyclohexane											
methylene chloride	1,000	300†chronic									
xylenes-o	200 total	50†chronic									
xylenes-m		50†chronic									
tetrachloroethene	300	40†chronic	no HR	0.15/0.02	$1.8x10^{-7}$					13.3/2.0	$1.64x10^{-5}$
toluene	300	80†chronic									
trichloroethene	500	100†intermed.							0.13	5.2/1.0	$2.4x10^{-4}$
vinyl chloride	0.1	30†intermed.				0.16	16/6.3	$5.8x10^{-5}$	0.16	16/6.3	$5.8x10^{-5}$
Totals: hazard and cancer risks		2.1970	0.0000			0.2		$5.8x10^{-5}$	0.58		$3.6x10^{-4}$

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3);
Second column = †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 2. Predicted Hazard Indices and Indoor Air Concentrations for chemicals measured in <u>shallow monitoring wells off the sites</u>, for conditions or building structures that might trap vapors.

Chemical	ATSDR Screening Values* µg/m3	ppbv	MW-10 (in the road)	Predicted conc. µg/m^3 ppbv	cancer risk	MW-12I	Predicted conc. µg/m^3 ppbv	cancer risk	MW-14T	Predicted conc. µg/m^3 ppbv	cancer risk
1,1,1,-trichloroethane	4,000										
1,1,-dichloroethane	-	50,000‡	0.017	8.4/2.1		0.0055	2.7/0.6				
1,1,-dichloroethene	80		0.091	18.2/4.6		0.068	13.7/3.5				
1,2,4,-trichlorobenzene	-	-									
1,2-dichlorobenzene	-	64,000‡				0.00053	0.1/0.02				
1,3-dichlorobenzene	-	-									
1,4-dichlorobenzene	100	10†chronic									
carbon disulfide	900	300†chronic									
chlorobenzene	-	50,000‡							0.00066	0.04/0.009	
cis1,2-dichloroethene	-	-	0.65	22.8/5.7		0.16	5.6/1.4				
trans1,2-dichloroethene	800	200‡	0.072	5.1/1.3		0.063	4.3/1.1				
ethylbenzene	4,000	1,000‡				0.079	3.1/0.6	$1.4x10^{-4}$			
isopropylbenzene	-	-									
methylisobutylketone	3,000	10,000‡									
methylcyclohexane											
methylene chloride	1,000	300†chronic									
xylenes-o	200 total	50†chronic									
xylenes-m		50†chronic									
tetrachloroethene	300	40†chronic								0.2/0.02	$2.0x10^{-7}$
toluene	300	80†chronic									
trichloroethene	500	100†intermed.				0.079	3.1/0.6	$1.422x10^{-4}$			
vinyl chloride	0.1	30†intermed.	4.56	455.6/178.3	$1.64x10^{-3}$	0.27	26.8/10.5	$9.69x10^{-5}$			
Totals: hazard and cancer risks		2.1970	5.39		$1.64x10^{-3}$	0.72		$3.8x10^{-4}$	0.0007		$2.0x10^{-7}$

Screening Values: First column = lowest ATSDR Air Comparison Values in micrograms per cubic meter (µg/m^3);
Second column = †inhalation minimum risk level or ‡lowest dose for adverse health effects in parts per billion per volume (ppbv).

Table 3a. Maximum concentrations in <u>on-site</u> surface soil (0 to 6 inches below ground surface).

Contaminants of Concern	Screening Value (mg/kg) ATSDR: Children/adults	Highest Soil Concentration (mg/kg)	Location of Highest Concentration	Number Soil Samples Above Screening Value
arsenic	20/200 EMEG	4.4	SS02 1301 N. Rome Street	ATSDR 0/7 DEP 1/7
(PAHs, TEQ)	0.1 CREG	1.4	SS04 1301 N. Rome Street	ATSDR 3/7 DEP 3/3
tetrachloroethene	200/2,000 RMEG	9.4	SS07 1204 N. Rome Street	ATSDR 0/7 DEP 1/7

Table 3b. Maximum concentrations in <u>on-site</u> subsurface soil (6 to 24 inches below ground surface).

Contaminants of Concern	Screening Value (mg/kg) ATSDR: Children/adults	Highest Soil Concentration (mg/kg)	Location of Highest Concentration	Number Soil Samples Above Screening Value
(PAHs, TEQ)	0.1 CREG	0.221	SS04 1533 Arch Street	ATSDR 1/7 DEP 1/7

Table 3c. Maximum concentrations in <u>off-site</u> surface soil (0 to 6 inches below ground surface).

Contaminants of Concern	Screening Value (mg/kg) ATSDR: Children/adults	Highest Soil Concentration (mg/kg)	Location of Highest Concentration	Number Soil Samples Above Screening Value
(PAHs, TEQ)	0.1 CREG	0.131	Future I-275 right-of-way	ATSDR 1/3 DEP 1/3

EMEG—Environmental Media Evaluation Guide, for long-term daily exposures lasting longer than a year
CREG—Cancer Risk Evaluation Guide for 1 excess cancer in 1 million persons
RMEG—Reference Dose Media Evaluation Guide, for long-term daily exposures lasting longer than a year
SCTL—Florida DEP's Soil Target Cleanup Level for residential (R) or industrial/commercial (I) land uses.
(PAHs, TEQ)—Polycyclic aromatic hydrocarbons, totaled to their benzo(a)pyrene toxicity equivalence
µg/kg—milligrams per kilogram

Table 4. Estimated doses from exposures to on-site surface soil.

Contaminant of Concern (maximum concentration)	Oral MRL (mg/kg/day)	Soil/dust-Ingestion (mg/kg/day)			Inhalation MRL (mg/m^3)	Soil/dust- Inhalation (mg/m^3)
		Child	Adult	Workers		Child and Adult
arsenic	0.0003 Chr	0.00006	0.000006	0.0000001	-	0.0000002
PAH TEQs	-	0.00002	0.000002	0.00000004	-	0.00000008
tetrachloroethene	0.05 Acute-	0.000125	0.000013	0.0000003	0.2 ppm Acute 0.04 ppm Chr.	0.00000051

Acute – Acute exposure length of 0-14 days

Int – Intermediate exposure length of 15- 364 days

Chr – Chronic exposure length of more than 365 days

NS – Not sampled in the initial sampling event.

mg/kg/day – milligram chemical per kilogram body weight per day

mg/m3 – microgram of chemical per cubic meter of air

M – Values were modeled (tables follow)

MRL – Minimum Risk Level: extrapolation of a No Observable Adverse Effect level in a study of exposures, calculated by dividing the study dose by safety factors.

Table 5. Comparison of doses calculated from highest measured on-site surface soil values to lowest observable adverse effect levels (LOAELs) in animal testing and human medical studies.

Chemicals in soil on-site	Doses are in mg/kg/day for ingestion and mg/m^3 for inhalation Soil					
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adults' theoretical increased cancer risk	workers' theoretical increased cancer risk
Arsenic (surface soil)	Ing. 0.00006 Inh. 0.000002	Ing. 0.000006 Inh. 0.000002	Ing. 0.00000013 Inh. 0.000002	Ing. 4:1,000,000 Inh. < 1:1,000,000	Ing. 4:1,000,000 Inh. < 1:1,000,000	Ing. < 1:1,000,000 Inh. < 1:1,000,000
ATSDR 2000a (Update)	Child surface soil ingestion dose (0.00006) is 33 times less than the dose (0.002, Chiou et al. 1997) associated with increased prevalence of cerebrovascular disease and cerebral infarction (an interruption of the blood supply to any part of the brain, resulting in damaged brain tissue). This dose is also 83 times less than the dose (0.005, Lianfang and Jianzhong 1994) associated with keratosis (a lump or growth on the skin that is the result of overproduction of the protein keratin), hyperkeratosis (a skin condition characterized by thickening and hardening of the skin), depigmentation, cyanosis (bluing) of extremities, palpitation/chest discomfort, fatigue, headache, dizziness, insomnia, nightmares, and numbness. These health effects would be unlikely, even in children with daily, long-term exposures to soil that might cause them to ingest soil incidentally. Adult surface soil ingestion dose (0.000006) is 333 times less than the lowest dose referenced (0.002, Chiou et al. 1997), so surface soil exposures would be unlikely to cause adverse non-cancer health effects in adult residents. Worker surface soil ingestion dose (0.0000001) is 20,000 times less than the lowest dose referenced (0.002, Chiou et al. 1997), so surface soil exposures would be unlikely to cause adverse non-cancer health effects in workers. Inhalation concentration (0.000002) is 350 times less than the amount associated with increased risk of stillbirth in humans (0.0007, Ihrig et al., 1998, As 3^+). The exposure levels to arsenic estimated for dust from surface soil are unlikely to cause adverse health effects in children, adults, or workers. Arsenic associated cancers: From lowest to highest dose cancer effect levels, chronic arsenic exposures in people have been linked to lung cancer, basal and squamous cell skin cancers, liver cancer (haemangioendothelioma), urinary tract cancers (bladder, kidney, ureter and all urethral cancers), and intraepidermal cancers. Intraepidermal is the name for the early pre-invasive form of squamous cell skin cancer. Pre-invasive means that the cancer cells are confined to the outermost layer of skin, the epidermis. At this stage, the cancer cells are unlikely to have spread to the lymph nodes, but they can spread along the skin surface. If left untreated, these cells can develop into an invasive cancer and spread into the lymphatic system.					

Chemicals in soil on-site	Doses are in mg/kg/day for ingestion and mg/m^3 for inhalation					Soil
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adults' theoretical increased cancer risk	workers' theoretical increased cancer risk
PAHs TEQ	Ing. 0.00002 Inh. 0.0000008	Ing. 0.000002 Inh. 0.0000008	Ing. 0.00000004 Inh. 0.0000008	Ing. 6:1,000,000 Inh. < 1:1,000,000	Ing. 6:1,000,000 Inh. < 1:1,000,000	Ing. < 1:1,000,000 Inh. < 1:1,000,000
ATSDR 1995 (Update)	Child surface soil ingestion dose (0.00002) is 130,000 times less than the dose (2.6, Neal and Rigdon, 1967) associated with stomach cancer in mice exposed to benzo[a]pyrene ad lib in food for 30 to 197 days (a period considered to a long-term or lifetime exposure in mice; in mice, non-cancer illnesses are all associated with much higher doses). Adult surface soil ingestion dose (0.000002) is 1,300,000 times less than the (2.6) dose associated with stomach cancer in mice. Worker surface soil ingestion dose (0.00000004) is 65,000,000 times less than the (2.6) dose associated with stomach cancer in mice. Inhalation concentration (0.0000008) is 125 times less than the dose (0.0001, Gupta et al. 1993)) associated with reduced lung function, abnormal chest x-ray, cough, bloody vomit, and throat and chest irritation, in persons exposed from 6 months to 6 years. Cancer and occupational studies; Worker exposures to high levels of PAHs show cancers (skin, bladder, lung and gastrointestinal) are the most significant endpoints of PAH toxicity. Long-term worker PAH exposures have been linked with skin and eye irritation, photosensitivity, respiratory irritation (with cough and bronchitis), and leukoplakia, a common, potentially pre-cancerous disease of the mouth that involves the formation of white spots on the mucous membranes of the tongue and inside of the mouth. Despite the increased risk associated with having leukoplakia, many people with this condition never get oral cancer. Other worker exposures have been linked to precancerous skin growths enhanced by exposure to sunlight, erythema (inflammation of subcutaneous fat tissue), skin burns, acneiform lesions, mild hepatotoxicity, and haematuria (passage of blood in the urine.). Also several PAH compounds are immunotoxic, and some suppress selective components of the immune system. Workers' dermal exposure studies indicate that although direct contact may be of concern at high exposure levels, they do not suggest that lower levels are likely to cause significant irritation (Goodfellow et al. 2001).					

Chemicals in soil on-site	Doses are in mg/kg/day for ingestion and mg/m^3 for inhalation					Soil
	children's dose	adult's dose	worker's dose	children's theoretical increased cancer risk	adults' theoretical increased cancer risk	workers' theoretical increased cancer risk
Tetrachloroethene	Ing. 0.000125 Inh. 0.0000005	Ing. 0.000013 Inh. 0.0000005	Ing. 0.0000003 Inh. 0.0000005	Ing. 6:1,000,000 Inh. < 1:1,000,000	Ing. < 1:1,000,000 Inh. < 1:1,000,000	Ing. < 1:1,000,000 Inh. < 1:1,000,000
ATSDR 1997	Child surface soil ingestion dose (0.000125) is 40,000 times less than the dose (5, Fredrickson et al., 1993) associated with developmental neurotoxicity in studies of mice exposed before birth. Adult surface soil ingestion dose (0.000013) is 384,615 times less than the dose (5, Fredrickson et al., 1993) associated with developmental neurotoxicity in studies of mice exposed before birth. Worker surface soil ingestion dose (0.0000003) is 16,666,666 times less than dose (5, Fredrickson et al., 1993) associated with developmental neurotoxicity in studies of mice exposed before birth. Inhalation concentration (0.0000005mg/m^3, converted to ppm is 0.00000009) is 78 million times less than the concentration (7.3 ppm, Cavelleri et al. 1994)) associated with color vision loss in humans exposed for nine years. Cancer and occupational studies Epidemiological studies associate TCE exposures with excess risk of kidney cancer, liver cancer, lympho-hematopoietic cancers†, cervical cancer, and prostate cancer. TCE has been extensively tested in animals, with mice developing liver tumors, lung tumors, and lymphomas, and rats developing kidney tumors and testicular tumors. The epidemiologic evidence is strongest at sites where the animals develop cancer, with site concordance for kidney cancer (in rats and humans), liver cancer (in mice and humans), and lympho-hematopoietic cancer (in mice and humans). TCE is also associated with cervical cancer and prostate cancer in humans, sites for which there are no corresponding animal models." (EPA 2001).					

† Cancers of the lymph and the blood forming systems (leukemia).

Table 6: Occupational standards (air) for chemicals totaled for vapor intrusion hazard indices.

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
1,1,1,-trichloroethane	2.2 mg/m^3 / No	NIOSH STEL 30 min. 1900 mg/m^3 (350 ppm) OSHA PEL - 1900 mg/m^3 (350 ppm)	Dizziness, lightheadedness, and suffocation are acute symptoms. Animal studies show that breathing air that contains very high levels of 1,1,1-trichloroethane (higher than 2,000 ppm) damage the breathing passages and cause mild effects in the liver, in addition to affecting the nervous system .	A colorless liquid with a sweet, sharp odor/ used as a solvent , degreaser, spot cleaner, and in glues, and aerosol sprays.
1,1,-dichloroethane	0.5 mg/m^3 / No	TLV is 100 ppm, 3x TLV for longer than 30 minutes is to be avoided, 5x TLV, not to be exceeded OSHA PEL - 400 mg/m3 (100 ppm).	Vapors may produce irritation of the respiratory tract and conjunctiva, CNS depression, and cardiac dysrhythmias. Kidney effects and cancer are known from long-term higher-level exposure animal studies.	A colorless, oily, liquid that evaporates quickly at room temperature and has a sweet odor like ether/ used to dissolve other substances such as paint, varnish and finish removers, and to remove grease.
1,1,-dichloroethene	0.2 mg/m^3 / No	TWA- 5 ppm, TLV for longer than 30 minutes is to be avoided, and under no circumstances should they exceed 5x TLV provided that the TLV-TWA is not exceeded. NIOSH usually rec. that occupational exposures to carcinogens be limited to the lowest feasible concentration.	Dizziness, drowsiness, headache, dyspnea and pneumonitis are acute symptoms. Exposure to high concentrations can produce central nervous system depression and unconsciousness. Hepatic and renal dysfunction may result from chronic exposure. Eye contact may cause conjunctivitis and transient corneal injury.	A colorless liquid or gas (above 89 degrees F), mild, sweet, chloroform-like odor/ used as co monomer, primarily with vinyl chloride.
1,2,4,-trichlorobenzene	0.2 mg/m^3 / No			
1,2-dichlorobenzene	0.2 mg/m^3/ No			
1,3-dichlorobenzene	0.105 mg/m^3/ No			
1,4-dichlorobenzene	0.8 mg/m^3 / No			

† The Wireless Information System For Emergency Responders (WISER), funded by the National Library of Medicine, was the source used for the current Occupational Standards. .

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
carbon disulfide	0.07 mg/m^3 / No	OSHA PEL 8-hr TWA 20 PEL Acceptable Ceiling Concentration: 30 ppm. PEL Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift: 100 ppm. Maximum Duration: 30 minutes.	Target organs affected include the central nervous system, cardiovascular system, peripheral nervous system, reproductive system, eyes, liver and skin. Chronic exposure produces numerous and varied effects related to generalized nerve injury, vascular changes, multiple organ damage, and neurological problems. Prolonged exposure may lead to the development of atherosclerosis, ischemic heart disease, polyneuropathy, and gastritis. Headache, dizziness, fatigue, nervousness, sleep disturbances, anorexia, and weight loss have been reported in workers following chronic exposure to carbon disulfide.	A clear, colorless or faintly yellow liquid; purest distillates have sweet, pleasing, & ethereal odor usual commercial and reagent grades are foul smelling/ used with optical glass, paints, enamels, varnishes, paint removers, tallow, explosives, rocket fuel, putty preservatives, rubber cement, solvent for waxes, lacquers, camphor, resins, vulcanized rubber and pesticide intermediates.
chlorobenzene	0.0595 mg/m^3 / No	8 hr TWA: 10 ppm 8-hr TWA: 75 ppm (350 mg/cu m). Excursions in worker exposure levels may exceed three times the TLV-TWA for no more than a total of 30 min during a workday, and under no circumstances should they exceed five times the TLV-TWA, provided that the TLV-TWA is not exceeded.	Skin and mucous membrane irritant, exposures may result in central nervous system depression, liver and kidney damage. Acute exposures may begin, depending on dose, with headaches and dizziness followed by gastrointestinal complaints, shortness of breath, tachycardia and circulatory insufficiency. Chronic inhalation exposures may result in eye irritation, headache, dizziness, somnolence and gastrointestinal disorders. Acute inhalation exposures to high concentrations may result in narcosis. There is no evidence that severe liver damage results from acute inhalation exposures.	A colorless liquid with an almond-like smell/ used as a tar and grease remover in cleaning and degreasing operations, as a solvent in surface coating and surface coating removers., and as a solvent in the production of bitumen and asphalt coatings for building protection.

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
cis1,2-dichloroethene trans1,2-dichloroethene	0.035 mg/m^3/ No 0.07 mg/m^3 / No	OSHA 8-hr TWA: 200 ppm (790 mg/cu m). Excursions in worker exposure levels may exceed 3x the TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed 5x the TWA, provided that the TWA is not exceeded (same for both)	Narcosis and anesthesia occur after inhalation. Adverse effects from inhalation exposure include bronchial irritation, dyspnea, pulmonary edema, respiratory depression, euphoria, dizziness, restlessness, irritability, incoordination, central nervous system depression, impaired concentration, confusion, drowsiness, loss of consciousness, seizures, renal and hepatic damage, as well as fatal cardiac dysrhythmias.	A colorless liquid with a slightly acrid, chloroform-like odor/ used as a solvent for waxes, resins, and acetylcellulose. It is also used in the extraction of rubber, as a refrigerant, in the manufacture of pharmaceuticals and artificial pearls and in the extraction of oils and fats from fish and meat.
ethylbenzene	1 mg/m^3 / No	8 hr TWA 100 ppm; 15 min STEL: 125 ppm. OSHA PEL 8-Hr Time Weighted Avg: 100 ppm (435 mg/cu m).	Ethylbenzene is an eye, skin, and mucous membrane irritant, exposure at significant concentrations may cause profuse tearing, conjunctivitis, nasal and respiratory tract irritation, chest constriction, vertigo, dizziness, headache, irritability, and functional nervous system disturbances. Narcosis may also occur. Chronic exposure in humans may cause fatigue, sleepiness, headache, and irritation of the eyes and respiratory tract. In experimental animals, exposure to ethylbenzene has caused eye, skin, and mucous membrane irritation; changes in liver and kidney weights; CNS depression; pulmonary edema; respiratory failure; leukocytosis; and increased platelet counts.	A colorless liquid with sweet gasoline like odor/ used in the production of synthetic rubber, as a solvent or diluent, as a component of automotive and aviation fuels; mfr of cellulose acetate and styrene

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
methylisobutylketone	0.08 mg/m^3 / No	8 hr TWA: 50 ppm; 15 min STEL: 75 ppm. OSHA PEL 8-Hr TWA 100 ppm 100 ppm (410 mg/cu m).	Acute inhalation effects vary, depending on extent and duration of exposure. Eye, nose, and throat irritation; nausea; headache; vertigo; in-coordination; CNS depression; narcosis, and cardio respiratory failure can occur. In most cases, recovery is usually rapid and complete. The major concern with chronic exposure is axonal neuropathy with secondary myelin damage, usually manifested as paresthesias (lack of feeling in the fingers and toes) and muscle weakness	A colorless liquid with faint, ketonic and camphor odor/ used as solvent for paints, varnishes, nitrocellulose, lacquers, mfr of methyl amyl alcohol; organic synthesis, extraction processes, including extraction of uranium from fission products, organic synthesis, used in dry-cleaning preparations, synthesis of methyl isobutyl carbionol (mibc), synthetic flavoring adjuvant: flavor useful in fruit flavors, rum cheese.
methylcyclohexane	3.01 mg/m^3 / No	not a normally a gas	Liver and kidney damage have occurred in experimental animals, with acute exposure, the primary target organ is the central nervous system. CNS excitation and seizures may occur. Other effects may include headache, agitation, ataxia, nausea, vomiting, dizziness, tremor, diarrhea, weakness, cyanosis, dyspnea, circulatory collapse, respiratory depression, and coma. Pulmonary edema has been reported. Blood dyscrasias, primarily aplastic anemia, may occur with chronic exposure.	A colorless, sand-like powder, crystals from benzene, alcohol, or xylene/ component of benzene hexachloride, the BHC-former insecticide

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
methylene chloride	3.01 mg/m^3 / **Yes**	OSHA 8-hr TWA: 50 ppm Excursions in worker exposure levels may exceed 3x the TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed 5x the TWA, provided that the TWA is not exceeded (same for both). 8 hour exp limit 25 ppm as an 8 hr TWA. STEL 125 ppm as determined over a sampling period of 15 minutes.	Vapors may cause dizziness or suffocation. Acute exp. are irritating to the eyes, skin, and mucous membranes, and may cause narcotic effects. High concentration exposure may result in CNS depression and respiratory failure. Other signs and symptoms of exposure may include somnolence, euphoria, irritability, fatigue, weakness, altered sleep patterns, numbness and tingling of the extremities, neurasthenic disorders, convulsions, pulmonary edema, change in cardiac rate, nausea, vomiting, anemia, and hemolysis. Acoustical and optical delusions and hallucinations were reported following exposure to methylene chloride for one year. Ingestion may produce gastrointestinal burns, hemorrhage, and necrosis. Liver and kidney damage and pulmonary congestion have been reported in experimental animals following chronic exposure. Methylene chloride is metabolized in part to carbon monoxide. Physical exertion increases absorption, conversion to carbon monoxide, and carboxyhemoglobin levels	A colorless liquid with sweet odor, like chloroform/ used as solvent in paint removers, for cellulose acetate; degreasing and cleaning fluids; as solvent in food processing and pharmaceutical aid (solvent). Also aerosol propellant; insecticide,
xylenes-o, m, and p	7 mg/m^3 / No	8 hr TWA): 100 ppm; 15 min, STEL: 150 ppm	Acute inhalation exposures may cause reversible hepatic and renal toxicity. High vapor concentrations can cause CNS excitation followed by narcosis, olfactory changes, respiratory tract irritation, and non-cardiogenic pulmonary edema. Severe exposure may result in death due to respiratory arrest and/or ventricular dysrhythmias.	A sweet-smelling colorless liquid used as Raw material for production of plasticizers; alkyd resins, glass-enforced polyesters, manufacture of phthalic anhydride

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
tetrachloroethene	0 mg/m^3 / **Yes**	ACGIH TLV of 50 ppm as an 8 hr time-weighted average (TWA) with a note to prevent skin contact. OSHA PEL, 8-hr TWA: 100 ppm. OSHA PEL Acceptable Ceiling Concentration: 200 ppm. OSHA PEL Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. Concentration: 300 ppm. Maximum Duration: 5 minutes in any 3 hours.	Vapor inhalation can cause central nervous system depression, liver necrosis, and effects on the lung, heart, and kidney.	A strong smelling colorless liquid used in the textile industry for dry-cleaning & for processing & finishing; used in both cold cleaning & vapor degreasing of metals; it is used as a chem intermediate in the synthesis of fluorocarbon 113, 114, 115, & 116; it is used as a heat-exchange fluid
toluene	0.4 mg/m^3 / No	OSHA PEL, 8-hr TWA: 200 ppm. OSHA PEL Acceptable Ceiling Concentration: 300 ppm. OSHA PEL Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. Concentration: 500 ppm. Maximum Duration: 10 minutes.	Chronic inhalation (particularly with inhalational abuse) is associated with muscular weakness, a gastrointestinal syndrome (pain, nausea, vomiting), renal tubular acidosis, hepatorenal failure and neuropsychiatric syndrome. a) EFFECTS may include hypokalemia, hematuria, proteinuria, oliguria, paresis, rhabdomyolysis, hallucinations, hyperactive reflexes, peripheral neuropathy, personality changes, tremors, headaches, emotional lability, memory loss. b) SEQUELAE - Progressive, irreversible encephalopathy with cognitive difficulty and cerebellar ataxia, and organic affective syndromes have been described.	A colorless liquid with sweet, pungent, benzene-like odor, used for mfg benzene derivatives, caprolactam, saccharin, medicines, dyes, perfumes, TNT; solvent recovery plants; component of gasoline; solvent for paints and coatings, gums, resins, rubber and vinyl organosol; diluent and thinner in nitrocellulose lacquers; adhesive solvent in plastic toys and model airplanes; detergent mfg; gasoline and naphtha constituent.

CHEMICAL	REFERENCE DOSE (RESIDENTIAL)/ CARCINOGENIC?	OCCUPATIONAL STANDARDS†	OTHER HEALTH EFFECTS	PROPERTIES/USE
trichloroethene	0.04 mg/m^3 / **Yes**	TLV- 8 hr TWA: 50 ppm; 15min STEL 100 ppm OSHA PEL 8-hr TWA 100 ppm., PEL Acceptable Ceiling Concentration: 200 ppm. PEL Acceptable maximum peak above the acceptable ceiling concentration for an 8-hour shift. Concentration: 300 ppm. Maximum Duration: 5 minutes in any 2 hours.	Narcosis and anesthesia occur after inhalation. Adverse effects from inhalation exposure include bronchial irritation, dyspnea, pulmonary edema, respiratory depression, euphoria, dizziness, restlessness, irritability, incoordination, central nervous system depression, impaired concentration, confusion, drowsiness, loss of consciousness, seizures, renal and hepatic damage, as well as fatal cardiac dysrhythmias.	A sweet smelling clear colorless or blue liquid used mainly for metal cleaning or degreasing. Trichloroethylene is used in degreasing operations in five main industrial groups: furniture and fixtures, fabricated metal products, electric and electronic equipment, transport equipment and miscellaneous manufacturing industries. It is also used in plastics, appliances, jewelry, automobile, plumbing fixtures, textiles, paper, glass and printing industries.
vinyl chloride	0.1 mg/m^3 / **Yes**	TLV- 8 hr TWA: 1 ppm; Excursions in worker exposure levels may exceed 3x the TWA for no more than a total of 30 min during a work day, and under no circumstances should they exceed 5x the TWA, provided that the TWA is not exceeded. OSHA: No employee may be exposed to vinyl chloride at conc. greater than 1 ppm averaged over any 8 hr period and no employee may be exposed to vinyl chloride at concentrations greater than 5 ppm averaged over any period not exceeding 15 min. No employee may be exposed to vinyl chloride by direct contact with liquid vinyl chloride.	The chronic exposure target organ is the liver. Direct hepatotoxicity, hepatomegaly, and hepatic cancers, including angiosarcoma, have been reported. Vinyl chloride is a human carcinogen and causes cancer of the hepatic, hematopoietic, central nervous, respiratory, and digestive systems. Acute inhalation may cause CNS and respiratory depression and seizures m	A sweet-smelling colorless liquid used in the manufacture of numerous products in building and construction, automotive industry, electrical wire insulation and cables, piping, industrial and household equipment, medical supplies, and is depended upon heavily by the rubber, paper, and glass industries.

TLV: threshold limit value set for workroom air to protect workers during an 8-hour shift over a 40-hour workweek.
OSHA: Occupational Safety and Health Administration,
Reference dose (used in the Johnson-Ettinger model), level at which health affects are not expected (by chemical), carcinogens with threshold levels may also have reference doses

Certification

The Florida Department of Health (DOH, Office of Environmental and Occupational Toxicology prepared this Health Consultation under a cooperative agreement with the Agency for Toxic Substances and Disease Registry. Florida DOH followed approved methodologies and procedures existing at the time the health consultation was begun. The Cooperative Agreement Partner completed editorial review.

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

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