Public Health Assessment

Public Comment Release

Vapor Intrusion and Off-Site Irrigation Well

CONTINENTAL CLEANERS

MIAMI, MIAMI-DADE COUNTY, FLORIDA

EPA FACILITY ID: FLD982130098

Prepared by the
Florida Department of Health

FEBRUARY 8, 2016

COMMENT PERIOD ENDS: APRIL 22, 2016

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Community Health Investigations
Atlanta, Georgia 30333

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Foreword

The Florida Department of Health (DOH) evaluates the public health threat of hazardous waste sites through a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR) in Atlanta, Georgia. This public health assessment is part of an ongoing effort to evaluate health effects associated with soil, groundwater, and vapors from the Continental Cleaners hazardous waste site. The DOH uses the following process for all sites to evaluate site-related public health issues:

■ Evaluating exposure: DOH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present, where it is on the site, and how human exposures might occur. The Florida Department of Environmental Protection (Florida DEP) and the U.S. Environmental Protection Agency (EPA) provided the information for this assessment.

■ Evaluating health effects: If DOH finds evidence that exposures to hazardous substances are occurring or might occur, their scientists will determine whether that exposure could be harmful to human health. DOH focuses this report on public health; that is, the health impact on the community as a whole, and bases it on existing scientific information.

■ Developing recommendations: The DOH outlines, in plain language, its conclusions regarding potential health environmental threats and offers recommendations for reducing or eliminating human exposure to contaminants. The role of the DOH in dealing with hazardous waste sites is primarily advisory. For that reason, the evaluation report will typically recommend actions for other agencies, including the U.S. Environmental Protection Agency (EPA) and the Florida DEP. If, however, an immediate health threat exists or is imminent, DOH will issue a public health advisory warning people of the danger, and will work to resolve the problem.

■ Soliciting community input: The evaluation process is interactive. The DOH starts by soliciting and evaluating information from various government agencies, individuals or organizations responsible for cleaning up the site, and those living in communities near the site. DOH shares any conclusions about the site with the groups and organizations providing the information. Once DOH prepares an evaluation report, they seek feedback from the public.

If you have questions or comments about this report, please contact:

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Or call: 850 245-4401 or toll-free in Florida: 1-877-798-2772

Summary

INTRODUCTION

At the Continental Cleaners hazardous waste site, the main concern of the Florida Department of Health (DOH) and the federal Agency for Toxic Substances and Disease Registry (ATSDR) is to supply workers and people living near the site with the best knowledge of how to safeguard their health.

The Continental Cleaners hazardous waste site is at 798 NW 62nd Street, Miami, Florida. Prior to 1969, the site was a gas station. From 1969 to 2005, it was an active drycleaner facility. From 2005 to 2012, the site was a drop-off location for on-site laundry and remote dry cleaning. In early 2012, the business closed. In August 1993, the Miami-Dade County Department Environmental Resources Management (DERM) discovered the drycleaner disposed of solvents to the floor drain, ground, and into an old oil water separator. Polluted soil and groundwater exist throughout the site. Investigators also found groundwater contamination offsite.

ATSDR and DOH are assessing this site as a part of their evaluation of listed sites on the United States Environmental Protection Agency's (EPA's) National Priorities List (NPL). ATSDR is mandated to evaluate public health issues at NPL sites, and DOH has a cooperative agreement with ATSDR to conduct these evaluations.

DOH reached the following four conclusions:

CONCLUSION #1

DOH concludes that soil gas measurements indicate the potential for vapor intrusion could expose future workers at this site. However, no indoor air data is available to evaluate the level of potential exposure.

BASIS FOR DECISION #1

EPA found soil gas beneath the on-site building above soil gas screening levels indicating that further evaluation is needed to assess exposures. Measured indoor air data needed to evaluate exposures is not available.

NEXT STEPS #1

DOH recommends that EPA investigate potential vapor intrusion into buildings within at least 100 feet of contamination, or further if preferential pathways may be present. ATSDR prefers concurrently collected indoor air, ambient air, and subslab gas data

for evaluating potential for health effects. Pending completion of a vapor intrusion evaluation, we recommend limiting access to the on-site building until it has been remediated or a mitigation system has been installed.

CONCLUSION #2

DOH concludes that existing data does not provide for a thorough evaluation of indoor air exposure in off-site residential buildings.

BASIS FOR DECISION #2

EPA found off-site soil gas contaminant vapors above soil gas screening levels indicating that further evaluation is needed to assess exposures. Measured indoor air data needed to evaluate exposures is not available.

CONCLUSION #3

DOH concludes that accidentally swallowing, touching, and/or breathing vapors from contaminants in the water from irrigation wells near the site are not expected to harm people's health.

BASIS FOR DECISION #3

The highest levels of contaminants in the closest known irrigation well are below levels expected to cause non-cancer or cancer illness. Tetrachloroethylene (PCE) was detected at a maximum concentration of 8.1 micrograms per liter (µg/L).

CONCLUSION #4

DOH concludes that people are not likely being exposed to contaminants in on-site soils or off-site private well water. If contact occurs, the contaminants are not likely to harm people.

BASIS FOR DECISION #4

The grassy area of the site is secured with a locked chain link fence. Concrete covers most of the rest of the site. People living near the site cannot contact on-site soils, since they cannot get onto the site. The private wells nearby are used for irrigation and should not be used as a source for drinking water. Instead, Miami-Dade County supplies area homes and businesses with unaffected potable water from a distant source.

FOR MORE INFORMATION

If you have concerns about your health or the health of your children, you should contact your health care provider. You may also call the DOH toll-free at 877-798-2772. Please ask for information about the Continental Cleaners hazardous waste site.

Background and Statement of Issues

The purpose of this public health assessment is to assess the public health threat from toxic chemicals in groundwater, soil, and air from the Continental Cleaners hazardous waste site. The Continental Cleaners site is at 798 NW 62nd Street, Miami, Miami-Dade County, Florida (Figures 1 and 2).

Continental Cleaners (the site) is in a densely populated mixed commercial/residential area of Miami known as Liberty City. Continental Cleaners is bordered to the north by Martin Luther King Boulevard and the Construction and Craft Workers' Union 1652 building. It is bordered to the west by Northwest 8th Avenue and the Belafonte Advisory Committee of Liberty City Youth (TACOLCY) Recreational Center. South of the site is a dirt drive, residential apartments, and homes. A vacant lot and a U.S. Post Office are located on the east side of Continental Cleaners.

Two other dry cleaning facilities are in the area. D and N Drycleaner is approximately 900 feet northeast of the site. Spotless Cleaners is approximately 1,200 feet west-northwest of the site. An Environmental Data Resources, Inc. search found no reports of groundwater contamination from these facilities [Metcalf & Eddy 2006].

From the 1930s to 1968, a gas station occupied the Continental Cleaners site. From 1969 to 2005, the site was an active drycleaner. In 2005, the facility ceased dry cleaning operations and became a conventional laundry and a drop-off location for dry cleaning at a remote site [Metcalf & Eddy 2006]. In January 2012, Continental Cleaners ceased operation, and the building has been vacant since. While it was an active drycleaner, the primary cleaning agent used was tetrachloroethylene (also known as perchloroethylene or PCE). In 1993, the Miami-Dade County Department of Environmental Resources Management (DERM) found PCE in the floor drain [Metcalf & Eddy 2006].

In March 2006 and March 2010, Florida DEP and their consultants found chlorinated solvents typical of dry cleaning operations, their breakdown products, and petroleum byproducts throughout the site's soil and groundwater.

The principle source of potable water in southeast Florida is the surficial Biscayne aquifer system (a sole-source aquifer). The Biscayne aquifer is composed of limestone, sandstone, and sand. In Broward County, however, it is mainly composed of sand [Weston 2006]. Because the Biscayne aquifer is near land surface, it is susceptible to contamination. Pollutants enter the aquifer by direct infiltration from land surface canals, septic tanks, drain fields, drainage wells, and solid waste dumps. Most pollutants that enter the aquifer are concentrated in the upper 20 to 30 feet. The ultimate fate of pollutants in this aquifer is the ocean; although, some adsorb to the aquifer materials, and pumping wells divert others. Groundwater generally flows east to southeast regionally toward the coast. However, the direction of flow may be influenced locally by pumping of well fields, seepage into drainage canals, and fluctuations of ocean tides [Klein and

Hull 1978; Schroeder et al. 1958]. Surficial groundwater flow near the site is generally to the north-northeast.

Residents and businesses in the area of the site receive their drinking water from municipal water supply. They have been connected to this supply system since the 1970s (Samir Elmir, DOH in Miami-Dade County, personal communication, 2013). The nearest residential drinking water well is approximately 2 miles south of the site and was not sampled. Two potable supply wells operated by the City of North Miami are approximately 3.8 miles north of the site. In 2009, the wells provided drinking water to a population of approximately 40,980 people [DEP 2009a, 2009b].

The nearest surface water is the New River Canal bay, which is approximately 1.5 miles north of the site.

On March 15, 2012 the EPA added Continental Cleaners to the NPL.

This assessment considers health concerns of nearby residents and explores possible associations with site-related contaminants. This assessment requires the use of assumptions, judgments, and incomplete data. These factors contribute to uncertainty in evaluating the health threat. Assumptions and judgments in this assessment are designed to be protective of public health and may overestimate the risk to public health.

Site Description

The Continental Cleaners site is a 2,361 square foot facility on a 0.3 acre lot (Figure 2). Land use surrounding the site is predominantly commercial and residential. The Belafonte TACOLCY park and recreation facility is located just west across NW 8th Avenue. An extension of the Miami-Dade College is approximately 600 feet northwest of the site. Another school (RJW Academy of Arts and Sciences) is 300 feet to the south of the site.

On March 30, 2011, DOH staff visited the site. They observed that site access was limited by a chain link fence (topped with barbed wire) enclosing the grassy area on the southern half of the site. Cement covered the northern half of the site. At the time of the site visit, Continental Cleaners was an active drop off facility. In January 2012 Continental Cleaners ceased operations, and the site has been vacant since.

Demographics

Approximately 29,956 people live within 1.0 mile of the site. Five percent (5%) are white, 78% are African-American, 7% are of Hispanic origin, and 10% represent other racial or ethnic groups. Thirty- four percent (34%) are less than 18 years old, and 66% are older than 18. Approximately twenty-one (21%) are women of child-bearing age (15-44 years old). Eighty-one percent (81%) have a high school diploma or less, and 19% have at least two years of college. Seventy-four percent (74%) speak only English, and 89% make less than $50,000 a year [EPA 2010].

Land Use

Land use south, west, and north of the Continental Cleaners site is predominantly residential with some commercial buildings along Martin Luther King Boulevard. Land use east of the Continental Cleaners site is predominantly commercial.

Community Health Concerns

On August 30, 2011, DOH attended an EPA and Florida DEP public meeting with residents of the nearby community. Approximately 11 community members attended the meeting. Most of them wanted more information on what was being done in the community. A few residents were concerned about the overall health of the community and the potential health impact of a hazardous waste site in their area.

DOH will solicit health concerns during the public comment period and will address them in the final report.

Discussion

Environmental Data

Soil Vapor

In May 2011, the EPA collected three on-site and nine off-site soil gas samples and analyzed them for volatile organic compounds (VOCs). Two of the three on-site samples were collected 6 inches beneath the building's slab (adjacent samples CC12 and CC13). The remaining 10 samples were exterior soil gas samples collected at a depth between 5 and 6 feet below ground surface (bgs) (samples CC01–CC07 and CC09–CC11) [EPA 2011a]. In January 2013, EPA collected additional sub-slab soil gas samples from inside Continental Cleaners (sample CCV101) and the Construction and Craft Workers Local Union building (sample CCV102). Soil gas sample locations are shown in Figures 3 and 3a.

DOH evaluated on-site soil gas concentrations using screening levels calculated from non-cancer and cancer air comparison values (CVs) and EPA's upper level attenuation factor recommended for screening of workers from exposure onsite to contaminants of concern in the air. DOH specifically examined concentrations in the three soil gas samples that were taken from just below the slab of the Continental Cleaners building. DOH calculated soil gas screening levels using ATSDR's air CVs and EPA's attenuation factor recommended for screening [EPA 2012a]. Maximum soil gas concentrations were adjusted for worker exposure by multiplying the concentration by (250/365 days per year) x (12/24 hours/day) then compared to the soil gas screening level [EPA 1991, 2011].

To assess on-site risks, DOH examined the concentrations measured in the sub-slab samples instead of the concentrations found in the exterior soil gas sample. The EPA recommends the collection of sub-slab samples because they provide direct evidence of the risk of vapor intrusion. Exterior soil gas samples may show significant temporal and spatial variability and, thus, not accurately represent vapor concentrations directly below a structure [EPA 2012a]. ATSDR prefers concurrently collected indoor air, ambient air, and subslab gas data for evaluating potential for health effects.

With the exception of the sub-slab sample collected in January 2013 from inside the Construction and Craft Workers Local Union building, the EPA collected only exterior soil gas samples offsite. Sub-slab sampling is intrusive and can be difficult to conduct off of a site. Exterior soil gas samples allow information to be obtained without entering buildings and can be collected on properties where no structures are present [EPA 2012a]. Analyses of on-site and off-site samples found PCE, trichloroethylene (TCE), vinyl chloride, 1,4-dioxane, and chloroform above soil gas screening levels (Tables 1 and 3) [EPA 2011a].

Since a limited number of soil gas samples were collected onsite and offsite, the full extent of contamination may not be adequately identified. Therefore, risks from vapor intrusion may not be fully assessed. EPA generally recommends evaluating buildings within 100 feet of contamination [EPA 2015], though preferential pathways can move soil gases farther and the accuracy of specific sources are sometimes difficult to quantify. Notably, the three onsite sub-slab samples were collected from the source area, and likely represent the worst contamination.

Groundwater

In March 2006, consultants for the Florida DEP collected 15 on-site groundwater samples from four direct push points and three monitoring wells (Figure 4). They collected samples from the direct push points at three different depth intervals: shallow (13 to 21 feet bgs), intermediate (21 to 31 feet bgs), and deep (31 to 36 feet bgs). All samples were analyzed in an on-site mobile laboratory. Following field screening, the contractors installed three monitoring wells by direct push at the rear of the Continental Cleaners building. Investigators collected the three well samples from the shallow (10 to 23 feet bgs) interval. A fixed-base laboratory analyzed the well samples for VOCs [Metcalf & Eddy 2006].

The direct push and monitoring well samples contained elevated concentrations of PCE and its breakdown compounds. The direct push sample of DP-1 had the highest levels (Figure 4). The contractors installed the MW-3 well in the DP-1 location. It contained the highest levels observed in the monitoring wells. The PCE, TCE, *cis*-1,2-dichloroethylene (*cis*-1,2-DCE), and *trans*-1,2-dichloroethylene (*trans*-1,2-DCE) concentrations measured in MW-3 (7,130 µg/L, 15,100 µg/L, 25,900 µg/L, and 636 µg/L, respectively; Figure 4) [Metcalf & Eddy 2006].

In March 2010, consultants for the Florida DEP collected seven on-site groundwater samples from monitoring wells in the shallow interval (8 to 25 feet bgs) and analyzed them for VOCs. This investigation found petroleum byproducts, PCE, and PCE breakdown products above EPA's and Florida DEP's MCLs, Florida DEP's Groundwater Cleanup Target Levels (GCTLs) (Figure 5) [Tetra Tech 2011].

During May 2011, the EPA collected 10 off-site and 8 on-site groundwater samples from 10 direct push points, 1 irrigation well, and 7 monitoring wells. Direct push points are shown in Figure 3 with the prefix "CC", with the exception of stations CC08, CC12, and CC13. The EPA collected only sub-slab soil gas samples at stations CC12 and CC13. Station CC08 is an off-site irrigation well sampled by EPA. It is of unknown depth and has an electrically driven pump. The permanent monitoring wells are labeled with the prefix "TCCF" [EPA 2011a].

Between July 2012 and November 2013, EPA collected approximately 400 groundwater samples for analysis as part of a remedial investigation (RI) to define the direction and delineate the extent of the groundwater contamination from the site (Figure 6) [Waller 2014].

The EPA analyzed the groundwater samples for VOCs. Laboratory analyses of monitor well and direct push point groundwater samples found PCE and PCE breakdown products above EPA's and Florida DEP's MCLs, Florida DEP's Groundwater Cleanup Target Levels (GCTLs), and select ATSDR drinking water comparison values [Waller 2014]. Because businesses and residences at and near the site are on municipal water supply, DOH does not consider exposure to contaminants through potable well water to be a health concern. However, irrigation wells are being used in the area. Laboratory analyses of water from the off-site irrigation well found many chemicals to be below detection levels. Chemicals that were detected measured below ATSDR drinking water comparison values (Table 5) [EPA 2011a].

Florida DEP and EPA have adequately characterized the extent of the groundwater contamination of the source area onsite. DOH provides a limited assessment of the potential risks from exposure to groundwater in irrigation wells due to the small number (2) of irrigation wells in the area.

Soil

During the March 2010 site assessment, a contractor for the Florida DEP collected a total of 20 soil samples from 10 on-site locations. The contractor collected 10 of the samples from the 0 to 2 feet bgs interval and 10 of the samples from the 2 to 4 feet bgs interval. It analyzed the samples for VOCs; and found petroleum products, PCE, and PCE breakdown products in some of the samples. The surface soil sample (TCCF008SF) containing the highest concentration of PCE (3.3 mg/kg) was significantly less than the ATSDR comparison value, which is a cancer risk evaluation guide (330 mg/kg) [Tetra Tech 2011].

Most of the site is behind a locked fence or covered in cement, thus limiting on-site soil exposure. Therefore, DOH does not consider the on-site soil at Continental Cleaners to be a current public health concern.

Identifying Contaminants of Concern

To identify contaminants of concern, DOH compares chemical concentrations found at a site to ATSDR and other comparison values [ATSDR 2005, 2013a]. DOH used the maximum concentration measured for a chemical at the Continental Cleaners site and nearby areas in each comparison because limited data are available for the different media (soil, water, and air) [EPA 1992]. Comparison values are specific for the medium contaminated (soil, water, and air, etc.).

The ATSDR has not determined comparison values for irrigation well exposure scenarios. People are exposed to a higher dose in drinking water scenarios compared to irrigation wells scenarios. To be protective of human health, DOH uses drinking water comparison values as screening guidelines when determining chemicals of concern for irrigation well scenarios.

DOH screened the environmental data using the following comparison values:

- ATSDR Cancer Risk Evaluation Guide (CREG). The ATSDR CREGs are media-specific comparison values that are used to identify concentrations of cancer-causing substances that are unlikely to result in a significant increase of cancer rates in an exposed population. The ATSDR develops CREGs using EPA's oral cancer slope factor (CSF) or inhalation unit risk (IUR), a target risk level (10^{-6}), and default exposure assumptions. The target risk level of 10^{-6} represents a calculated risk of 1 excess cancer case in an exposed population of 1 million. At this time, CREGs are available only for adult exposures [ATSDR 2005].
- ATSDR Environmental Media Evaluation Guide (EMEG). The EMEGs represent concentrations of substances in water, soil, and air to which humans may be exposed during a specified period of time (acute, which is for14 days or less; intermediate, which is for 15 to 365 days; or chronic, which is for 365 days or more) without experiencing non-cancerous adverse health effects. The EMEGs have been calculated using Minimal Risk Levels (MRLs) and default exposure assumptions. The default exposure assumptions account for variations in water and soil ingestion between adults and children. An MRL is an estimate of daily human exposure to a substance that is likely to be without non-carcinogenic health effects during a specified duration of exposure based on ATSDR evaluations [ATSDR 2005].
- EPA Lifetime Health Advisory (LTHA). An LTHA is the concentration of a chemical in drinking water that is not expected to cause any adverse noncarcinogenic effects for a lifetime of exposure. The LTHAs serve as guidance to government officials and managers of water systems in protecting public health as needed. However, they are not legally enforceable Federal standards. An LTHA is calculated from an associated Drinking Water Equivalent Level

(DWEL) and includes a drinking water Relative Source Contribution (RSC) factor of contaminant-specific data or a default of 20% of total exposure from all sources. The DWEL is a drinking water lifetime exposure level, assuming 100% exposure from the medium, at which adverse noncarcinogenic health effects would not be anticipated to occur. An LTHA is based on exposure of a 70-kilogram (kg) adult consuming 2 liters of water per day [EPA 2012b].

- Florida DEP and/or EPA Maximum Contaminant Level (MCL). An MCL is the maximum amount of a contaminant permitted in drinking water. An MCL is set as closely to the Maximum Contaminant Level Goal (MCLG) for the chemical as feasible using best available analytical and treatment technologies and considering cost. An MCLG is a non-enforceable goal set at a level at which no known or anticipated adverse human health effects are anticipated. It allows for an adequate margin of safety. The MCLs are legally enforceable standards [EPA 2012b]. Florida DEP lists its MCLs in Chapter 62-550, Florida Administrative Code (F.A.C.). They are either equal to or less than EPA's MCLs.
- EPA Reference Concentration for Chronic Inhalation Exposure (RfC). An estimate of a continuous inhalation exposure to a contaminant that is likely without appreciable risk of harmful effects to the human population (including sensitive subgroups) during a lifetime of exposure. The inhalation RfC considers toxic effects for both the respiratory system (place of entry) and effects external to the respiratory system (extrarespiratory or systemic effects). It can be derived from a No Observed Adverse Effect Level (NOAEL), Lowest Observed Adverse Effect Level (LOAEL), or benchmark concentration, with uncertainty factors generally applied to address limitations of the data used. The EPA includes uncertainties that may span an order of magnitude to ensure that the possibility of health effects is overestimated. The RfC is used in non-cancer health assessments [EPA 2014].
- EPA Regional Screening Level (RSL). A risk-based concentration derived from standard equations that combine exposure information assumptions with EPA toxicity data. A RSL is developed using risk assessment guidance from the EPA Superfund program and may be applied to Superfund sites. Sources of these toxicity values consist of EPA's Integrated Risk Information System (IRIS), Provisional Peer Reviewed Toxicity Values (PPRTVs) identified by EPA's Superfund Health Risk Technical Support Center, ATSDR MRLs, Chronic Reference Exposure Levels (RELs) established by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment, PPRTV appendix screening toxicity values, and EPA Superfund program's Health Effects Assessment Summary Table (HEAST). The RSLs are not cleanup standards and should not be applied as such. DOH applied RSLs for residential air and residential tap waters in its evaluations of the various VOCs measured at and within the vicinity of Continental Cleaners. With regard to cancer risks, RSLs are based on a target risk level of 10^{-6} [EPA 2013]. In evaluating non-cancer risks, DOH uses a Hazard Quotient (HQ) equal to 1 for each contaminant in its screening. The Hazard Quotient is the ratio of potential exposure to a contaminant and the applicable reference dose or the level at which no adverse effects occur.

When it is equal to 1 or less, then no adverse non-cancer health effects are expected from the exposure [CEHT 2005].

When determining which comparison value to use; DOH follows ATSDR's general hierarchy, uses professional judgment, and identifies the lowest value consistent with site conditions. The EPA RSL was used only when no other comparison value was available for a contaminant.

DOH selects for further evaluation those contaminants with maximum concentrations above their comparison values. Comparison values, however, are not thresholds of toxicity. DOH does not use them to predict health effects or establish clean-up levels. A concentration above a comparison value does not necessarily mean harm will occur. It does, however, indicate the need for further evaluation. In addition, when no comparison values are available or laboratory detection limits are above comparison values, DOH evaluates those contaminants with regard to the concentrations identified and whether they are commonly of concern for the type of hazard waste site being evaluated. If a contaminant is present at concentrations above background levels and/or a common concern for that type of hazardous waste site, DOH retains it for analysis of potential health effects.

DOH further evaluates a contaminant that is a known or probable human carcinogen if the concentration is above the laboratory detection limit and exceeds a comparison value for a cancer-causing agent. The DOH quantifies the increased possible cancer risk to an adult with chronic exposure to a contaminant of concern.

After adjusting for less than a lifetime exposure, DOH multiplies the estimated indoor air concentration by the appropriate EPA-established IUR or the measured groundwater concentration by the appropriate EPA-established CSF. DOH estimates the most conservative, health-protective increased cancer risk. However, if there is no potency factor (CSF or IUR) for a chemical, DOH cannot quantify the risk.

The EPA conducted laboratory analyses for numerous VOCs in both the soil gas and groundwater samples that the agency collected at and around Continental Cleaners. These types of chemicals come from natural and human sources, and many are common throughout the environment. Several of them do not have comparison values or their comparison values are below laboratory detection limits.

Seven of the measured chemicals in soil gas do not have adequate toxicology information to establish comparison values. Two of these compounds, heptane and 1,3,5-trimethylbenzene, can be found at dry cleaning sites [SCRD n.d.]. No ATSDR comparison values are available for these chemicals. EPA has RSLs for total petroleum hydrocarbons. Mixtures of "low aliphatic" hydrocarbons such as heptane have an RSL of 600 $\mu g/m^3$, and mixtures of medium aromatic hydrocarbons such as 1,3,5-trimethylbenzene have an RSL of 3 $\mu g/m^3$. The highest concentration of heptane measured was 8.1 $\mu g/m^3$ in off-site soil gas [EPA 2011a]. The highest concentration that

could be measured for 1,3,5-trimethylbenzene was 1.5 $\mu g/m^3$ (estimated). This compound was detected in an on-site sub-slab soil gas sample [EPA 2011a].

A consultant for the New Jersey Department of Environmental Protection (NJDEP) conducted an investigation of sources of VOC contamination in indoor air. The NJDEP consultant found n-heptane in at least 50% of 100 homes sampled. The mean concentration detected in the samples was 4.43 $\mu g/m^3$, and the maximum concentration measured was 49 $\mu g/m^3$ [Weisel 2006]. This compound is frequently found in indoor air because it is present in many commonly used products. Sources of this chemical consist of gasoline, nail polish, petroleum products, and wood office furniture [NJDEP 2013]. Because of the low concentrations detected by the EPA at the Continental Cleaners site, DOH does not consider heptane to be a contaminant of concern.

In his investigation, the NJDEP consultant found 23 out of 100 indoor air samples for 1,3,5-trimethylbenzene to be above the laboratory detection limit. The 90th percentile value equaled 2.63 $\mu g/m^3$, and the maximum value was 11 $\mu g/m^3$ [Weisel 2006]. Common background sources of 1,3,5-trimethylbenzene are gasoline and automobile exhaust [NJDEP 2013]. Because such a low concentration of 1,3,5-trimethylbenzene was detected in only one on-site sub-slab soil, DOH does not consider 1,3,5-trimethylbenzene as a contaminant of concern.

Eighteen of the chemicals measured in soil gas offsite and/or onsite had detection limits above the comparison values. All samples contained the chemicals undetected based on the assigned detection limits. Two of the compounds could potentially be found at dry cleaning sites: carbon tetrachloride and 1,2-dichloroethane [SCRD n.d.]. Detection limits for carbon tetrachloride were 2.6, 2.7, and 26 $\mu g/m^3$ in off-site and on-site samples [EPA 2011a]. At these levels and after attenuation, indoor air concentrations would be less than 0.26, 0.27, and 2.6 $\mu g/m^3$ at the various sample sites. Detection limits for 1,2-dichloroethane were 1.6, 1.7, and 17 $\mu g/m^3$ in off-site and on-site samples. After attenuation potential indoor air concentrations would be less than 0.16, 0.17, and 1.7 $\mu g/m^3$ [EPA 2011a].

The NJDEP reported that various studies indicate a median background level of approximately 0.6 $\mu g/m^3$ of carbon tetrachloride in indoor air [NJDEP 2013]. The EPA compiled information on expected ranges and variability of background VOC concentrations in indoor air from 15 studies conducted between 1990 and 2005. The federal agency found that carbon tetrachloride is one of the most commonly detected VOCs in indoor air due to background sources [EPA 2011b]. Based on this information and the low concentrations of carbon tetrachloride that may be measured at decreased detection levels, DOH does not consider carbon tetrachloride to be a contaminant of concern at the Continental Cleaners site.

The compound 1,2-dichloroethane is commonly found in polyresin decorations. In an industrial facility in Colorado, elevated levels of the VOC were linked to polyvinyl chloride and vinyl composite floor adhesive that were used in a building remodel [Kurtz et al. 2010]. The NJDEP determined the median background level for the contaminant in

homes is 0.1 µg/m^3 [NJDEP 2013]. The agency's consultant found a maximum concentration of 3.5 µg/m^3 in 100 indoor air samples surveyed [Weisel 2006]. Because 1,2-dichloroethane would occur at concentrations close to background if detected in indoor air around the Continental Cleaners site, DOH does not consider it a contaminant of concern.

For further evaluation of potential non-cancerous health effects, DOH identified PCE and TCE as contaminants of concern in both on-site and off-site soil gas (Tables 1 and 3).

For further evaluation of potential cancerous health effects; DOH identified benzene, chloroform, PCE, and TCE as contaminants of concern in both on-site and off-site soil gas (Tables 1 and 3). The DOH found vinyl chloride and 1,4-dioxane are also possible carcinogenic contaminants of concern in on-site soil gas (Table 1). Lastly, DOH determined that 1,3-butadiene is a potential carcinogenic contaminant of concern in off-site soil gas (Table 3).

The DOH also looked at contaminant concentrations in groundwater from the irrigation well IW01, approximately 50 feet south of the site (Table 5). The EPA did not analyze for 1,3-butadiene or 1,4-dioxane in the groundwater sample as it did in the soil gas samples [EPA 2011a]. All other contaminants were either undetected in laboratory analyses or measured below comparison values. Five of the chemicals do not have adequate toxicology information, and, therefore, do not have any comparison values. However, none of these chemicals are common at dry cleaning sites [SCRD n.d.]. In addition, four of the chemicals measured in the irrigation well had detection limits above their CREG values. Only one contaminant, 1,2-dichloroethane, is commonly seen at dry cleaning sites [SCRD n.d.]. The VOC 1,2-dichloroethane was measured at less than the detection limit of 0.50 µg/L in the well [EPA 2011a]. The CREG equals 0.38 µg/L for the compound. The exact concentration was not identified. However, it is close to or below the comparison value. Thus, in the evaluation of non-cancerous and cancerous health effects, DOH did not identify any contaminants of concern in the groundwater sample from the one irrigation well.

A chemical identified as a contaminant of concern does not necessarily mean that exposure to it will result in illness. To be protective of health, comparison values are set well below levels that are actually associated with illness. Identification of contaminants of concern enables DOH to narrow the focus of the public health assessment to those chemicals requiring further evaluation for potential public health risk.

Pathway Analyses

Chemical contamination in the environment can harm your health but only if you have contact with those contaminants (exposure). Without contact or exposure, there is no harm to health. If there is contact or exposure, how much of the contaminants you contact (concentration), how often you contact them (frequency), for how long you contact them (duration), and the danger of the contaminant (toxicity) all determine the risk of harm.

Knowing or estimating the frequency with which people could have contact with hazardous substances is essential to assessing the public health importance of these contaminants. To decide if people can contact contaminants at or near a site, DOH looks at human exposure pathways. Exposure pathways have five parts. They are:

1. a source of contamination like a hazardous waste site,
2. an environmental medium like air, water, or soil that can hold or move the contamination,
3. a point where people come into contact with a contaminated medium like water at the tap or soil in the yard,
4. an exposure route like ingesting (contaminated soil or water) or breathing (contaminated air),
5. a population who could be exposed to contamination like nearby residents.

DOH eliminates an exposure pathway if at least one of the five parts referenced above is missing and will not occur in the future. Exposure pathways not eliminated are either completed or potential. For completed pathways, all five pathway parts exist and exposure to a contaminant has occurred, is occurring, or will occur. For potential pathways, at least one of the five parts is missing, but could exist. Also for potential pathways, exposure to a contaminant could have occurred, could be occurring, or could occur in the future.

Completed Exposure Pathway

For this assessment, DOH evaluates the possible long-term health threat from exposure via nearby irrigation wells (Table 6). For this completed pathway, Continental Cleaners is the source. Groundwater is the environmental medium. Landscape areas being watered by the irrigation wells are the exposure points. Incidental ingestion of the water and breathing vapors while irrigation is occurring are the exposure routes. Exposure scenarios include children playing in water sprinklers and adults gardening or working in the yard.

For this exposure pathway, DOH evaluated data collected by EPA from a single irrigation well south of the site. For the initial screening, DOH examined the ingestion of potentially contaminated groundwater because it is one of the most significant exposure pathways at a site [ATSDR 2005]. Evaluation of the irrigation well as if it is a drinking water well is an extremely conservative approach to estimating health risks. Thus, the actual health risks are likely much lower.

Potential Exposure Pathways

For this assessment DOH evaluates the possible long-term health threat from two potential exposure pathways: on- and off-site vapor intrusion from contaminated groundwater (Table 7). For the potential vapor intrusion pathway, Continental Cleaners is the source. Chlorinated solvents (like PCE) and their breakdown products move vertically down to the groundwater table, where groundwater transports them horizontally. Some of the groundwater contaminants may evaporate as vapors (the environmental medium) and

possibly travel upward into buildings, making indoor air the possible point of human exposure. Breathing the air inside these buildings would be the exposure route. Workers at Continental Cleaners and nearby residents are the potentially exposed populations.

Eliminated Exposure Pathways

DOH concludes that contact with on-site soil by community members is an eliminated exposure pathway (Table 8). There is no evidence of a completed exposure pathway to surface or subsurface soil at the site. A cement parking lot covers most of the front of the site and a chain link fence encloses the back of the site. Therefore, as long as the fencing and parking lot cover are maintained, soil is not an exposure pathway.

Drinking and showering with water from nearby private or municipal wells are also eliminated exposure pathways (Table 8). There are no known private or municipal drinking water wells within less than 2 miles of the Continental Cleaners site. Residents in this area get their drinking water from a municipal water supply.

Public Health Implications

DOH provides site-specific public health recommendations on the basis of toxicological literature, levels of environmental contaminants, evaluation of potential exposure pathways, duration of exposure, and characteristics of the exposed population. Whether a person will be harmed depends on the type/amount of contaminant, how they are exposed, how long they are exposed, how much contaminant is absorbed, genetics, and individual lifestyles.

After identifying contaminants of concern (COC), DOH evaluates exposures by estimating daily doses for children and adults. Toxicology uses dose to compare toxicity of different chemicals in different animals. DOH uses the units of milligrams (mg) of contaminant per kilogram (kg) of body weight per day (mg/kg/day) to express doses in this assessment. A milligram is 1/1,000 of a gram; a kilogram is approximately 2 pounds.

When evaluating potential exposure to an atmospheric gas, estimation of an inhaled dose is generally not necessary. Toxicological literature reports doses as concentrations that can be directly compared to concentrations measured at a site [ATSDR 2005]. In assessing health effects to workers, DOH adjusted the estimated indoor air concentration of each contaminant onsite. Adjustments were made based on exposure time and compared to the soil screening value (Table 1). The exposure period for a worker is typically less than a resident.

In addition, DOH estimates increased cancer risk for adults for chronic exposure to each contaminant of concern that is a known or probable human carcinogen and exceeds a comparison value for a cancer-causing agent. The DOH quantifies the increased possible risk by multiplying the estimated indoor air concentration by the appropriate EPA-established IUR and groundwater concentration by the appropriate EPA-established CSF.

DOH estimates the most conservative, health protective increased cancer risk. The actual increased cancer risk is likely lower. Because of large uncertainties in the way scientists estimate cancer risks, the actual increased risk of cancer may be as low as zero. If there is no potency factor for a contaminant in the air or groundwater (IUR or CSF), DOH cannot quantify the risk.

On-Site Soil Gas

DOH evaluated on-site soil gas concentrations using screening levels calculated from non-cancer and cancer air comparison values (CVs) and EPA's upper level attenuation factor recommended for screening of workers from exposure onsite to contaminants of concern in the air. DOH specifically examined concentrations in the three soil gas samples that were taken from just below the slab of the Continental Cleaners building. DOH calculated soil gas screening levels using ATSDR's air CVs and EPA's attenuation factor recommended for screening [EPA 2012a].One soil gas sample (CCV101 – Figure 3) was not analyzed for chloroform, 1,3-butadiene or 1,4-dioxane. This accounts for the differences in the total number of samples listed in Tables 1 and 2. Soil gas screening level = air CV/ attenuation factor of 0.1. Maximum soil gas concentrations were adjusted for worker exposure by multiplying the concentration by (250/365 days per year) x (12/24 hours/day) then compared to the soil gas screening level [EPA 1991, 2011].

Benzene

Benzene comes from both industrial and natural sources. It is a colorless liquid with a sweet odor. Benzene is present in crude oil, diesel, gasoline, and cigarette smoke. Benzene has also been used in some commercial cleaners [ATSDR 2007].

The maximum on-site sub-slab soil gas concentration for benzene was an estimated 2.8 $\mu g/m^3$ and the maximum sub-slab soil gas concentration adjusted for worker exposure was an estimated 0.96 $\mu g/m^3$ (Table 1). The adjusted concentrations did not exceeded the soil gas screening level of 1.3 $\mu g/m^3$ for benzene in any of the 3 sub-slab samples (Table 2). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of benzene. Assessment of health risks is based on indoor air exposure. Soil gas measurements only provide an indication of the potential for migration of subsurface vapors migrating into indoor air.

Chloroform

Most of the chloroform found in the environment comes from industry. It is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. Chloroform has been used in the past as an anesthetic and today is used primarily to make other chemicals [ATSDR 1997a].

The maximum on-site sub-slab soil gas concentration for chloroform was 69 μg/m^3 and the maximum sub-slab soil gas concentration adjusted for worker exposure was 23.6 μg/m^3 (Table 1). The adjusted concentrations exceeded the soil gas screening level of 0.43 μg/m^3 for chloroform in 2 of 2 sub-slab samples (Table 2). The soil gas sample from CCV101 was not analyzed for chloroform. Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of chloroform. Assessment of health risks is based on indoor air exposure. Soil gas measurements only provide an indication of the potential for migration of subsurface vapors migrating into indoor air.

Tetrachloroethylene (PCE)

PCE is a man-made chemical widely used in dry cleaning operations. It is a colorless liquid with a sharp, sweet odor. PCE is also used in metal-degreasing operations [ATSDR 1997b].

The maximum on-site sub-slab soil gas concentration for PCE was 62,000 μg/m^3 and the maximum sub-slab soil gas concentration adjusted for worker exposure was 21,204 μg/m^3 (Table 1). The adjusted concentrations exceeded the soil gas screening level of 38 μg/m^3 for PCE in 3 of 3 sub-slab samples (Table 2). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of PCE. Assessment of health risks is based on indoor air exposure. Soil gas measurements only provide an indication of the potential for migration of subsurface vapors migrating into indoor air.

Trichloroethylene (TCE)

TCE is a man-made chemical mostly used as a solvent to remove grease from metal parts. It is a colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is sometimes found in correction fluid, paint removers, adhesives, and spot removers. It is also one of the chemicals produced when PCE chemically breaks down [ATSDR 1997c].

The maximum on-site sub-slab soil gas concentration for TCE was 560 μg/m^3 and the maximum sub-slab soil gas concentration adjusted for worker exposure was 191.52 μg/m^3 (Table 1). The adjusted concentrations exceeded the soil gas screening level of 2.4 μg/m^3 for TCE in 3 of 3 sub-slab samples (Table 2). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of TCE. Assessment of health risks is based on indoor air exposure. Soil gas measurements only provide an indication of the potential for migration of subsurface vapors migrating into indoor air.

Vinyl Chloride

Vinyl chloride is a man-made chemical that does not occur naturally. At room temperature, it is a colorless gas, with a mild sweet odor. It is used primarily in the manufacture of polyvinyl chloride (PVC). It is also one of the chemicals produced when PCE and other chlorinated chemicals breaks down [ATSDR 2006].

The maximum on-site sub-slab soil gas concentration for vinyl chloride was an estimated 1.5 μg/m^3 and the maximum sub-slab soil gas concentration adjusted for worker exposure was an estimated 0.513 μg/m^3 (Table 1). The adjusted concentrations exceeded the soil gas screening level of 1.1μg/m^3 for vinyl chloride in 0 of 3 sub-slab samples (Table 2). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of vinyl chloride. Assessment of health risks is based on indoor air exposure. Soil gas measurements only provide an indication of the potential for migration of subsurface vapors migrating into indoor air.

Off-Site Soil Gas (5-6 feet deep)

DOH evaluated off-site soil gas concentrations using screening levels calculated from non-cancer and cancer air CVs and EPA's upper level attenuation factor recommended for screening of individuals from exposure off-site to contaminants of concern in the air. DOH examined concentrations in the nine soil gas samples and one sub-slab sample taken from properties near the Continental Cleaners building (Figure 3). DOH calculated soil gas screening levels using ATSDR's air CVs and EPA's attenuation factor recommended for screening [EPA 2012a]. Soil gas screening level = air CV/ attenuation factor of 0.1. Off-site soil gas data was collected from a depth of 5 to 6 feet bgs.

Benzene

Benzene comes from both industrial and natural sources. It is a colorless liquid with a sweet odor. Benzene is present in crude oil, diesel, gasoline, and cigarette smoke. Benzene has also been used in some commercial cleaners [ATSDR 2007].

The maximum off-site soil gas concentration for benzene was 3.4 μg/m^3 (Table 3). The soil gas concentrations exceeded the screening level of 1.3 μg/m^3 for benzene in 2 of 10 samples (Table 4). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of benzene.

1,3-Butadiene

1,3-Butadiene is a chemical made from the processing of petroleum. It is a colorless gas with a mild gasoline-like odor. About 60% of the manufactured 1,3-butadiene is used to make synthetic rubber. Synthetic rubber is widely used for tires on cars and trucks. The Department of Health and Human Services (DHHS), the International Agency for Research on Cancer (IARC), and the EPA have determined that 1,3-butadiene is a human carcinogen. Studies have shown that workers exposed to 1,3-butadiene may have an increased risk of cancers of the blood and lymphatic system.

The maximum off-site soil gas concentration for 1,3-butadiene was an estimated 1.3 μg/m^3 (Table 3). The concentrations exceeded the soil gas screening level of 0.33 μg/m^3 for 1,3-butadiene in 2 of 9 soil gas samples (Table 4). The soil gas sample from CCV102 was not analyzed for 1,3-butadiene. Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of 1,3-butadiene.

Chloroform

Most of the chloroform found in the environment comes from industry. It is a colorless liquid with a pleasant, nonirritating odor and a slightly sweet taste. Chloroform has been used in the past as an anesthetic and today is used primarily to make other chemicals [ATSDR 1997a].

The maximum off-site soil gas concentration for chloroform was 4.5 $\mu g/m^3$ (Table 3). The soil gas concentrations exceeded the screening level of 0.43 $\mu g/m^3$ for chloroform in 7 of 9 samples (Table 4). The soil gas sample from CCV102 was not analyzed for chloroform. Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of chloroform.

Tetrachloroethylene (PCE)

PCE is a man-made chemical widely used in dry cleaning operations. It is a colorless liquid with a sharp, sweet odor. PCE is also used in metal-degreasing operations [ATSDR 1997b].

The maximum off-site soil gas concentration for PCE was 2,800 $\mu g/m^3$ (Table 3). The soil gas concentrations exceeded the screening level of 38 $\mu g/m^3$ for PCE in 4 of 10 samples (Table 4). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of PCE.

Trichloroethylene (TCE)

TCE is a man-made chemical mostly used as a solvent to remove grease from metal parts. It is a colorless liquid with a somewhat sweet odor and a sweet, burning taste. It is sometimes found in correction fluid, paint removers, adhesives, and spot removers. It is also one of the chemicals produced when PCE chemically breaks down [ATSDR 1997c].

The maximum off-site soil gas concentration for TCE was 31$\mu g/m^3$ (Table 3). The soil gas concentrations exceeded the screening level of 2.4 $\mu g/m^3$ for TCE in 1 of 10 samples (Table 4). Soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure of TCE.

Off-Site Irrigation Well (groundwater)

Few contaminates were detected in the off-site irrigation well just south of the site. With the exception of PCE, all contaminants that measured above detection levels were below their respective EPA maximum contaminant level (MCL) for groundwater. PCE was detected above the MCL of 5 $\mu g/L$ at 8.1 $\mu g/L$.

DOH considers drinking water guidelines protective of human health for risks associated with irrigation wells. Therefore, residents exposed to contaminants in the one off-site irrigation well that EPA sampled are not likely to experience non-cancer or cancer related illnesses as a result of watering lawns or gardens. Residents should not drink from irrigation wells and should not use the irrigation well water to clean fish or food preparation surfaces.

Mixtures

Because people are often exposed to several chemicals at the same time, health scientists are often asked to evaluate exposure to a mixture of chemicals. Certain chemical mixtures exhibit additive toxicity when the individual chemicals are administered at doses that are near the individual toxic thresholds.

For the irrigation well and off-site vapor intrusion pathway, contaminants are below levels expected to have significant additive or toxic interactions.

DOH evaluated on-site soil gas concentrations using screening levels calculated from non-cancer and cancer air comparison values (CVs) and EPA's upper level attenuation factor recommended for screening of workers from exposure onsite to contaminants of concern in the air. DOH specifically examined concentrations in the three soil gas samples that were taken from just below the slab of the Continental Cleaners building. DOH calculated soil gas screening levels using ATSDR's air CVs and EPA's attenuation factor recommended for screening [EPA 2012a]. PCE and TCE would appear to be the most problematic of the COCs above the soil gas screening levels. However, soil gas samples alone do not allow for an assessment of health risks due to indoor air exposure.

Health Outcome Data

DOH epidemiologists did not evaluate area cancer rates. Although, numerous on-site soil gas results exceeded soil screening levels, the business where exposure could occur is currently closed. Because the exposed population is relatively small, it is statistically unlikely that exposure to contaminant vapors in the air at this site would result in an observable case of cancer.

Conclusions

1. DOH concludes that soil gas measurements indicate the potential for vapor intrusion could expose future workers at this site. However, no indoor air data is available to evaluate the level of potential exposure.
2. DOH concludes that existing data does not provide for a thorough evaluation of indoor air exposure in off-site residential buildings.

3. DOH concludes that accidentally swallowing, touching, and/or breathing vapors from contaminants in the water from irrigation wells near the site are not expected to harm people's health.
4. DOH concludes that people are not likely to be exposed to contaminants in on-site soils or off-site private well water. If contact occurs, the contaminants are not likely to harm people.

Recommendations

1. DOH recommends that people not use the on-site building until the vapor intrusion risk has been fully assessed and mitigated or until the on-site soil and groundwater has been remediated.

2. DOH recommends that EPA continue to delineate the groundwater contamination to the north and east of the site.

Actions Planned

The DOH will work with the DOH in Miami-Dade County to inform nearby residents of their evaluation of data from the Continental Cleaners site. The DOH will evaluate new information and conduct additional assessments as needed.

DOH will solicit public comment on this report and will address any comments and health concerns in the final report.

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Appendix A

Tables and Figures

Table 1. Maximum Contaminant Concentrations Measured in On-Site Sub-slab Soil Gas

Contaminant	Maximum Concentration in Sub-slab Soil Gas ($\mu g/m^3$)[a,b,c,d]	Soil Gas Adjusted for Worker Exposure ($\mu g/m^3$)[a,e]	Air Comparison Value ($\mu g/m^3$)[a,f]	Soil Gas Screening Level ($\mu g/m^3$)[h]	Source of Comparison Value[f,g]	# of Samples above Comparison Value/ Total # Samples[i]
Benzene	2.8 J	0.96 J	0.13	1.3	CREG	0/3
1,3-Butadiene	19 U	---	0.033	0.33	CREG	0/2
Chloroform	69	23.6	0.043	0.43	CREG	2/2
1,4-Dioxane	5.2 J	1.8 J	0.49	4.9	Carcinogenic RSL	1/2
Tetrachloroethylene	62,000	21,204	3.8	38	CREG	3/3
Trichloroethylene	560	191.52	0.24	2.4	CREG	3/3
Vinyl Chloride	1.5 J	.513 J	0.11	1.1	CREG	2/3

(a) $\mu g/m^3$ = micrograms per cubic meter
(b) Source of data: [Waller 2014]
(c) J qualifier indicates the chemical was identified and its reported value is an estimate
(d) U qualifier indicates the chemical was analyzed for but not detected; the value reported is the minimum detection limit
(e) — indicates an indoor air concentration was not calculated because chemical was not detected in soil gas
(f) Comparison value only used as a guideline for selecting chemicals for further scrutiny and not to judge the risk of illness
(g) Comparison values are as follows:
CREG = Cancer Risk Evaluation Guide; contaminant concentration estimated to result in no more than 1 excess cancer case in a population of 1 million (10^{-6}) adults exposed during their lifetime; developed by Agency for Toxic Substances and Disease Registry (ATSDR)
RSL = Regional Screening Level; a risk-based concentration derived from standard equations that combine exposure information assumptions with EPA toxicity data; carcinogenic and non-carcinogenic values developed by EPA are based on 10^{-6} cancer risk.
(h) Soil gas screening levels calculated using ATSDR's air comparison values and EPA's attenuation factor recommended for screening. Soil gas screening level = air comparison value / attenuation factor
(i) One soil gas sample (CCV101 – Figure 3) was not analyzed for chloroform, 1,3-butadiene or 1,4-dioxane. This accounts for the differences in the total number of samples listed.

Table 2. Contaminant Concentrations Measured in On-Site Soil Gas

Contaminant	CC05		CC12(s)		CC13 (s)		CCV101(s)		Soil Gas Screening Level (µg/m³)	# of Samples Above Screening Value/Total # of Samples(1)
	Soil Gas (µg/m³)	Soil Gas Adjusted for Worker Exposure (µg/m³)	Soil Gas (µg/m³)	Soil Gas Adjusted for Worker Exposure (µg/m³)	Soil Gas (µg/m³)	Soil Gas Adjusted for Worker Exposure (µg/m³)	Soil Gas (µg/m³)	Soil Gas Adjusted for Worker Exposure (µg/m³)		
Benzene	3.7	1.2654	2.8 J	0.96 J	2.2	0.7524	200 U	--	1.3	0/4
1,3-Butadiene	ND	--	ND	--	ND	--	NA	--	0.33	0/3
Chloroform	220	75.24	69	23.598	37	12.654	NA	--	0.43	3/3
1,4-Dioxane	ND	--	ND	--	5.2	1.7784	NA	--	4.9	0/3
Tetrachloroethylene	8,000	2,736	62,000	21,204	35,000	11,970	28,000	9,576	38	4/4
Trichloroethylene	1,000	342	560	191.52	390	133.38	200 U	--	2.4	3/4
Vinyl Chloride	ND	--	1.5	0.513	1.5	0.513	200 U	--	1.1	2/4

Source of data: [Waller 2014]

µg/m³ = micrograms per cubic meter
J qualifier indicates the chemical was identified and its reported value is an estimate
U qualifier indicates the chemical was analyzed for but not detected; the value reported is the minimum detection limit
-- indicates an indoor air concentration was not calculated because chemical was not detected in soil gas
(s) Sub-slab soil gas sample location
(1) One soil gas sample (CCV101 – Figure 3) was not analyzed for chloroform, 1,3-butadieneor 1,4-dioxane. This accounts for the differences in the total number of samples listed.

Table 3. Maximum Contaminant Concentrations in Off-Site Soil Gas

Contaminant	Maximum Concentration in Exterior Soil Gas ($\mu g/m^3$)[a,b,c,d]	Air Comparison Value ($\mu g/m^3$)[a,e]	Soil Gas Screening Level ($\mu g/m^3$)[g]	Source of Comparison Value[e,f]	Total # of Samples above Screening Value/ Total # Samples[h]
Benzene	3.4	0.13	1.3	CREG	2/10
1,3-Butadiene	1.3 J	0.033	0.33	CREG	2/9
Chloroform	4.5	0.043	0.43	CREG	7/9
1,4-Dioxane	39 U	0.49	4.9	Carcinogenic RSL	0/9
Tetrachloroethylene	3,100	3.8	38	CREG	4/10
Trichloroethylene	31	0.24	2.4	CREG	1/10
Vinyl Chloride	11 U	0.11	1.1	CREG	0/10

(a) $\mu g/m^3$ = micrograms per cubic meter
(b) Source of data: [Waller 2014]
(c) J qualifier indicates the chemical was identified and its reported value is an estimate
(d) U qualifier indicates the chemical was analyzed for but not detected; the value reported is the minimum detection limit
(e) Comparison value only used as a guideline for selecting chemicals for further scrutiny and not to judge the risk of illness
(f) Comparison values are as follows:
CREG = Cancer Risk Evaluation Guide; contaminant concentration estimated to result in no more than 1 excess cancer case in a population of 1 million (10^{-6}) adults exposed during their lifetime; developed by Agency for Toxic Substances and Disease Registry (ATSDR)
RSL = Regional Screening Level; a risk-based concentration derived from standard equations that combine exposure information assumptions with EPA toxicity data; carcinogenic and non-carcinogenic values developed by EPA are based on 10^{-6} cancer risk.
(g) Soil gas screening levels calculated using ATSDR's air comparison values and EPA's attenuation factor recommended for screening. Soil gas screening level = air comparison value / attenuation factor
(h) One soil gas sample (CCV101 – Figure 3) was not analyzed for chloroform, 1,3-butadieneor 1,4-dioxane. This accounts for the differences in the total number of samples listed.

Table 4. Contaminant Concentrations Measured in Off-Site Soil Gas

Sample Location	CC01	CC02	CC03	CC04	CC06	CC07	CC09	CC10	CC11	CCV102(s)	Soil Screening Level
Contaminant	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	**Soil Gas Result (µg/m3)**	
Benzene	3	3.4	0.64 J	0.24 J	1.1 J	0.35 J	0.23 J	0.51 J	0.27 J	0.2 U	1.3
1,3-Butadiene	1.3 J	1.1 J	--	--	--	--	--	--	--	NA	0.33
Chloroform	0.39 J	1.6 J	0.74	1.7 J	--	4.5	2.0	3.3	0.53 J	NA	0.43
1,4-Dioxane	--	--	--	--	--	--	--	--	--	NA	4.9
Tetrachloroethylene	1.6 J	9.5	--	--	3,100	430	100	76	1.4 J	28	38
Trichloroethylene	--	--	--	--	31	1.2 J	--	--	--	0.2 U	2.4
Vinyl Chloride	--	--	--	--	--	--	--	--	--	0.2 U	1.1

Source of data: [Waller 2014]

µg/m^3 = micrograms per cubic meter
J qualifier indicates the chemical was identified and its reported value is an estimate
U qualifier indicates the chemical was analyzed for but not detected; the value reported is the minimum detection limit
-- indicates an indoor air concentration was not calculated because chemical was not detected in soil gas
(s) Sub-slab soil gas sample location

Table 5. Maximum Contaminant Concentrations in Off-Site Irrigation Well IW01[1]

Contaminant	Maximum Concentration in Groundwater (µg/L)[a,b,c,d,e]	CREG Groundwater Comparison Value[a,f,g,h] (µg/L)	MCL Groundwater Comparison Value[a,f,g,h] (µg/L)	LTHA Groundwater Comparison Value[a,f,g,h] (µg/L)	# of Samples above Comparison Value/ Total # Samples[d,g]
Benzene	0.50 U	0.64	1		0/2
1,3-Butadiene	*	---	---	---	---
Chloroform	0.52 J			70	0/2
1,4-Dioxane	*	0.34		200	--
Tetrachloroethylene	8.1	17	3		1/2
Trichloroethylene	0.50 U	0.76	3		0/2
Vinyl Chloride	0.50 U	0.025	1		0/2

(1) Irrigation well IW01 is located at the Epiphany Apartments approximately 50 feet south of the site
(a) µg/L = micrograms per liter
(b) Source of data: [EPA 2011] US Environmental Protection Agency. 2011. Report on Continental Cleaners Soil Gas and Groundwater Study, Miami, Miami-Dade County, Florida, May 24-26, 2011. Atlanta: US Environmental Protection Agency, Region 4, Science and Ecosystem Support Division
(c) U qualifier indicates the chemical was analyzed for but not detected; the value reported is the minimum detection limit
(d) * indicates chemical was not analyzed for in groundwater
(e) J qualifier indicates the chemical was identified and its reported value is an estimate
(f) Comparison value only used as a guideline for selecting chemicals for further scrutiny and not to judge the risk of illness
(g) --- indicates no drinking water comparison value is established for that chemical
(h) Comparison values are as follows:

CREG = Cancer Risk Evaluation Guide; contaminant concentration estimated to result in no more than 1 excess cancer case in a population of 1 million (10^{-6}) adults exposed during their lifetime; developed by Agency for Toxic Substances and Disease Registry (ATSDR)

LTHA = Lifetime Health Advisory; concentration in drinking water that is not expected to result in any adverse non-carcinogenic health effects for a lifetime of exposure; developed by United States Environmental Protection Agency (EPA)

MCL = Maximum Contaminant Level; legally enforceable standard that is a threshold limit on the amount of a contaminant allowed in public drinking water systems; developed by EPA or Florida Department of Environmental Protection (DEP)

Table 6. Completed Human Exposure Pathway at the Continental Cleaners Site

Completed Pathway Name	Completed Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	
Irrigation wells	Dry cleaner solvents from Continental Cleaners	Groundwater	Nearby lawns and gardens watered from irrigation wells	Incidental ingestion of water and inhalation of vapors	Irrigation well users	Past, present, and future

Table 7. Potential Human Exposure Pathways at the Continental Cleaners Site

Potential Pathway Name	Potential Exposure Pathway Elements					Time
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population	
Vapor intrusion from ground water into air of on-site facility	Dry cleaner solvents from Continental Cleaners	Indoor air	Indoor air of on-site facility	Inhalation	4 on-site workers	Past and future
Off-site residential vapor intrusion from groundwater	Dry cleaner solvents from Continental Cleaners	Indoor air	Indoor air of nearby homes and businesses	Inhalation	Unknown number of nearby residents	Past, present, and future

Table 8. Eliminated Human Exposure Pathways at the Continental Cleaners Site

Eliminated Pathway Name	Eliminated Exposure Pathway Elements				
	Source	Environmental Media	Point of Exposure	Route of Exposure	Exposed Population
Incidental ingestion (swallowing) of on-site soil	Dry cleaner solvents from Continental Cleaners	Soil	None	Ingestion	None
Drinking private well water	Dry cleaner solvents from Continental Cleaners	Groundwater	None	Ingestion	None
Showering with private well water	Dry cleaner solvents from Continental Cleaners	Groundwater	None	Inhalation	None

Figure 1. Location of Continental Cleaners Site in Miami-Dade County, Florida

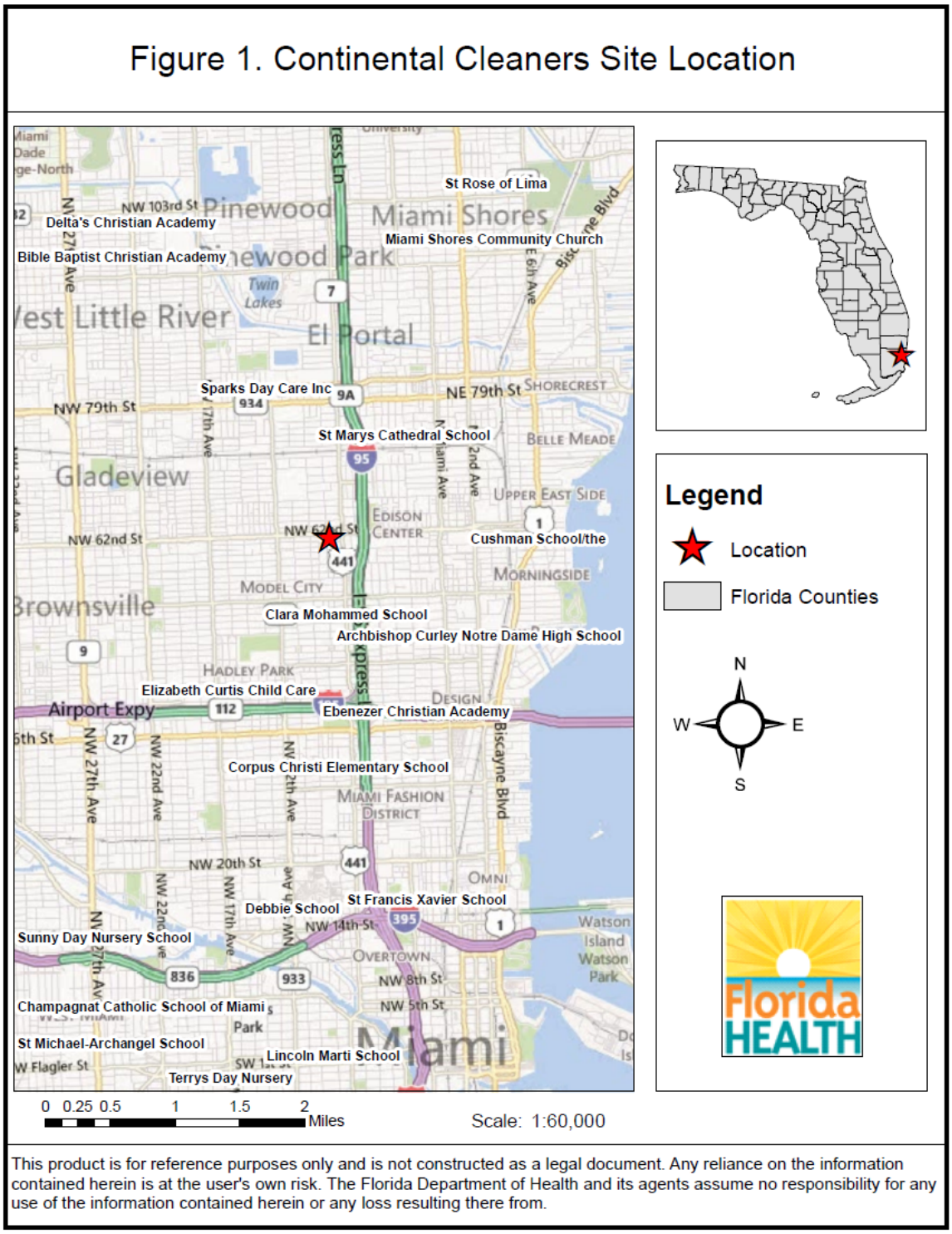


Figure 2. Continental Cleaners Property Boundaries

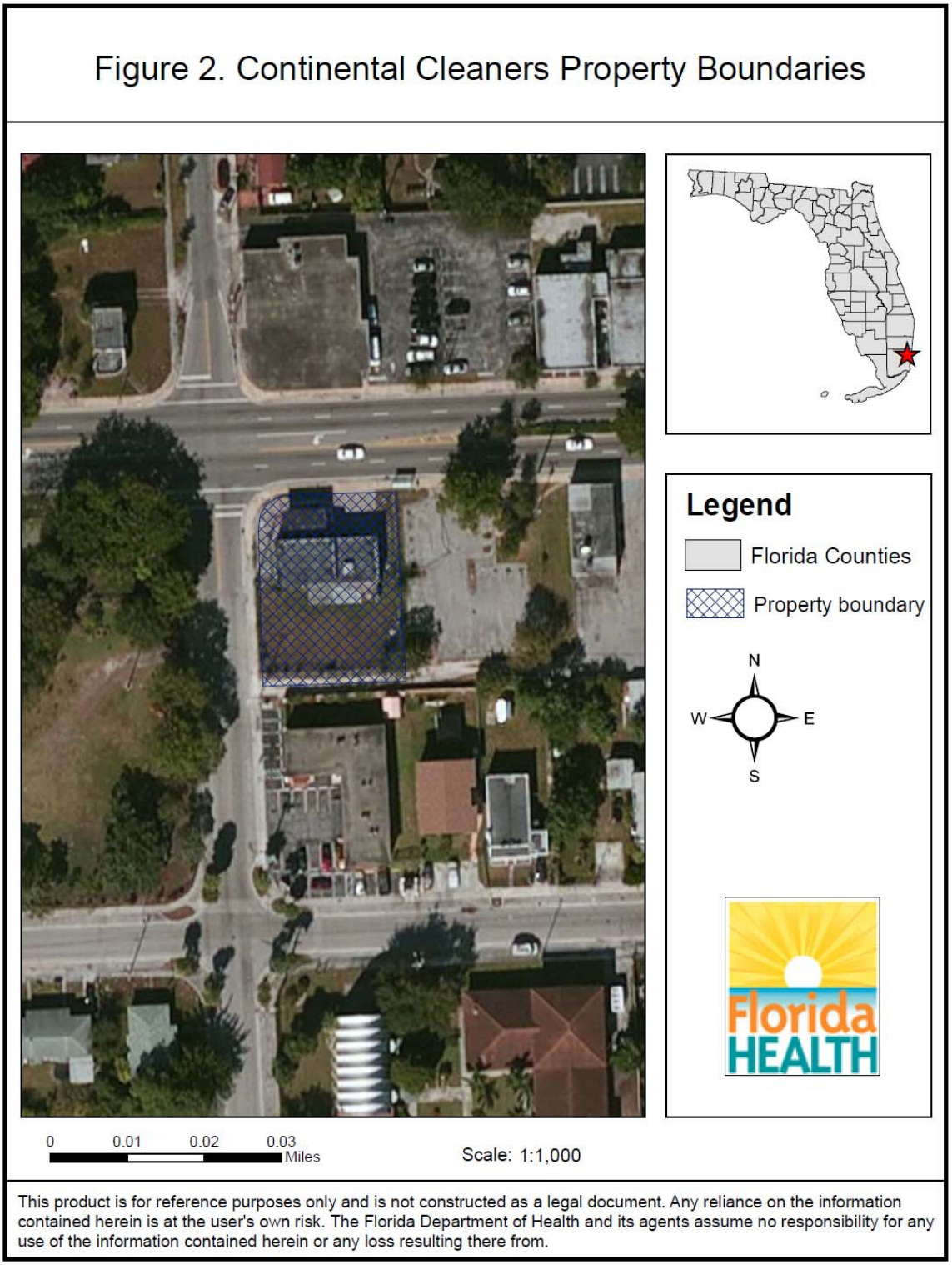


Figure 3. Continental Cleaners Soil Vapor Sample Locations

Figure 3a. Union Hall Soil Vapor Sample Locations

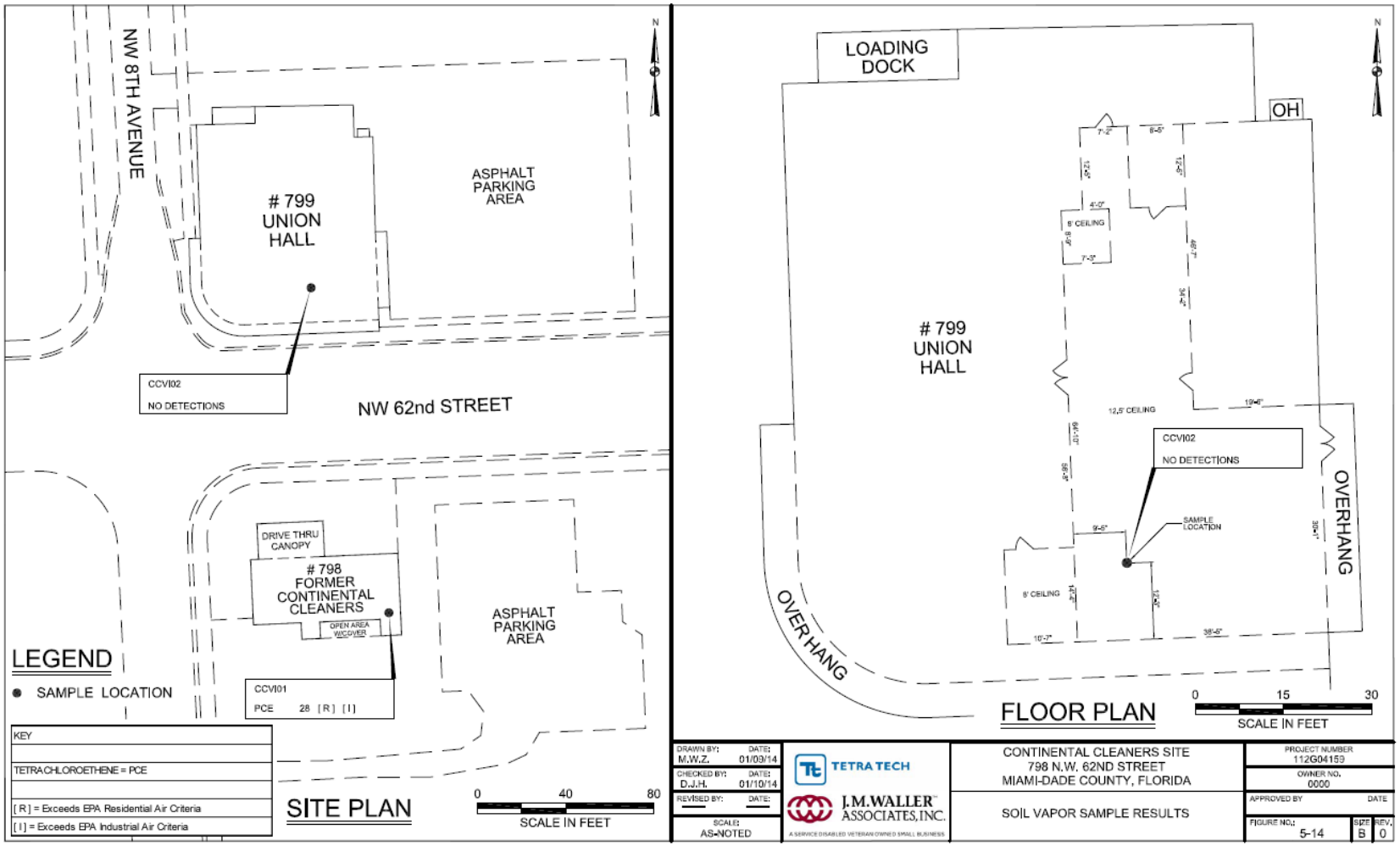
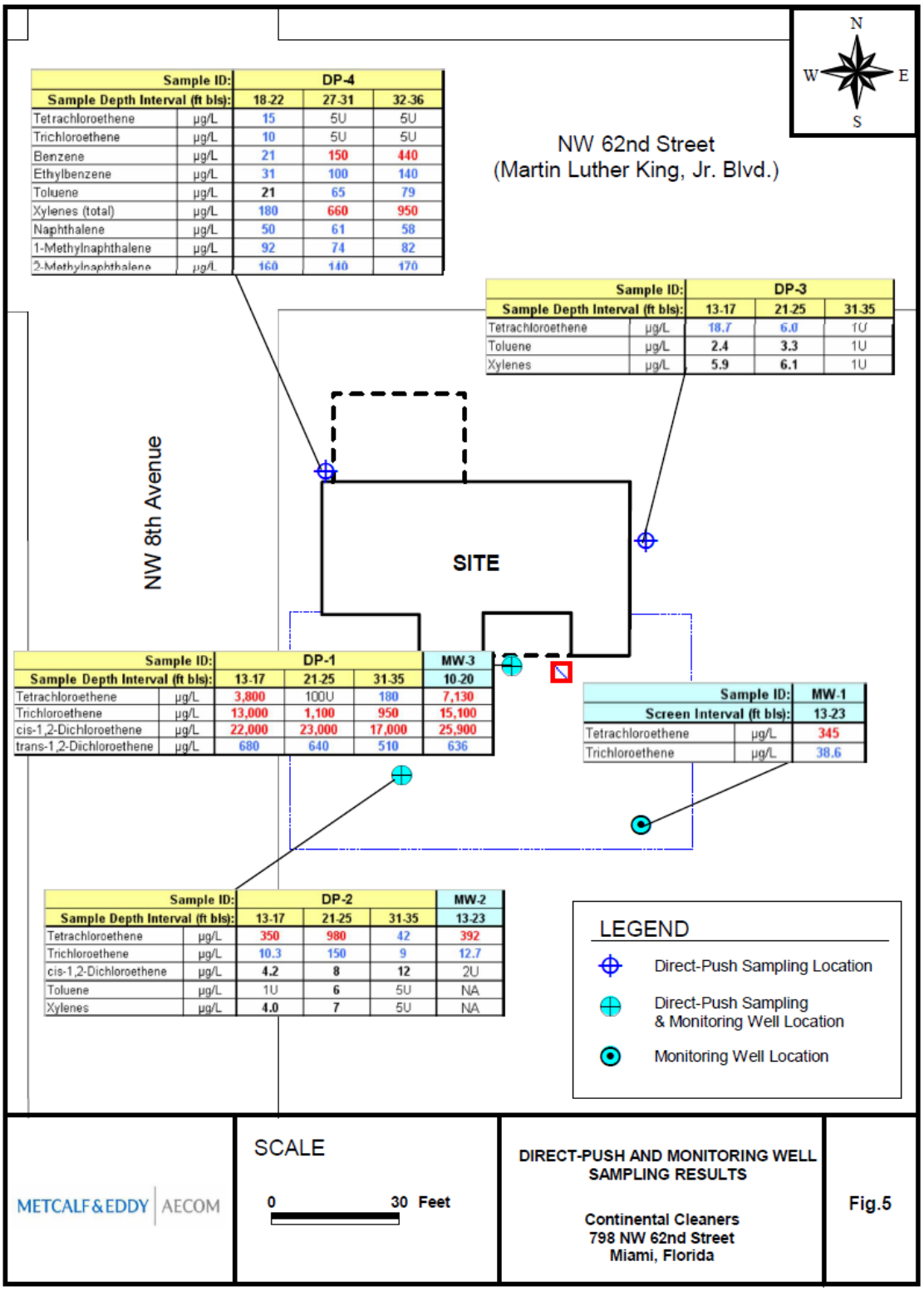


Figure 4. Map and Results of Groundwater Sampling



Sample ID:		DP-4		
Sample Depth Interval (ft bls):		18-22	27-31	32-36
Tetrachloroethene	µg/L	15	5U	5U
Trichloroethene	µg/L	10	5U	5U
Benzene	µg/L	21	150	440
Ethylbenzene	µg/L	31	100	140
Toluene	µg/L	21	65	79
Xylenes (total)	µg/L	180	660	950
Naphthalene	µg/L	50	61	58
1-Methylnaphthalene	µg/L	92	74	82
2-Methylnaphthalene	µg/L	160	140	170

Sample ID:		DP-3		
Sample Depth Interval (ft bls):		13-17	21-25	31-35
Tetrachloroethene	µg/L	18.7	6.0	1U
Toluene	µg/L	2.4	3.3	1U
Xylenes	µg/L	5.9	6.1	1U

Sample ID:		DP-1			MW-3
Sample Depth Interval (ft bls):		13-17	21-25	31-35	10-20
Tetrachloroethene	µg/L	3,800	100U	180	7,130
Trichloroethene	µg/L	13,000	1,100	950	15,100
cis-1,2-Dichloroethene	µg/L	22,000	23,000	17,000	25,900
trans-1,2-Dichloroethene	µg/L	680	640	510	636

Sample ID:		MW-1
Screen Interval (ft bls):		13-23
Tetrachloroethene	µg/L	345
Trichloroethene	µg/L	38.6

Sample ID:		DP-2			MW-2
Sample Depth Interval (ft bls):		13-17	21-25	31-35	13-23
Tetrachloroethene	µg/L	350	980	42	392
Trichloroethene	µg/L	10.3	150	9	12.7
cis-1,2-Dichloroethene	µg/L	4.2	8	12	2U
Toluene	µg/L	1U	6	5U	NA
Xylenes	µg/L	4.0	7	5U	NA

From May 2006 Investigation of the Continental Cleaners Site [Metcalf & Eddy 2006]

Figure 5. Continental Cleaners Groundwater Contamination Map

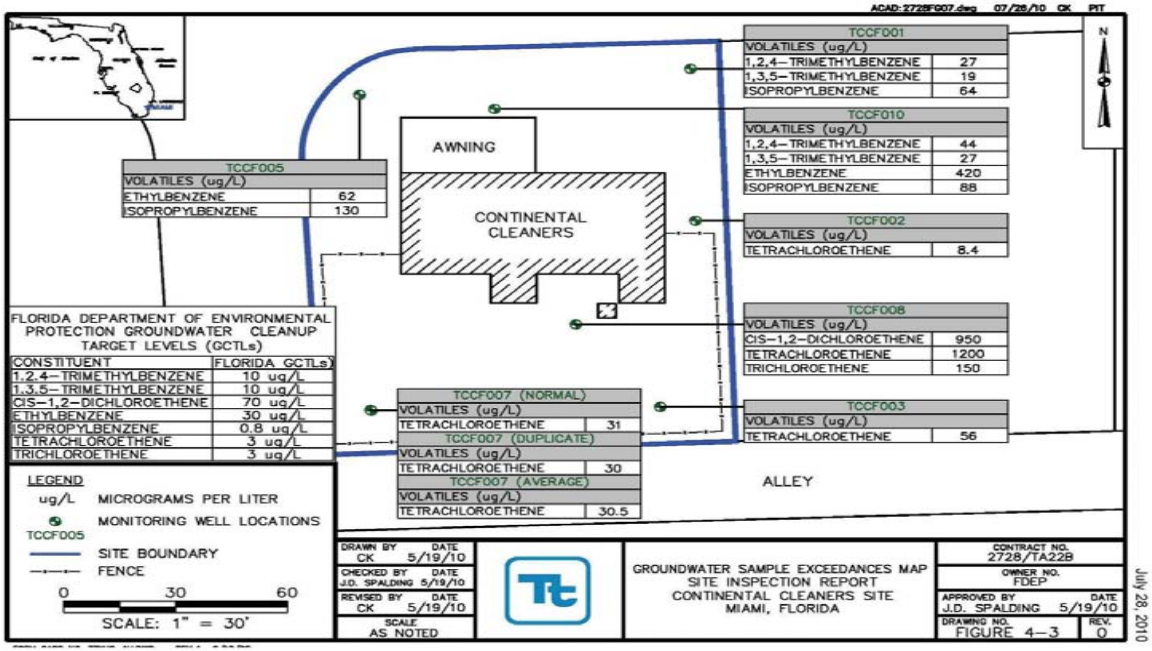
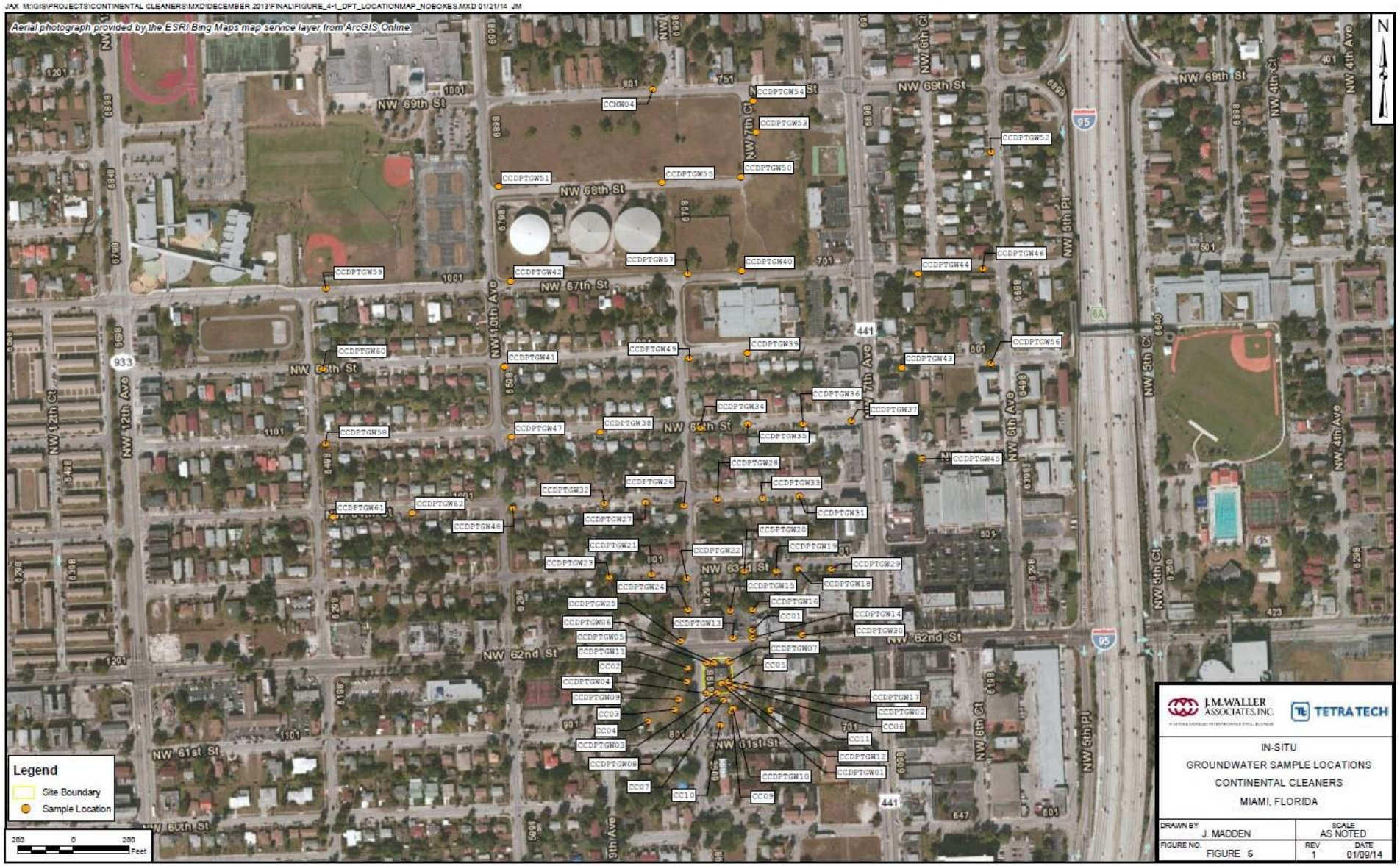


Figure 6. Continental Cleaners Groundwater Sample Locations



Appendix B

Residential Soil Gas Calculations

Calculations for maximum soil gas concentrations (no attenuation) exceeding screening levels in the residential area south of the site.

Chloroform

C_{ia} = 4.5 μg/m^3
ET = 24 hours/day
EF = 350 days/year
ED = 33 years
AT_c= 78 years × 365 days/year × 24 hours/day = 683,280 hours
EC_c= (C_{ia} × ET × EF × ED)/AT_c
= (4.5 μg/m^3 × 24 hours/day × 350 days/year × 33 years)/683,280 hours
= 1.95 μg/m^3

IUR = 2.3×10^{-5} (μg/m^3)$^{-1}$
ER = EC_c × IUR
= 1.95 μg/m^3 × 2.3×10^{-5} (μg/m^3)$^{-1}$ = 4.49×10^{-5}

Tetrachloroethylene

C_{ia} = 430 μg/m^3
ET = 24 hours/day
EF = 350 days/year
ED = 33 years
AT = 78 years × 365 days/year × 24 hours/day = 683,280 hours
EC = (C_{ia} × ET × EF × ED)/AT_c
= (430 μg/m^3 × 24 hours/day × 350 days/year × 33 years)/683,280 hours
= 186.75 μg/m^3

IUR = 2.6×10^{-7} (μg/m^3)$^{-1}$
ER = EC_c × IUR
= 186.75 μg/m^3 × 2.6×10^{-7} (μg/m^3)$^{-1}$ = 4.86×10^{-5}

Where
C_{ia} = concentration in indoor air (micrograms per cubic meter or μg/m^3)
ET = exposure time (hours/day)
EF = exposure frequency (days/year)
ED = exposure duration (years)
AT = averaging time (hours) = exposure duration for non-cancer effects × 365 days/year × 24 hours/day
EC = exposure concentration
IUR= inhalation unit risk [(μg/m^3)$^{-1}$] (value found on EPA's Integrated Risk Information System according to chemical)
ER = estimated theoretical risk (unitless)

Glossary

Absorption
The process of taking in. For a person or 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)**.

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

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

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.

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

Cancer risk
A theoretical risk of 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.

Chronic
Occurring over a long time (more than 1 year) (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**).

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**).

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.

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**).

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

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.

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.

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 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**.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces (compare with **surface water**).

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

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.

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 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**).

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.

mg/kg
Milligram per kilogram.

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**).

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.

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.

NPL (see **National Priorities List for Uncontrolled Hazardous Waste Sites)**

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).

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

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

Receptor population
People who could come into contact with hazardous substances (see **exposure pathway**).

Reference dose ()
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.

Risk
The probability that something will cause injury or harm.

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**).

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.

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**.

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.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs (compare with **groundwater**).

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**).

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.

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**).

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

Greetings,

You are receiving a document from the Agency for Toxic Substances and Disease Registry (ATSDR). We are very interested in your opinions about the document you received. We ask that you please take a moment now to complete the following ten question survey. You can access the survey by clicking on the link below.

Completing the survey should take less than 5 minutes of your time. If possible, please provide your responses within the next two weeks. All information that you provide will remain confidential.

The responses to the survey will help ATSDR determine if we are providing useful and meaningful information to you. ATSDR greatly appreciates your assistance as it is vital to our ability to provide optimal public health information.

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