Public Health Assessment

Final Release

Evaluation of Public Water Quality Concerns Related to Contamination Migrating from the Walker Machine Products Superfund Site

WALKER MACHINE PRODUCTS SITE
COLLIERVILLE, SHELBY COUNTY, TENNESSEE

EPA FACILITY ID: TNN000410124

TDEC DOR FACILITY ID: #79-845

Prepared by
Tennessee Department of Health

AUGUST 18, 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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 60-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Foreword

This document summarizes an environmental public health investigation performed by the State of Tennessee Department of Health's Environmental Epidemiology Program. Our work is conducted under a Cooperative Agreement with the federal Agency for Toxic Substances and Disease Registry. In order for the Health Department to answer an environmental public health question, several actions are performed:

Evaluate Exposure: Tennessee health assessors begin by reviewing available information about environmental conditions at a site. We interpret environmental data, review site reports, and talk with environmental officials. Usually, we do not collect our own environmental sampling data. We rely on information provided by the Tennessee Department of Environment and Conservation, U.S. Environmental Protection Agency, and other government agencies, businesses, or the general public. We work to understand how much contamination may be present, where it is located on a site, and how people might be exposed to it. We look for evidence that people may have been exposed to, are being exposed to, or in the future could be exposed to harmful substances.

Evaluate Health Effects: If people could be exposed to contamination, then health assessors take steps to determine if it could be harmful to human health. We base our health conclusions on exposure pathways, risk assessment, toxicology, cleanup actions, and the scientific literature.

Make Recommendations: Based on our conclusions, we will recommend that any potential health hazard posed by a site be reduced or eliminated. These actions will prevent possible harmful health effects. The role of Environmental Epidemiology in dealing with hazardous waste sites is to be an advisor. Often, our recommendations will be action items for other agencies. However, if there is an urgent public health hazard, the Tennessee Department of Health can issue a public health advisory warning people of the danger, and will work with other agencies to resolve the problem.

If you have questions or comments about this report, we encourage you to contact us.

Please write to: Environmental Epidemiology
Tennessee Department of Health
4th Floor, Andrew Johnson Tower
710 James Robertson Parkway
Nashville TN 37243

Or call us at: 615-741-7247 or toll-free 1-800-404-3006 during normal business hours

email: eep.health@tn.gov

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Summary

Introduction

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) evaluated potential environmental exposures from the Walker Machine Products (WMP) Superfund Site. The purpose of this Public Health Assessment is to document the potential health impact of contaminants found in soil and groundwater. A historic release of the chlorinated solvent chemical tetrachloroethylene (PCE) thought to come from the WMP Site could threaten the water quality of the Town of Collierville. A portion of the Town's drinking water supply comes from underground wells located in the same general area as the site. The U.S. Environmental Protection Agency (EPA) proposed to add the WMP Site to its National Priorities List (NPL) of hazardous waste sites on December 12, 2013. The WMP Site was officially listed on the NPL on May 8, 2014. The NPL is part of EPA's Superfund clean-up process intended to identify the nation's hazardous waste sites most in need of further investigation and cleanup. EEP became involved with the WMP Site because Congress mandates the Agency for Toxic Substances and Disease Registry (ATSDR) conduct public health activities at Superfund sites EPA proposes adding to its NPL.

Many local, state, and federal agencies are working together to understand the implications of decades of industrial activity on this site. All stakeholders with interest in the WMP Site should be part of the long-term land use and planning. ATSDR's top priority at this site is to ensure the Town of Collierville's leaders, Public Utilities Division personnel, and TDEC have the best information possible to safeguard the health of Collierville's citizens.

The public health assessment was released for a public comment period of 60 days on April 5, 2016. TDH EEP did not receive any public comments.

Overview

EEP reached five conclusions about the WMP Site. EEP concludes:

Conclusions

Conclusion 1	Drinking, touching, and showering from the drinking water from the Town of Collierville Well Plant #1 near the Walker Machine Products (WMP) Site is not expected to harm people's health.
Basis for Decision	Based on the 2014 and 2015 quarterly sampling events, there is only a very small amount of tetrachloroethylene (PCE), less than 1 microgram per liter (µg/L) measured in the Town of Collierville Well Plant #1 drinking water distributed to customers as verified by the most recent quarterly testing. Exposures to this small amount of PCE are unlikely to be associated with any health impacts.
Next Steps	EEP recommends that monitoring and water treatment processes continue for the municipal water system as required by the US Safe Drinking Water Act. Untreated (raw) water monitoring, conducted at least quarterly, is recommended to understand the fate and transport of the contaminated groundwater plume moving west from the WMP Site.
Conclusion 2	It is unknown if vapor intrusion is occurring in buildings adjacent to the WMP Site because indoor air sampling has not been performed in other nearby buildings.
Basis for Decision	Groundwater contamination extends from the WMP Site beneath the former Witt International (WI) building. The adjacent former WI building is known to house various businesses, one of which is a children's gymnastics studio. An evaluation of the potential for vapor intrusion (VI) is continuing at the WMP Site.
Next Steps	EEP supports the continued evaluation of the vapor intrusion pathway conducted by EPA at the WMP Site. Specifically, EEP recommends concurrent sub-slab and indoor air sampling at the WI building to understand the potential for vapor intrusion to occur.
Conclusion 3	The health of workers performing excavation work on the site or off-site nearby should not be harmed if they come into contact with groundwater containing site-related chemicals.
Basis for Decision	Groundwater is not used on the site and is inaccessible unless workers excavate a very deep trench that encounters groundwater. Groundwater is encountered at approximately 50 to 60 feet below ground surface in the vicinity of the site. The only likely way workers would come into contact with groundwater containing site-

	related chemicals is through sampling of onsite and off-site monitoring wells.
Next Steps	EEP recommends if site excavation activities are conducted, institutional controls should be adopted and proper health and safety precautions should be taken to protect any workers. Proper health and safety procedures and personal protective equipment should be worn by workers performing excavations or sampling groundwater monitoring wells.
Conclusion 4	Current or future exposure to onsite surface soil contamination will not harm the health of those who work on or trespass on the site.
Basis for Decision	Site-related contamination was not found in limited surface soil samples collected and tested.
Next Steps	None at this time.
Conclusion 5	Current or future exposure to onsite subsurface soil contamination will not harm the health of those who work on or trespass onto the site.
Basis for Decision	Potential site-related chemicals were found at very low, estimated levels in limited site subsurface soil samples collected and tested.
Next Steps	Adopting institutional controls and taking proper health and safety precautions to protect any workers are recommended if site excavation activities are conducted.
For More Information	If you have any questions or concerns about your health, contact your healthcare provider. For more information on this environmental site, call TDEC toll free at 1-888-891-8332. For more information on this health report, please call TDH EEP at 615-741-7247 or 1-800-404-3006 during normal business hours. You can also email TDH EEP at eep.health@tn.gov.

Statement of Issues and Background

The Tennessee Department of Health's (TDH) Environmental Epidemiology Program (EEP) evaluated possible environmental health exposures at the Walker Machine Products (WMP) Superfund Site. The U.S. Environmental Protection Agency (EPA) proposed to add the WMP Site to its National Priorities List (NPL) of hazardous waste sites on December 11, 2013. The WMP Site was officially listed on the NPL on May 8, 2014. The NPL is part of EPA's Superfund clean-up process to determine the nation's worst hazardous waste sites needing investigation and possible cleanup. Congress mandates the U.S. Agency for Toxic Substances and Disease Registry (ATSDR) conduct public health activities at Superfund sites EPA proposes adding to its NPL. ATSDR provides funding for EEP through a cooperative agreement to conduct environmental investigations in Tennessee. EEP prepared this Public Health Assessment for the WMP Site.

Chlorinated solvent chemicals have been found in groundwater both onsite and off-site. One chemical found at the WMP Site has also been found in one of the Town of Collierville's municipal water supply wells located in the well field closest to the WMP Site. The water supply well field has the ability to pull the chemicals from the site to it. Also, the natural groundwater flow in the area is generally toward the well field.

Various municipal source water wells at other water plants in Collierville have shown evidence of environmental contamination since the late 1980's. Most of the contamination has been attributed to the Smalley Piper and Carrier Sites, which both impact the Town of Collierville's municipal Well Plant #2. Both the Smalley-Piper and Carrier sites are listed on the U.S. EPA National Priorities List. While these companies share responsibility for contamination in Collierville, other sources cannot be ruled out (HES 2006, ENSAFE 2004). The WMP contaminant plume also contributes to local impacts potentially threatening the town's drinking water sources. Over 12,000 customers receive water from the Town of Collierville's municipal Well Plant #1.

The public health assessment was released for public comment on April 5, 2016. The public comment lasted 60 days until June 4, 2016. TDH EEP did not receive any public comments.

Objectives

The specific objectives of this Public Health Assessment are as follows:

1. Evaluate the public health impact of WMP Site pollution in onsite soil, due to potential migration of chemicals from soil and groundwater, and in water used by the Town of Collierville residents.

2. Determine if ingestion of drinking water, direct skin contact to the water, or inhalation volatile chemicals released from the water into the air during showering and bathing from the Town of Collierville's water could harm people's health.

Site Location and Details

The WMP Site is located at 459 Washington Street in Collierville, Shelby County, Tennessee, 38017, in an industrial/commercial area. Site geographic coordinates are North 35.0419° latitude and West 089.6532° longitude. The Tennessee Department of Environment and Conservation

(TDEC), Division of Remediation (DoR) Site Number is # 79-845. The EPA identification number, as recorded in the Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) database, is TNN000410124 (EPA 2013).

The WMP site property is 5 acres in size. The site is almost square in shape and is situated on the south side of Washington Street east of downtown Collierville (Figure 1). The property consists of a metal and concrete building (the manufacturing building) surrounded by concrete parking/storage pads to the north and south. Another metal building to the east is used for storage. There is grass cover to the west and gravel cover in between the two buildings (Figure 2). The remainder of the property to the east and south is grass-covered. Onsite, there is a circular-shaped concrete pad that once was the location of an above-ground storage tank (AST) and an adjacent drainage pit used to contain spills from the AST (Figure 2). An oil/water separator is located south of the manufacturing building adjacent to an intermittent stream running along the southern property boundary (TDEC 2010).

The site is bound by the Norfolk Southern Railroad on the south, Washington Avenue on the north, undeveloped forested land on the east, and the former Witt International (WI) property to the west. WI manufactured commercial heat transfer equipment from 1961 to 1999 at their location on Washington Street (TDEC 2009). The former WI building was converted into several commercial businesses (TDEC 2010) including a children's gymnastics center. Additionally there is a manufacturing building to the north of the site as well as a small development of single family homes further southwest of the site. The site is fenced along the western boundary with the former WI property. Site access is uncontrolled to the north, south, and east (TDEC 2010) and hence, is able to be accessed by trespassers. In 2015, the WMP Site housed an active business with approximately twenty workers. The property is currently owned by Langley Wire Cloth Products, Inc.

Site Operational History

Walker Machine Products produced automated machine screw products. The company was in operation from 1953 until approximately 2002 (TDEC 2012). WMP used mineral spirits to clean the finished products. Brass parts were cleaned in 1,1,1-trichloroethane (1,1,1-TCA). The used solvent was placed in an AST after use. The mineral spirits were filtered and reused. There may have been other solvents used to clean parts. A 1987 Tennessee Occupational Safety and Health Administration (OSHA) Inspection Report stated the company was releasing solvents to the surface soil onsite and into the sewer drain at the rear of the building. An oil/water separator was used by WMP and appears to have received solvent waste as well. The oil/water separator still exists on-site but is not used by the present company (TDEC 2012). Releases from this oil/water separator are believed to be one of the sources for the onsite contamination. TDEC DoR, Jackson Field Office (DoR-JFO) staff searched the Shelby County, Tennessee Register of Deeds and Internet archives to discover the historic and current ownership of the site. Deed records for the site before 1953 could not be located or were not legible (Shelby County 2010).

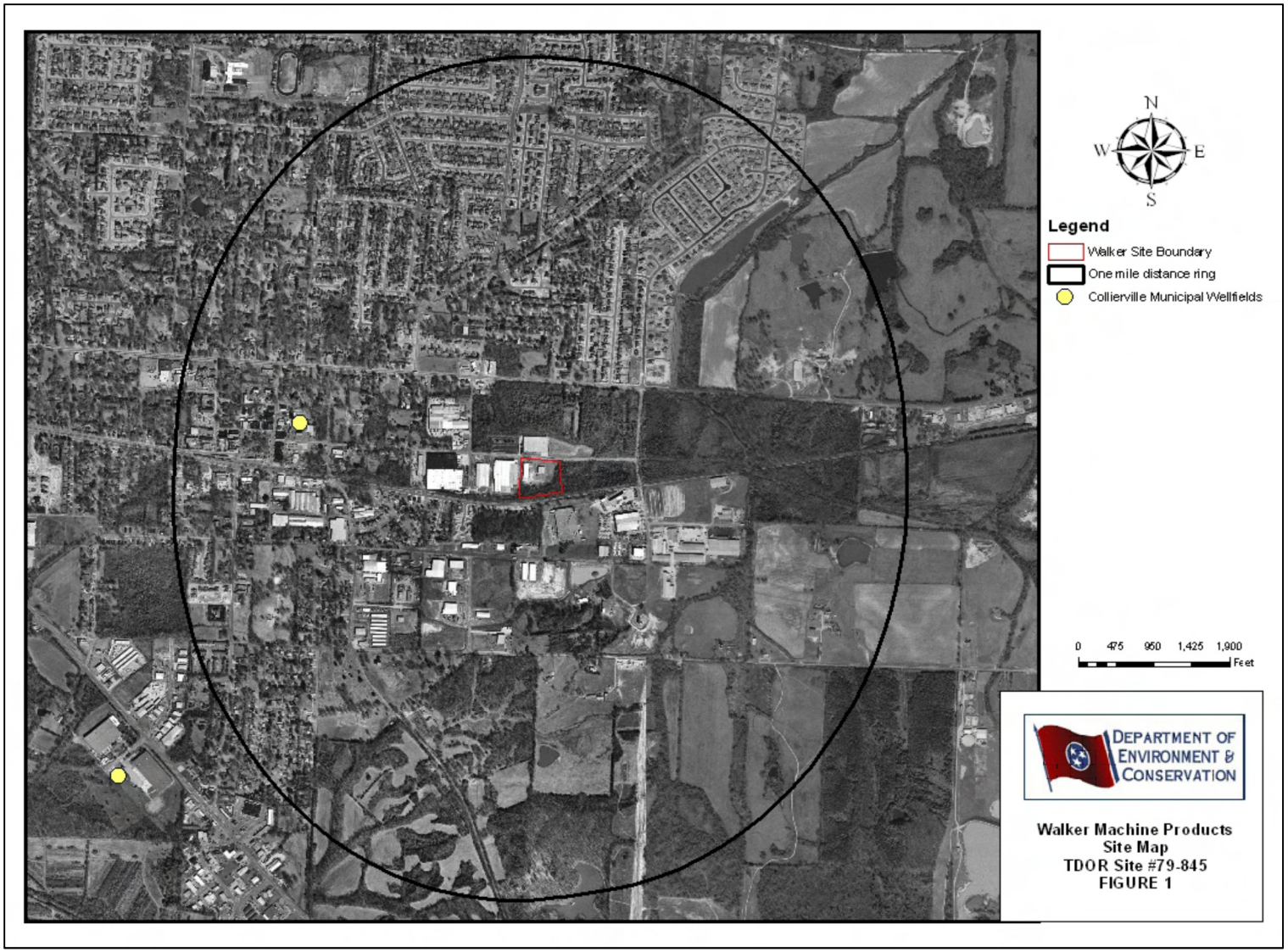


Figure 1. Walker Machine Products Site Location Map and its location in relation to the Collierville, Tennessee municipal well fields. Source: TDEC Memphis Field Office DoR.

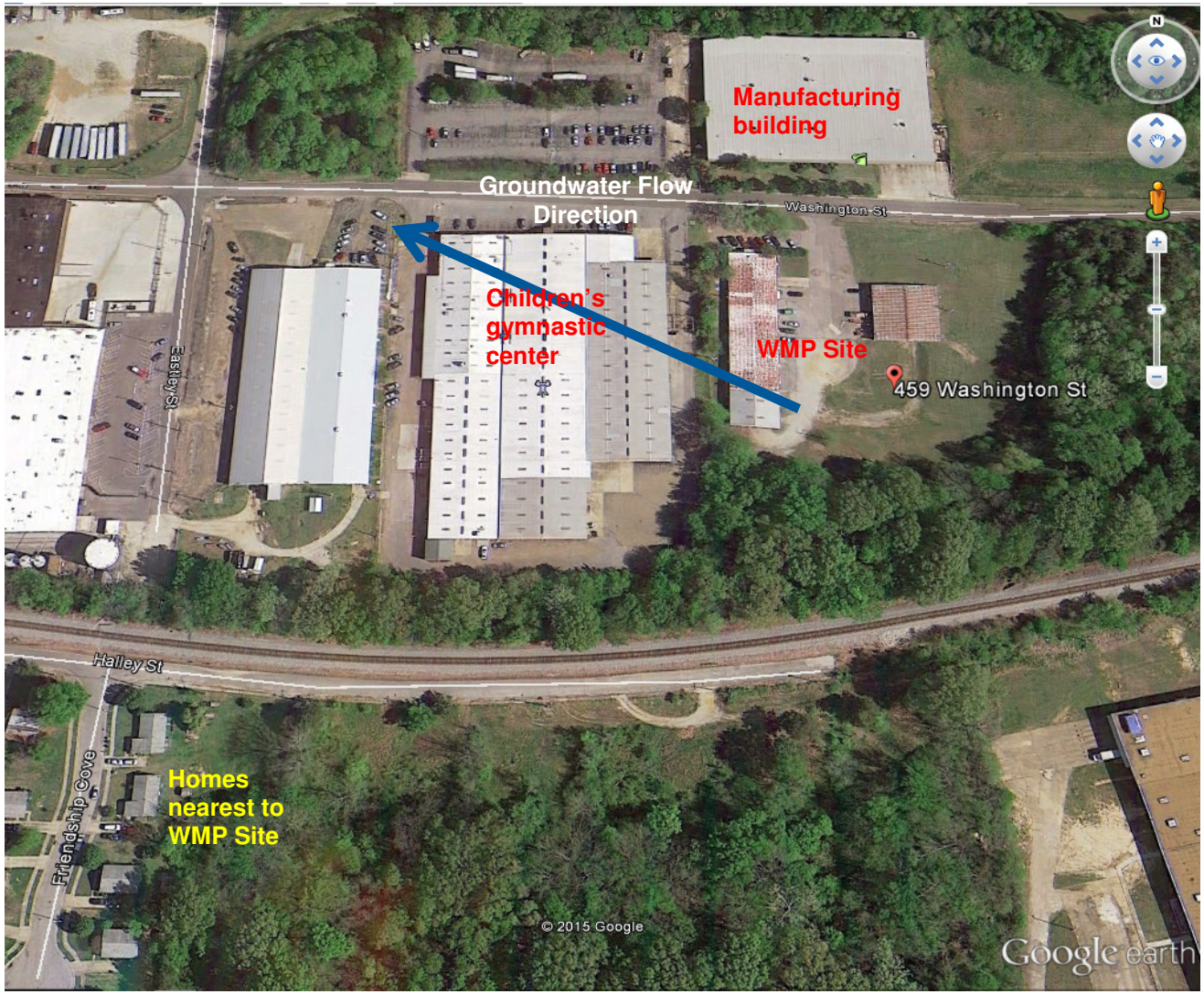


Figure 2. Walker Machine Products (WMP) Site Map. The former WMP Site property is noted, along with the children's gymnastic center to the west, the nearest homes to the southwest, and a manufacturing building to the north. The approximate north-westward groundwater flow direction is also shown. Source: Google Earth 2015.

Current Operations

In early 2016, Langley Wire Cloth Products (Langley) recently ceased operations on the WMP Site. It was not related to Walker Machine Products. Langley made wire cloth products for several applications, including automotive and heavy machinery filters (TDEC 2008). Chlorinated solvent chemicals are not used by Langley Wire Cloth Products (TDEC 2012).

Climate

Collierville has a humid, subtropical climate with four distinct seasons. Meteorological data for the Town of Collierville shows the warmest month being July with an average daily maximum temperature of 91°F. The coldest month is January with an average daily minimum temperature of 28°F (HES 2006). Summers are humid; snow is minimal. The highest recorded temperature for Collierville area was 106°F in August 2000, and the lowest recorded temperature was -6°F in December 1989 (TDEC 2008). Collierville averages approximately 52.7 inches of rain per year, with April being the wettest month and October being the driest month (World Climate 2010). The average monthly wind speed for Town of Collierville ranges from 6.8 to 10.5 miles per hour (USDC 1961). The lowest wind speed occurs in August, and the highest wind speed occurs in March. The prevailing wind direction in the area is north-northeast.

Water Use

The Town of Collierville's Department of Public Services provides drinking water for the rapidly growing suburban area. The town currently has five drinking water plants that pump water from 12 different wells. The town is operating only four plants consisting of ten wells due to contamination in wells at drinking Water Plant #2. Water Plant #2 has been impacted by chromium-6 from Smalley-Piper and by chlorinated solvent chemicals from a Carrier Corporation manufacturing plant. Water Plant #2 is located adjacent to the Carrier Corporation NPL site (TDEC 2007). The contamination in drinking Water Plant #2 was found several years ago. Chromium-6 is much harder to remove from water than VOCs are. For this reason Water Plant #2 was permanently taken offline in late 2003 in order to protect residents from using contaminated water.

Groundwater is used by the Town of Collierville and drawn into the drinking water plants. This water is defined as raw water. The raw water is then treated for human use and consumption. The finished product drinking water from the treatment plants is called finished water. The water from all operating water plants is then blended into the water distribution system which has a capacity of about 23 million gallons per day (MGD). The Town of Collierville provides an average of 5.5 million gallons of water on a daily basis to its 15,876 connections representing 41,280 people. Well Plant #1, consisting of three wells, is located within ½ mile from the WMP Site. As previously noted, two of the three wells in Well Plant #1 have had historic chemical contamination. Recently, only Well 103 has had continuing detections of a chemical of concern. As part of treatment, the water from the wells is aerated and treated to remove chemicals before it is distributed to 12,384 residents (TDEC 2011). No permanent water supply wells were found on the WMP Site.

Land Use and Demographics

Collierville, Tennessee, ZIP code 38017, consists of a defined downtown area and several outlying subdivisions. It is a suburb located in the Memphis, Tennessee metropolitan area. There are a range of land uses in Collierville. A town of large homes and considerable retail expansion, Collierville does have smaller older homes in the heart of the city. Industry is located in the area south of the main east-west street, Poplar Avenue.

As determined by house count, a total of 205 residents live within ¼ mile of the WMP Site (TDEC 2010). There are no residences within 200 feet of the site. The population within one mile of the WMP Site was estimated to be 12,384 people (TDEC 2011). Collierville's population has steadily increased since the 1990s.

According to the 2010 Census, 45,965 people lived in Collierville, a nearly 34% increase since 2000. Of these, 35,035 or nearly 80% were Caucasian, 4,771 or nearly 10% were African-Americans, and 3,205 or nearly 10% were of other races. Of these residents, 51.1% of people 16 years and older, were in the civilian labor force. Of these, 40.6% were employed, and 10.6% were unemployed (Census 2010).

In 2010, 96% of the adults, 25 years old or older, were a high school graduate or higher with 51.8% having a bachelor's degree or higher (Census 2010). There are 2 schools located within approximately 1 mile of the WMP Site. Collierville Middle School is located about ¾-mile west of WMP while Collierville Elementary is located about 1 mile northwest of WMP. The distance to the nearest daycare is approximately 2,000 feet to the northwest (TDEC 2009).

In 2010, 82.9% of housing units were owner-occupied and 17.1% were renter-occupied. Of the 17,736 housing units, 4.2% were vacant. Eighty-five percent of units were single-family detached homes. Seventy-one percent of the housing units had been built before 2000 (Census 2010).

Housing near the site includes wood framed and brick single-family homes and apartments. The nearest home to the site is approximately 0.14 miles to the southwest. Light industries, commercial businesses, and a children's gymnastic center are also located adjacent to the site.

Community Involvement

There has been one community meeting regarding the site. On December 16, 2013, EPA held a public meeting about the site status and future investigation activities at the Walker Machine Products Site. EPA explained what the WMP Site's listing on the NPL meant, and who would oversee the future work activities that may be completed as part of the remedial process for the site. Stakeholders in the community including representatives from the water utility, the current owners of Langley Wire Cloth, and some nearby residents had measureable interest in the WMP Site. Short summaries of the site history and environmental investigation activities conducted to date were presented. Questions from the public involved how information about the cleanup would be shared and the timeframe for future clean-up actions. Since being listed on the NPL, EPA anticipates having another public meeting in the future. Before the public meeting, EEP met with TDEC and EPA officials and was able to tour the site and surrounding community, discuss background site information, environmental sampling data, and concerns of the agencies and of the community.

Regional Geology and Hydrogeology

Understanding the geology of the Memphis area is critical to understanding the importance of the chemicals migrating from the WMP Site. Contamination from the WMP Site can migrate downward with relative ease and reach the Memphis Sand unit that is the source of water for the Town of Collierville's wells at Well Plant #1. Therefore, the water source for over 12,000 people could potentially be influenced by contamination from the WMP Site. The following paragraphs attempt to illustrate why the geology of the WMP Site area is important to the understanding the movement of contamination from the site.

The WMP Site is situated in the Gulf Coastal Plain section of the Coastal Plain physiographic province in Shelby County. The Gulf Coastal Plain section in the Memphis area is characterized by thick loess deposits associated with alluvial plains from Mississippi River tributaries. Underlying this loess is the Memphis Sand that is the principal aquifer in the Memphis region.

The Memphis Sand, locally known as the "500-foot" sand, is the aquifer used for both municipal and industrial supplies in the Memphis area. The relatively young, Tertiary-age, Memphis Sand consists of a thick layer of sand which at various levels has lenses of clay, silt, and minor amounts of lignite. The Memphis Sand ranges in thickness from 500 feet to approximately 900 feet (Hess 2006). The sand is also very porous allowing it to be a good aquifer but also making it vulnerable to contamination. The three city water supply wells are screened in the Memphis Sand. Screen depths range from 192 to 529 feet below ground surface (bgs). Screen lengths range from 40 to 101 feet in the three supply wells at Well Plant #1 (TDEC 2011).

The alluvium, fluvial, and loess deposits make up the shallow water-table (unconfined) aquifers, which regionally are separated from the underlying aquifers by the Jackson Clay confining bed. Locally this confining unit is absent. The Memphis Sand and the Fort Pillow Sand regionally are artesian (confined) aquifers meaning they are under pressure and want to flow upwards. However, due to the absence of a confining unit, locally artesian conditions are likely reduced. The Memphis Sand and the Fort Pillow Sand are separated by the Flour Island confining bed. Most of the water used for municipal and industrial supplies in the Memphis area is derived from the Memphis Sand and Fort Pillow Sand (HES 2006).

Since the Memphis and Fort Pillow Sands are the aquifers used in the area for large amounts of water, many water users could potentially be at risk if the water in these sands becomes contaminated. The chemicals released from the WMP Site can travel and move downward very easily through these sands and be present in groundwater for a long time. A small amount of these chemicals can contaminate a large volume of groundwater. These chemicals also do not break down easily and tend to linger for long periods of time contaminating all groundwater they dissolve into. If they do break down, some may break down into more harmful chemicals.

Surface Water

Surface water runoff at the site enters an intermittent stream south of the main portion of the site. The intermittent stream flows east approximately 0.4 miles before entering an unnamed tributary of the Wolf River. From this point, the 15-mile surface water pathway ends in the Wolf River approximately 12.5 miles northwest in the City of Memphis. The Wolf River then discharges to the Mississippi River north of Mud Island in Memphis (TDEC 2010).

Discussion

Introduction to Chemical Exposure

To determine whether persons have been or are likely to be exposed to chemicals, TDH EEP evaluates pathways that could lead to human exposure. Chemicals released into the environment have the potential to cause harmful health effects. Nevertheless, a release does not always result in exposure. People can only be exposed to a contaminant if they come into contact with it. If no one comes into contact with a contaminant, then no exposure occurs, and thus, no health effects could occur. An exposure pathway contains five parts:

- a source of contamination
- contaminant transport through an environmental medium
- a point of exposure
- a route of human exposure, and
- a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements have been, are, or will be present at the site. An exposure pathway is considered incomplete if one of the five elements is missing.

The source of contamination is the place where the chemical was released. For the WMP Site, there were three possible sources for the groundwater contamination found. The first source was spills and leaks from the oil/water separator (TDEC 2010). The second source, according to a 1987 Tennessee Occupational Safety and Health Administration (TOSHA) Inspection Report, was the draining of spent solvent onto the ground and into the sewer drain at the south end of the building (TDEC 2010). A third source was possibly from a drum of TCE found south of the onsite manufacturing building (TDEC 2012).

Overview of Previous Site Investigations

Environmental investigations have been conducted on the WMP Site since 2007. Many of the investigations have been led by the Jackson and Memphis, Tennessee offices of TDEC, along with those conducted jointly with EPA.

The DoR-JFO conducted a Site Prescreening Investigation at WMP site in 2007, collecting surface and subsurface soil samples and installing and sampling monitoring wells at the site (TDEC 2008). Sample results showed subsurface soil and groundwater contamination in the area surrounding and downgradient from the former oil/water separator (TDEC 2008). Levels of volatile organic compounds (VOCs), including tetrachloroethylene (PCE), trichloroethylene (TCE), 1,1-dichloroethene (1,1-DCE), cis-1,2-dichloroethene (cis-1,2-DCE), and methyl ethyl ketone (MEK), were present above EPA maximum contaminant levels (MCLs) in well WM03 (TDEC 2008). It's unknown if all these chemicals were once used at WMP. Some definitely were. Some of these chemicals could be breakdown products of chemicals used at the site. WMP was known to use 1,1,1-TCA in its parts washing process (TDEC 2012). A sample collected from the former oil/water separator by DoR-JFO in July 2007 showed 35 parts per billion (ppb) of vinyl chloride, 14 ppb of cis-1,2-DCE, and 9.4 ppb of MEK (TDEC 2008). 1,1,1-TCA can break down into cis-1,2-DCE, and/or 1,1-DCE and eventually vinyl chloride.

Due to groundwater contamination above EPA maximum contaminant levels (MCLs) and proximity to the Town of Collierville Well Plant #1, TDEC recommended further investigation for the WMP Site (TDEC 2008).

The former WI property is adjacent to the WMP Site. Groundwater contamination was also found on the WI property during a 2008 Site Inspection (TDEC 2009). TDEC believes WI only used oils and TCE for cleaning parts before assembly. The same contaminants found at the WMP Site, were also found under the WI which lies directly downgradient of what are believed to be the sources of VOC contamination in the oil/water separator area of the WMP Site (TDEC 2009). Groundwater samples collected from the adjacent WI property showed levels of PCE, TCE, 1,1,1- TCA, 1,1-dichloroethane (1,1-DCA), 1,1-DCE, and cis-1,2-DCE in the well closest to the WMP Site oil/water separator. The presence of these chemicals, especially 1,1,1-TCA and PCE, confirms the WMP Site groundwater contamination has migrated off-site.

As mentioned previously, the Town of Collierville's Well Plant #1 is one-half mile downgradient from the WMP Site. If chemicals from WMP migrated off-site, they likely would be captured by these wells and could be present in the raw water drawn from the wells. Small amounts of PCE were found in the raw water from two of three wells at Well Plant #1 in the past two years.

Site-Related Chemicals of Concern

Chlorinated solvents which are VOCs are the chemicals of concern. Chlorinated solvents are a large family of volatile chemical compounds containing chlorine. The information and the various environmental media sampling results from previous site investigations were compared to ATSDR and EPA health screening values. Specific VOCs detected in groundwater monitoring wells both onsite and off-site include: PCE, TCE, 1,1,1-TCA, 1,1-DCE, cis-1,2-DCE, and 1,1-DCA. The main chemicals of concern are 1,1,1-TCA, PCE, and TCE. 1,1,1-TCA because of its documented use onsite. PCE because of the high levels found in site groundwater monitoring wells, and it was historically found in two of the municipal supply wells in Well Plant #1. TCE because it is both a breakdown chemical of PCE and has been found at levels above health screening values in onsite groundwater. Even though 1,1,1-TCA was used on the site and TCE has been detected in site monitoring wells making it the main onsite chemical of concern, PCE is the main chemical of concern off-site as it has been the potential site-related chemical found in samples of the raw, untreated water from two of the three Collierville water supply wells at Well Plant #1.

Health Comparison Values

An evaluation of site-related environmental contamination consists of a two-tiered approach: (1) a screening analysis and (2) a more in-depth analysis to determine public health implications of site-specific exposures (ATSDR 2005). First, maximum concentrations of detected substances are compared to media-specific environmental guideline comparison values (CVs). If concentrations exceed the environmental guideline CVs, these substances, referred to as Contaminants of Potential Concern (COPCs), are selected for further evaluation. If contaminant levels are found above environmental guideline CVs, it does not mean adverse health effects are likely, but a health guideline comparison is necessary to evaluate site-specific exposures. Once exposure doses are estimated, they are compared with health guidelines and study effect levels to determine the likelihood of adverse health effects.

Environmental Guideline Comparison

There are a number of CVs available for screening environmental contaminants to identify COPCs (ATSDR 2005). These include ATSDR Environmental Media Evaluation Guides (EMEGs) and Reference Dose Media Evaluation Guides (RMEGs). EMEGs are estimated levels of chemicals to which humans may be exposed to during a specific time (acute, intermediate, or chronic exposure) without experiencing adverse health effects. RMEGs represent the level of a chemical in water or soil at which a chronic human exposure is not likely to result in adverse non-carcinogenic effects. If the substance is a known or a probable carcinogen, ATSDR's Cancer Risk Evaluation Guides (CREGs) were considered as CVs. CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed during their lifetimes (78 years).

In the absence of an ATSDR CV, CVs from other sources may be used to evaluate contaminant levels in environmental media. U.S. Environmental Protection Agency (USEPA) MCLs for drinking water and USEPA Regional Screening Levels (RSLs) were also used as comparison values. RSLs are contaminant concentrations corresponding to a fixed level of risk (i.e., a Hazard Quotient of 1, or lifetime excess cancer risk of one in one million, or 10^{-6}, whichever results in a lower contaminant concentration) in water, air, biota, and soil (USEPA 2014a). The background lifetime risk of cancer is about one in two for men and one in three for women (ACS 2013). All cancer risk values used express the additional chance of developing cancer above this baseline. Comparison values for the site-related chemicals found in soil are found in Table 1. Comparison values for those chemicals found in site groundwater are shown in Table 2.

Substances exceeding applicable environmental guideline CVs were identified as COPCs and evaluated further to determine whether these contaminants pose a health threat to exposed or potentially exposed receptor populations. In instances where an environmental guideline CV or toxicological information is unavailable, the substance may be retained for further evaluation.

Table 1. ATSDR and EPA soil comparison values for Walker Machine Products Site-related chemicals. Comparison values include ATSDR EMEGs and CREGs and EPA non-cancer and cancer effects RSLs. All comparison values are reported in milligrams per kilogram (mg/kg).

Chemical	ATSDR EMEG	ATSDR CREG	EPA non-cancer effects RSL	EPA cancer effects RSL
benzene	25c[2]/350a[3]	13	8.2	1.2
PCE	300c/4200a	330	81	240
TCE	25c/350a	15	0.41	0.94
1,2,4 trimethylbenzene	ngv	ngv	5.8	ngv
o-xylene[1]	10,000c/140,000a	ngv	65	ngv

Notes:

PCE = tetrachloroethylene

TCE = trichloroethylene

ATSDR EMEG = Agency for Toxic Substance and Disease Registry Environmental Media Evaluation Guide (ATSDR 2015). Chronic non-cancer exposure comparison values (exposure greater than 365 days) used to determine if chemical levels require further health-based screening. They are estimated levels of the chemical to which humans may be exposed to without experiencing adverse health effects. EMEGs listed followed by a "c" are those established for children. EMEGs listed followed by an "a" are those established for an adult. Chronic EMEGs are listed unless otherwise specified by a[1]. a[1] indicates the comparison value is a Reference Dose Media Evaluation Guide (RMEG). RMEGs represent levels of the chemical at which daily human exposure is unlikely to result in adverse non-carcinogenic effects.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2015). Cancer risk comparison values for cancer risk of 1 excess cancer in 1,000,000 people (10^{-6} risk) over a 70-year lifetime. A CREG is an environmental media-specific comparison value used to identify levels of cancer-causing chemicals that are unlikely to result in an increase of cancer rates to those people that have been exposed to the chemical.

EPA RSLs = Environmental Protection Agency Regional Screening Level (EPA 2014). These non-cancer and cancer health effects residential screening levels were developed using risk assessment guidance from the EPA Superfund Program. RSLs are levels of that chemical considered by EPA to be protective for humans (including sensitive groups) over a 70-year lifetime.

Modifiers:

ngv = No guidance value available. EPA has not found suggestive evidence of carcinogenic potential and has not developed a guidance value.

[1] = total xylenes comparison value used as surrogate comparison value for o-xylene.

[2] = child EMEG comparison value

[3] = adult EMEG comparison value

Table 2. ATSDR and EPA water comparison values for WMP Site-related chemicals. Comparison values include EPA drinking water MCLs, ATSDR EMEGs and CREGs and EPA non-cancer and cancer effects RSLs. All comparison values are reported in micrograms per liter (µg/L).

Chemical	MCL	ATSDR non-cancer effects comparison values	ATSDR CREG	EPA non-cancer effects RSL	EPA cancer effects RSL
benzene	5	5c/18a	0.64	3.3	0.45
1,1,1-TCA	200	20,000c/70,000a[1]	nc	800	nc
1,1-DCA	ngv	ngv	ngv	380	2.7
1,1-DCE	7	90c/320a	nc	28	nc
cis-1,2-DCE	70	20c/70a[1]	nc	3.6	nc
PCE	5	60c/210a[1]	17	4.1	11
TCE	5	5c/18a	0.76	0.28	0.49
toluene	1,000	800c/2,800a[1]	ngv	110	nc

Notes:

MCL = EPA maximum contaminant level allowed for drinking water

1,1,1-TCA = 1,1,1-trichloroethane

1,1-DCA = 1,1-dichlroethane

1,1-DCE = 1,1-dichloroethylene

cis-1,2-DCE = cis-1,2-dichloroethylene

PCE = tetrachloroethylene

TCE = trichloroethylene

ATSDR non-cancer health effects comparison values = Agency for Toxic Substance and Disease Registry Environmental Media Evaluation Guide (ATSDR 2015). Chronic non-cancer exposure comparison values (exposure greater than 365 days) used to determine if chemical levels require further health-based screening. They are estimated levels of the chemical to which humans may be exposed to without experiencing adverse health effects. EMEGs listed followed by a "c" are those established for children. EMEGs listed followed by an "a" are those established for an adult. Chronic EMEGs are listed unless otherwise specified by a[1]. a[1] indicates the comparison value is a Reference Dose Media Evaluation Guide (RMEG). RMEGs represent levels of the chemical at which daily human exposure is unlikely to result in adverse non-carcinogenic effects.

ATSDR CREG = Agency for Toxic Substances and Disease Registry Cancer Risk Evaluation Guide (ATSDR 2015). Cancer risk comparison values for cancer risk of 1 excess cancer in 1,000,000 people (10^{-6} risk) over a 70-year lifetime. A CREG is an environmental media-specific comparison value used to identify levels of cancer-causing chemicals that are unlikely to result in an increase of cancer rates to those people that have been exposed to the chemical.

EPA RSLs = Environmental Protection Agency Regional Screening Level (EPA 2014). These non-cancer and cancer health effects screening levels were developed using risk assessment guidance from the EPA Superfund Program. RSLs are levels of that chemical considered by EPA to be protective for humans (including sensitive groups) over a 70-year lifetime.

Modifiers:

nc = Not classified as to carcinogenicity and no guidance value is available.

ngv = No guidance value available. EPA has not found suggestive evidence of carcinogenic potential and has not developed a guidance value.

c = child ATSDR non-cancer comparison value

a = adult ATSDR non-cancer comparison value

Site Sampling Results

TDEC 2007 Pre-CERCLIS Screening Inspection

In 2007, TDEC performed a site investigation to understand if there were contaminants migrating into the groundwater from the WMP Site. Three groundwater monitoring wells were drilled to a depth of 80 feet bgs. Groundwater has been typically encountered onsite at 55 to 60 feet bgs. Groundwater samples were collected from these monitoring wells to characterize the contamination, but these wells are not used for drinking water purposes. Three surface soil samples were collected and analyzed. Three subsurface soil samples from the well borings over a depth range from 0 to 5 feet bgs were also collected and analyzed. Water samples from two municipal wells at Well Plant #1 were also collected (TDEC 2008).

Soil

As shown in Tables 3 and 4, WMP Site surface and subsurface soils were not contaminated with VOCs, although the number of surface and subsurface soil samples collected was limited. Table 3 shows VOC results from the one background surface soil sample location and two downgradient sample locations. The downgradient sample locations are located within an off-site intermittent drainage and a collection pond. These downgradient surface soil locations were thought to be the most likely contaminated areas. The surface soil samples were collected by TDEC from a depth of 0 to 6 inches. Table 4 shows the results of 1 background and 2 onsite subsurface soil samples. These subsurface soil samples were collected as a five foot composite sample from 0 to 5 feet bgs on behalf of TDEC by an EPA contractor. The subsurface soil sample locations correspond to the locations of the monitoring wells installed. The two onsite subsurface soil samples had minor levels of 1,2,4-trimethylbenzene and o-xylene. One subsurface soil sample had a minor amount of PCE. These low levels did not exceed ATSDR or EPA soil comparison values.

Both the surface and subsurface soil sampling indicate that onsite contamination is not related to chemicals being spilled onto the ground, as in the case of a spill or intentional release. The soil data collected during this investigation agree with the oil/water separator being the possible source (TDEC 2010).

Groundwater

Background and downgradient groundwater monitoring wells were installed and sampled as part of the investigation. One background well, Well WM01, and three downgradient wells, Wells WM02, WM03, WM04, were completed. These initial well locations are shown on Figure 3. The background groundwater monitoring well WM01 had measureable levels of benzene, chloromethane, and toluene. None of the levels of these chemicals were above ATSDR or EPA comparison values (Table 2). PCE was found in Well WM02 south of the WMP warehouse building. Levels of PCE were below ATSDR and EPA comparison values. Wells WM03 and WM04 showed much higher levels of PCE. Well WM03 is located adjacent to the former underground oil/water separator south of the main WMP manufacturing building. Well WM04 is located off-site south of the WMP property along Halley Street, south of the Norfolk Southern railroad right-of-way. These two wells also had detectable levels of TCE, 1,1-DCE, cis-1,2-DCE, and 1,1-DCA. Nearly all detections were above the compounds' respective ATSDR or EPA comparison values. However, there is **no exposure pathway** for people to drink the

groundwater found in these groundwater monitoring wells as the wells are not accessible to the general public. Levels of 1,1,1-TCA found in these two wells were below its respective ATSDR and EPA comparison values. All water sample results are shown in Table 5.

Table 3. Summary of Surface Soil Sampling Results for the TDEC 2007 Walker Machine Products Site investigation. All results are reported in micrograms per kilogram (µg/kg).

Chemical	SS-01 (Background)	SS-02 (intermittent stream)	SS-03 (collection pond)	SS-04 (duplicate)
benzene	ND	ND	ND	ND
PCE	ND	ND	ND	ND
TCE	ND	ND	ND	ND
1,2,4 trimethylbenzene	ND	ND	ND	ND
o-xylene	ND	ND	ND	ND

Notes:
PCE = tetrachloroethylene
TCE = trichloroethylene
SS = surface soil sample

Modifiers:
ND = Chemical not detected above method detection limit for the analysis.

Table 4. Summary of Subsurface Soil Sampling Results for the TDEC 2007 Walker Machine Products Site investigation. All results are reported in micrograms per kilogram (µg/kg).

Chemical	SB-01A (Background)	SB-02 (0-5 feet)	SB-03 (0-5 feet)
benzene	ND	ND	ND
PCE	ND	ND	1.8
TCE	ND	ND	ND
1,2,4 trimethylbenzene	ND	0.31 J	ND
o-xylene	ND	0.28 J	0.23 J

Notes:
PCE = tetrachloroethylene
TCE = trichloroethylene
SB = subsurface boring

Modifiers:
J = estimated value of the chemical. Level present is below the calibration range of the testing device.
ND = Chemical not detected above method detection limit for the analysis.

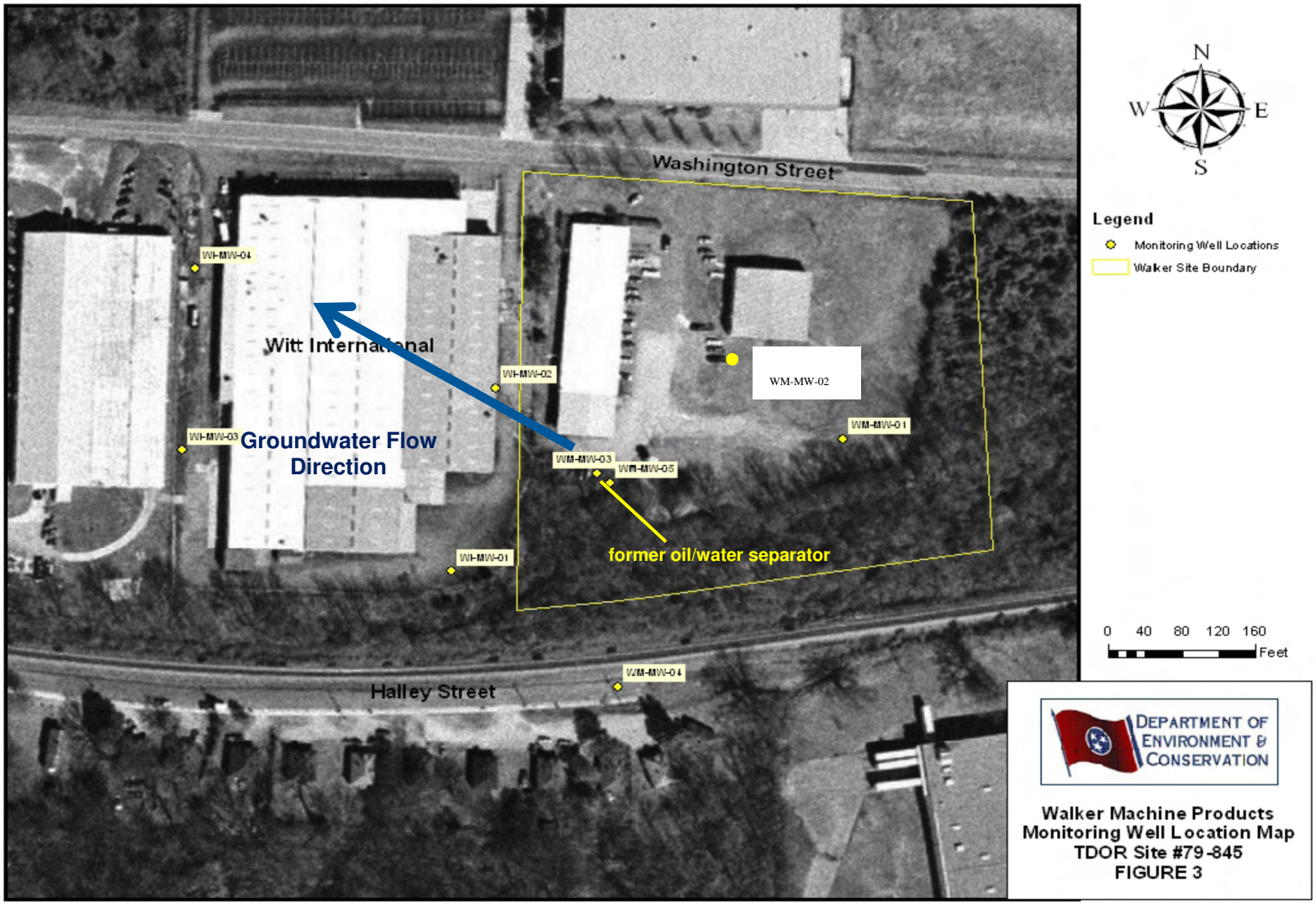


Figure 3. Locations of groundwater monitoring wells at and near the Walker Machine Products NPL Site, Collierville, TN. The approximate groundwater flow direction at the site is also shown. Source: TDEC 2012

Table 5. Summary of Groundwater Sampling Results – Site Related Chemicals for the TDEC 2007 Walker Machine Products Site investigation. All results are reported in micrograms per liter (µg/L). Bold values are those above ATSDR and EPA comparison values.

Chemical	WM01 (Background)	WM02	WM03	WM04
1,1,1-TCA	<0.5	<0.5	12	11
1,1-DCA	<0.5	<0.5	**9.9**	**9.5**
1,1-DCE	<0.5	<0.5	25	27
cis-1,2-DCE	<0.5	<0.5	<5	48
PCE	<0.5	0.38	**590**	**600**
TCE	<0.5	<0.5	**48**	**46**

Notes:

1,1,1-TCA = 1,1,1-trichloroethane
1,1-DCA = 1,1-dichloroethane
1,1-DCE = 1,1-dichloroethylene
cis-1,2-DCE = cis-1,2-dichloroethylene
PCE = tetrachloroethylene
TCE = trichloroethylene

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.
* = Exposure to site groundwater is not a completed pathway.
Result in **Bold** shows levels of the chemical above one or more comparison value.

Municipal Water

Two of the three wells in Town of Collierville Well Plant #1, located one-half mile from the WMP Site, were also sampled during the 2007 Pre-CERCLIS Screening Investigation. At the time, no detections of site-related chemicals were found (TDEC 2008).

TDEC 2009 Witt International (WI) Property Pre-CERCLIS Inspection

Groundwater contamination was found in monitoring wells beneath the adjacent WI property as a result of TDEC's 2009 site inspection. While monitoring well data can be used to characterize the contamination that exists, it should be noted that this water is not used for drinking water purposes. The same chemicals found on the WMP Site were found in groundwater monitoring well samples collected from WI, especially in the well closest to WMP's former oil/water separator, which was WI02 (TDEC 2009). Two WMP groundwater monitoring wells were sampled, WM01 and WM03. WM01 is the background well for the WMP Site and it did not contain any site-related chemicals. Well WM03, closest to the oil/water separator, contained levels of PCE, TCE, cis-1,2-DCE, and 1,1-DCA above ATSDR and EPA comparison values. Levels of 1,1,1-TCA found in this well were below its respective ATSDR and EPA comparison values. Test results of the groundwater sampling on the WI wells in 2009 are shown below in Table 6.

Table 6. Summary of Monitoring Well Groundwater Sampling Results – Site Related Chemicals from the groundwater sampling done as part of the TDEC 2009 Witt International (WI) Site Inspection. All results are reported in micrograms per liter (µg/L). Bold values are those above ATSDR and EPA comparison values. Wells with designations beginning with WI are located on the Witt International Site. Wells with designations beginning with WM are off-site on the WMP Site property. Bold results are above their respective ATSDR or EPA RSL comparison values.

Chemical	WI-01 (Background)	WI-02	WI-03	WI-04 and duplicate	WM01	WM03
1,1,1-TCA	3.6	21	<0.5	<0.5 / <0.5	<0.5	30
1,1,2-TCA	<0.5	0.47	<0.5	<0.5 / <0.5	<0.5	**0.92**
1,1-DCA	1.1	**20**	<0.5	<0.5 / <0.5	<0.5	**51**
1,2-DCA	<0.5	**0.81**	<0.5	<0.5 / <0.5	<0.5	**0.77**
1,1-DCE	10 J	81	<0.5	<0.5 / <0.5	<0.5	69
cis-1,2-DCE	1.9 J	**14**	<0.5	<0.5 / <0.5	<0.5	**85**
PCE	**91**	**210**	0.72	**8.1** / 0.66	<0.5	**830**
TCE	**4.3**	**17**	<0.5	<0.5 / <0.5	<0.5	**65**
methylene chloride	<0.5	<5	5.7	5.2 / 4	<0.5	<5
1,1,2-trichloro-1,2,2-trifluoroethane	<0.5	<5	<0.5	<0.5 / <0.5	<0.5	0.51
carbon tetrachloride	<0.5	<5	<0.5	<0.5 / <0.5	<0.5	**12**
trans-1,2-DCE	<0.5	<5	<0.5	<0.5 / <0.5	<0.5	1.2

Notes:

1,1,1-TCA = 1,1,1-trichloroethane

1,1,2-TCA = 1,1,2-trichlroethane

1,1-DCA = 1,1-dichloroethane

1,2-DCA = 1,2-dichloroethane

1,1-DCE = 1,1-dichloroethylene

cis-1,2-DCE = cis-1,2-dichloroethylene

PCE = tetrachloroethylene

TCE = trichloroethylene

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.
J = estimated value of the chemical. Level present is below the calibration range of the testing device.
Result in **Bold** shows levels of the chemical above one or more comparison value.

TDEC 2010 WMP Site Reassessment

During this investigation TDEC oversaw, along with an EPA contractor, the installation of two additional groundwater monitoring wells for the facility and the sampling of remaining onsite and off-site monitoring wells. One of the two new monitoring wells was installed onsite, while the other was installed off-site to the south along a city street. Additionally, a MIP investigation was done to provide vertical profiles of VOCs in subsurface soil and groundwater at the site.

Soil

No surface soil samples were collected during this investigation because the site is either paved, gravel covered, or has grass on it making soil exposure unlikely. However, four subsurface soil samples collected from the two newly installed groundwater monitoring wells were analyzed by EPA's Region 4 Science and Ecosystem Support Division laboratory. None of the four samples collected had measureable amounts of WMP Site-related chemicals.

Groundwater

The background groundwater monitoring well at the site did not have any detections of site-related chemicals above detection limits. Other onsite monitoring wells contained PCE, TCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and 1,1,1-TCA. PCE, TCE, and cis-1,2-DCE, and 1,1-DCE were found at levels above their respective ATSDR and EPA comparison values Results are shown in Table 7.

Off-site groundwater monitoring wells at the former WI building were also sampled as part of this investigation. Detections of WMP Site-related chemicals were found in the four WI wells. Although lower than in onsite monitoring wells, levels of PCE, TCE, and 1,1-DCE in the WI wells were above their respective ATSDR and EPA comparison values.

TDEC 2011 WMP Site Investigation

Another round of groundwater sampling from the WMP and the WI site monitoring wells was accomplished during this investigation. Additionally, a qualitative passive soil-gas study was done in the area south of the main WMP building and direct push borings were also installed to confirm the soil-gas survey results.

Soil

Four subsurface soil samples were collected and tested for VOCs. Soil sample depths ranged from 3 to 5 feet bgs to 23 to 24 feet bgs. VOCs were detected in three of the four samples. The most abundant VOC detected was PCE, followed by TCE, 1,1-DCA, 1,1-DCE, and 1,1,1-TCA.

Groundwater

The background groundwater monitoring well at the site did not have any detections of site-related chemicals above detection limits. Other onsite monitoring wells containing PCE, TCE, cis-1,2-DCE, 1,1-DCE, 1,1-DCA, and 1,1,1-TCA. PCE, TCE, cis-1,2-DCE, and 1,1-DCE were

found at levels above their respective ATSDR and EPA comparison values. 1,1-DCA and 1,1,1-TCA were not found above their ATSDR and EPA comparison values.

Table 7. Summary of Monitoring Well Groundwater Sampling Results – Site Related Chemicals from the groundwater sampling done as part of the TDEC 2010 Walker Machine Products (WMP) Site Reassessment. All results are reported in micrograms per liter (µg/L). Bold values are those above ATSDR and EPA comparison values. Wells with designations beginning with WM are located on or associated with the WMP Site. Wells with designations beginning with WI are off-site on the Witt International property.

Chemical	WM01 (Background)	WM03 and Duplicate	WM04	WM05	WI-01	WI-02	WI-04
1,1,1-TCA	<0.5	50 / 49	7.6	9.6 J	10	39	<0.5
1,1-DCA	<0.5	**43** / **40**	**3**	**7.8** J	**4.1** J	**40**	<0.5
1,1-DCE	<0.5	**140** / **130**	11	21	29	**180**	<0.5
cis-1,2-DCE	<0.5	**110** / **100**	**9.1**	**50**	**9.8**	**26**	<0.5
PCE	<0.5	**1,500** / **1,400**	**330**	**900**	**450**	**500**	0.61
TCE	<0.5	**89** / **84**	**13**	**46**	**18**	**31**	<0.5

Notes:

1,1,1-TCA = 1,1,1-trichloroethane

1,1-DCA = 1,1-dichloroethane

1,1-DCE = 1,1-dichloroethylene

cis-1,2-DCE = cis-1,2-dichloroethylene

PCE = tetrachloroethylene

TCE = trichloroethylene

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.

J = estimated value of the chemical. Level present is below the calibration range of the testing device.

50 / 49 = Original sample / Duplicate sample result

Result in **Bold** shows levels of the chemical above one or more comparison value.

Again, off-site groundwater monitoring wells at the former WI property were sampled. Detections of WMP Site-related chemicals were found in the four WI wells. Although lower than in WMP onsite monitoring wells, levels of PCE and TCE in the WI monitoring wells were above their respective ATSDR and EPA, comparison values in 3 of the 4 wells. Results are shown in Table 8.

TDEC 2012 Expanded Site Investigation

Activities conducted during the Expanded Site Investigation called for a MIP investigation of subsurface soil and possibly groundwater, followed by subsurface soil and groundwater sampling based on MIP results. Nine existing monitoring wells were also sampled during this investigation.

Table 8. Summary of Monitoring Well Groundwater Sampling Results – Site Related Chemicals from the groundwater sampling done as part of the TDEC 2011 Walker Machine Products (WMP) Site Investigation. All results are reported in micrograms per liter (µg/L). Bold values are those above ATSDR and EPA comparison values. Wells with designations beginning with WM are located on or associated with the WMP Site. Wells with designations beginning with WI are off-site on the Witt International property.

Chemical	WM01 (Background)	WM03 and Duplicate	WM04	WM05	WI01	WI02	WI03	WI04
1,1,1-TCA	<0.5	72 / 67	10	66	7.9	77	0.8	<0.5
1,1-DCA	<0.5	**87** / **82**	**2.8**	**50**	**3.4 J**	**86**	0.31 J	<0.5
1,1-DCE	<0.5	**210** / **190**	17	**180**	24	**380**	4.6	<0.5
cis-1,2-DCE	<0.5	**110** / **110**	**8**	**120**	**8.9**	**51**	0.44 J	<0.5
PCE	<0.5	**1,400** / **1,300**	**330**	**1,500**	**400**	**1,000**	**82**	0.72
TCE	<0.5	**110** / **110**	**15**	**120**	**18**	**73**	**2.4**	<0.5

Notes:

1,1,1-TCA = 1,1,1-trichloroethane

1,1-DCA = 1,1-dichloroethane

1,1-DCE = 1,1-dichloroethylene

cis-1,2-DCE = cis-1,2-dichloroethylene

PCE = tetrachloroethylene

TCE = trichloroethylene

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.

J = estimated value of the chemical. Level present is below the calibration range of the testing device.

210 / 190 = Original sample / Duplicate sample result

Result in **Bold** shows levels of the chemical above one or more comparison value.

MIP Investigation

A total of 35 MIP borings were advanced into the subsurface, providing real time data on subsurface VOC levels. Based on MIP results, three locations were selected for temporary well installation and groundwater and subsurface soil sampling.

The MIP investigation was successful in that two possible source areas were detected during the investigation. One location was reportedly just outside a roll-up door on the west side of the building, and the other was in back of the main building in a gravel area, and possibly attributable to the oil/water separator (TDEC 2012).

Groundwater

Groundwater is contaminated by several VOCs, with the highest levels of VOC contamination located in the area of a former oil/water separator (Table 9). Lower levels of several VOCs were detected in wells to the northwest, the predominant groundwater flow direction, but also to the south and southwest, in the presumed upgradient and side gradient directions. It is believed the contamination found in the upgradient direction is possibly due to the occurrence of a relatively shallow (10 to 49 feet bgs) rock layer dipping to the south in the vicinity of the site, possibly carrying contaminants to the south as it runs along this relatively impervious layer. As contaminants sink to the water table, contaminants would then follow groundwater flow direction, which is to the west-northwest, toward the Town of Collierville Well Plant #1.

Temporal trends from 2007 to 2012 clearly show contaminant concentrations increasing in Wells WM03 and WM05. Chemical increases in Wells WM04, WI02, and WI03 appear to be stabilizing in the 2012 measurements. However, there is **no exposure pathway** for people to drink the groundwater found in these groundwater monitoring wells.

Well Plant #1 Sampling – 2014 and 2015

The finished water from Town of Collierville Well Plant #1 was sampled in May at the request of TDEC. The Town of Collierville regularly samples the finished water after it is treated using the Town's treatment process of adding lime, fluoride, and chlorine, and aerating the water after it is extracted from the individual Wells 101, 102, and 103. Well Plant #1 has always had aeration as a form of water treatment. After treatment, the water is distributed throughout the system.

The finished water sample collected in April 2014 did not have any levels detected for all regulated and unregulated VOCs tested (Table 10). The three municipal wells supplying Well Plant #1 were each sampled individually during 2014. The results of the four 2014 sampling events for Wells 101, 102, and 103 are presented in Table 10. Table 11 shows the results for the four 2015 sampling events.

Only one site-related chemical was found in the unfinished water from two municipal wells. PCE was found historically in Wells 101 and 103. PCE in well 101 ranged from 0.6 to 1.0 micrograms per liter (µg/L) and was only found during two sampling events in 2014. PCE was found in a range from 2.3 to 6.3 µg/L in Well 103. Six of nine PCE sampling results in 2014 and 2015 exceed its EPA MCL of 5 µg/L. Very low levels of benzene and toluene were also found in the Well 103 sample. The levels of benzene detected since quarterly sampling began in 2014 have been well below its respective MCL. However, the levels of benzene were above either the ATSDR CREG or EPA RSL comparison values. The level of toluene found in the water in Well 103 was below all ATSDR and EPA RSL comparison values and it's MCL.

Finished water from Well Plant #1 is tested for VOCs on a quarterly basis. A very low level of PCE at 0.7 µg/L was found in the December 2015 sampling of the finished water. Previous finished water samples did not identify very low levels of PCE. The Town of Collierville's water distribution system is a blended system so no one area is served by just one well plant. Treatment

Table 9. Summary of Monitoring Well Groundwater Sampling Results – Site Related Chemicals from the groundwater sampling done as part of the TDEC 2012 Walker Machine Products (WMP) Site Investigation. All results are reported in micrograms per liter (µg/L). Bold values are those above ATSDR and EPA comparison values. Wells with designations beginning with WM are located on or associated with the WMP Site. Wells with designations beginning with WI are off-site on the Witt International property.

Chemical	WM01 (Background)	WM03 and Duplicate	WM04	WM05	WI01	WI02	WI04
1,1,1-TCA	<0.5	72 / 69	10	67	5.6	68	<0.5
1,1-DCA	<0.5	**97** / **96**	2.7 J	**61**	**3.1 J**	**73**	<0.5
1,1-DCE	<0.5	**220** / **210**	17	**200**	18	**400**	<0.5
cis-1,2-DCE	<0.5	**130** / **130**	**6.8**	**160**	**8.4**	**52 J**	<0.5
PCE	<0.5	**1,700** / **1,700**	**220**	**2,000**	<29	**370**	<15
TCE	<0.5	**130** / **130**	**11**	**150**	**7.5**	**50**	**0.99 J**

Notes:

1,1,1-TCA = 1,1,1-trichloroethane
1,1-DCA = 1,1-dichloroethane
1,1-DCE = 1,1-dichloroethylene
cis-1,2-DCE = cis-1,2-dichloroethylene
PCE = tetrachloroethylene
TCE = trichloroethylene

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.
J = estimated value of the chemical. Level present is below the calibration range of the testing device.
72 / 69 = Original sample / Duplicate sample result
Result in **Bold** shows levels of the chemical above one or more comparison value.

Table 10. Summary of Town of Collierville Water Plant #1 (WP#1) raw water municipal well sampling for the year 2014. There are 3 wells that compose the raw water source for Water Plant #1 Groundwater Sampling Results – Wells 101, 102, and 103. All results are reported in micrograms per liter (µg/L). Shaded and bold values are those above ATSDR and EPA comparison values or EPA MCLs. Water produced is then treated before being distributed to users in Collierville.

	Comparison Values			**Finished Water Entry Point A Samples - 2014**			**Well Plant #1 Raw Water Samples - 2014**														
							Well 101					**Well 102**					**Well 103**				
Chemical	**EPA MCL**	**ATSDR NC/C CVs**	**EPA RSLs NC/C**	**4/01**	**5/28**	**12/17**	**5/05**	**5/28**	**6/24**	**9/03**	**12/17**	**5/05**	**5/28**	**6/24**	**9/03**	**12/17**	**5/05**	**5/28**	**6/24**	**9/03**	**12/17**
benzene	**5**	**5/0.64**	**3.3/0.46**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	***1.6***	<0.5	***1.6***	***0.54***	***1.2***
PCE	**5**	**80/17**	**4.1/11**	<0.5	<0.5	<0.5	<0.5	*0.6*	*1.0*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	**5.7**	*2.6*	*2.3*	*3.7*	**5.3**
toluene	**1000**	**800/-**	**110/-**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	*0.7*	<0.5	*0.8*	<0.5	<0.5

Notes:

PCE = tetrachloroethylene

EPA MCL = U.S. Environmental Protection Agency Maximum Contaminant Level: Legally enforceable maximum levels of contaminants allowed in drinking water (2015).

ATSDR = Agency for Toxic Substances and Disease Registry: NC = non-cancer comparison values; C = Cancer Health Comparison Values (March 2015)

EPA RSLs = U.S. Environmental Protection Agency Regional Screening Levels: NC = non-cancer comparison values; C = Cancer Health Comparison Values (2014)

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.

5.7 = Result that is shaded and **BOLD** is above EPA's drinking water maximum contaminant level (MCL).

1.6 = Result is above a tap water ATSDR comparison value.

0.56 = Result in *italics* is a detection that is below the MCL for the chemical.

18/.64 = non-cancer/cancer health effects screening value

- = no cancer health effects screening value established because chemical is considered non-cancerous.

Table 11. Summary of Town of Collierville Water Plant #1 (WP#1) raw water municipal well sampling for the year 2015. There are 3 wells that compose the raw water source for Water Plant #1 Groundwater Sampling Results – Wells 101, 102, and 103. All results are reported in micrograms per liter (µg/L). Shaded and bold values are those above ATSDR and EPA comparison values or EPA MCLs. Water produced has been successfully treated before being distributed to users in Collierville.

	Comparison Values			**Finished Water Entry Point A Samples - 2015**				**Well Plant #1 Raw Water Samples - 2015**											
								Well 101				**Well 102**				**Well 103**			
Chemical	**EPA MCL**	**ATSDR NC/C CVs**	**EPA RSLs NC/C**	**3/18**	**6/16**	**10/09**	**12/08**	**3/18**	**6/16**	**10/09**	**12/08**	**3/18**	**6/16**	**10/09**	**12/08**	**3/18**	**6/16**	**10/09**	**12/08**
benzene	**5**	**5/0.64**	**3.3/0.46**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	OS	OS	***1.0***	***1.1***	***1.0***	***0.9***
PCE	**5**	**80/17**	**4.1/11**	<0.5	<0.5	<0.5	*0.7*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	OS	OS	**5.3**	**5.5**	**6.3**	**5.7**
toluene	**1000**	**800/-**	**110/-**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	OS	OS	<0.5	<0.5	<0.5	<0.5

Notes:

PCE = tetrachloroethylene

EPA MCL = U.S. Environmental Protection Agency Maximum Contaminant Level: Legally enforceable maximum levels of contaminants allowed in drinking water (2015).

ATSDR CVs = Agency for Toxic Substances and Disease Registry Comparison Values: NC = non-cancer comparison values; C = cancer health comparison values (March 2015)

EPA RSLs = U.S. Environmental Protection Agency Regional Screening Levels: NC = non-cancer comparison values; C = Cancer Health Comparison Values (2014)

Modifiers:

<0.5 = Chemical result is below the method detection limit of the testing device. Limit is shown.

OS = Well was out of service and no sample was collected.

5.5 = Result that is shaded and **BOLD** is above EPA's drinking water maximum contaminant level (MCL).

1.6 = Result is above a tap water ATSDR comparison value.

0.56 = Result in *italics* is a detection that is below the MCL for the chemical.

18/.64 = non-cancer/cancer health effects screening value

- = no cancer health effects screening value established because chemical is considered non-cancerous.

has been done continuously ever since the water plant was constructed in the late 1950s and is expected to continue in the future.

Indoor Air

An evaluation of the potential for vapor intrusion (VI) for on-site and off-site properties has been ongoing and has been led by EPA. Indoor air sampling was first done in October 2014. Levels of PCE and TCE at the WMP building (onsite) were elevated such that EPA performed an interim measure in March 2015, installing a sub-slab building mitigation system, to protect the health of current workers. Post-installation indoor air sampling was conducted by an EPA contractor in late March 2015 and again in October 2015.

An evaluation of the indoor air pre-mitigation and post-mitigation was completed by ATSDR and the Tennessee Department of Health's Environmental Epidemiology Program was finalized in a Letter Health Consultation in July 2015. High concentrations of chemicals exist in the soil gas beneath the site and in groundwater which may extend from the site beneath other adjacent and nearby off-site commercial buildings. Site-related chemicals were not found in the soil-gas locations along Halley Street.

Evaluation of the likelihood for VI to occur in homes and businesses both on-site and off-site should be completed by EPA to ensure that potential exposures to chemicals in indoor air do not pose a health risk to workers and residents near the WMP Site.

Exposure Pathways Analysis

The five elements to consider when deciding if a person may be exposed to a chemical are: (1) where is the chemical coming from (source), (2) what in a person's environment has been contaminated (environmental medium), (3) is there a way a person might come into contact with the chemical (exposure point), (4) how they might come into contact with the chemical (exposure route), and (5) who might be exposed to it (exposed population), An exposure pathway is complete if there is proof or expectation all 5 elements are present. The exposure pathways at the WMP Site are described in Table 12.

The environmental media transports the contaminants. Environmental media are groundwater, surface water, soils, or air. For this site, the chemicals were present in onsite soils beneath the site. The chemicals can be transported through the groundwater. The point of exposure is the place where people come into contact with the contaminated media. The route of exposure is the way the contaminant enters the body. Ways a contaminant can enter the body are through ingestion, inhalation, or dermal contact. If people came into contact with untreated water, they could be exposed through ingestion, inhalation, and dermal contact. Overall, onsite soils, groundwater, and indoor air are the possible points of exposure for this site. In the past, during site operations, the air at the site may also have been a point of exposure.

For this site, all three routes of exposure are potentially present. A person could ingest potentially contaminated water through the public water supply if the water was not successfully treated. A person could inhale the vapors of chemicals, either onsite or off-site, through inhalation of contaminated indoor air. This includes workers at Langley Wire Cloth who work in the former WMP building.

Table 12. Exposure pathways for the general public, onsite workers, and trespassers at the Walker Machine Products Site.

Source	Environmental Medium	Exposure Point	Exposure Route	Exposed Population	Time Frame	Exposure
VOCs	Surface soil	Contact with dust or soil particles	Ingestion and Dermal contact	Onsite workers	Past Present Future	Potential[2] Potential Potential
	Subsurface soil	Contact with dust or soil particles	Ingestion and Dermal contact	Trespassers	Past Present Future	Incomplete[1] Incomplete Incomplete
		Onsite excavations	Ingestion and Dermal contact	Onsite workers	Past Present Future	Potential Completed[3] Potential
VOCs	Collierville municipal water	Household tap	Ingestion, Dermal contact, Inhalation	City residents	Past Present Future	Incomplete Incomplete Incomplete
	Groundwater	Private well water	Ingestion, Dermal contact, Inhalation	Nearby residents and visitors that use private well water	Past Present Future	Potential Potential Potential
		Groundwater intrusion into excavations	Ingestion and Dermal contact	Onsite workers	Past Present Future	Potential Completed Potential
	Off-site Surface waters	Contact with dust or soil particles	Ingestion and Dermal contact	Trespassers	Past Present Future	Potential Incomplete Potential
VOCs	Air	Emissions from stored spent chemicals and from groundwater	Inhalation	Nearby residents	Past Present Future	Potential Incomplete Incomplete
				Onsite workers	Past Present Future	Potential Incomplete Incomplete

Table 12. Exposure pathways for the general public, onsite workers, and trespassers at the Walker Machine Products Site.

Source	Environmental Medium	Exposure Point	Exposure Route	Exposed Population	Time Frame	Exposure
	Soil-gas	Vapor Intrusion from chemicals in subsurface soil or groundwater beneath the site	Inhalation	Nearby residents and workers	Past Present Future	Potential Potential Potential

VOCs = Volatile Organic Compounds

[1] = Incomplete indicates at least 1 element of the exposure was or is not present

[2] = Potential indicates all 5 elements of the exposure pathway may have occurred in the past or may occur in the future.

[3] = Completed indicates all 5 elements of the exposure pathway are either expected to occur or are occurring.

Physical contact alone with a potentially harmful chemical in the environment by itself does not necessarily mean a person will develop adverse health effects. A chemical's ability to affect health is controlled by a number of other factors, including the:

- amount of the chemical a person is exposed to (dose)
- length of time a person is exposed to the chemical (duration)
- number of times a person is exposed to the chemical (frequency)
- person's age and health status, and
- person's diet and nutritional habits.

There have not been nor are there any current exposures as the finished water is tested and results reported to TDEC. In the past, WMP workers could have been exposed to hazardous chemicals as part of their jobs. Workers exposures would have been regulated by occupational safety and health practices and regulations after the Occupational Safety and Health Administration (OSHA) was established in 1971.

A sensitive population may exhibit a different or enhanced response to hazardous chemicals than will most persons exposed to the same level of hazardous chemicals in the environment. Reasons for sensitivity might include genetic makeup, age, gender, health and nutritional status, and exposure to other toxic substances. In general the elderly, with declining organ function, and the young, with immature and developing organs, are more vulnerable to toxic substances than healthy adults.

Evaluation of Health Effects

Health Effects of Site-Related Chemicals

The health effects of each of the main site-related chemicals are discussed here. It is important to note there must be an exposure over some period of time to have any potential health effects from these chemicals.

General Information on Chlorinated Solvents

Chemicals identified in groundwater at the WMP Site are grouped in a class of chemicals called chlorinated solvents. The site-related chemicals PCE, TCE, cis-1,2-DCE, 1,1-DCE, 1,2-DCA, and 1,1,1-TCA are all chlorinated solvents. They are used for a wide variety of commercial and industrial purposes, including as degreasers, cleaning solutions, paint thinners, pesticides, resins, glues, and a host of other mixing and thinning solutions. Their chlorine-containing chemical structure helps them to efficiently dissolve organic materials like fats and greases and to serve as raw materials or intermediates in the production of other chemicals. They are used widely and have been manufactured in large quantities (ATSDR 2014a, 2014b).
Chlorinated solvents in general are harmful to human and ecological health. They can cause or are suspected of causing cancer, and are toxic or harmful to aquatic organisms.

Spills and leaks of chlorinated solvents have caused widespread subsurface contamination in the environment. Commonly these chemicals, in their pure form, are present in the subsurface in the form of non-aqueous phase liquids (NAPL, the bulk chemical product), as dissolved contaminants in groundwater, associated with aquifer sediments, and as vapors in the unsaturated zone. Because the density of these NAPL's is greater than water, they tend to sink in groundwater systems. This typically creates complex spreading and groundwater contaminant plume patterns, long-term sources remaining in the subsurface, and difficult clean-up (EPA 2014).

The health evaluation of chemicals present in groundwater will focus on PCE since it is present in the highest amounts at the WMP Site, and it is present in Well 103 of the Town of Collierville's Well Plant #1. The detected chemicals in groundwater at the site, including TCE, cis-1,2-DCE, 1,1-DCE, 1,2-DCA, and 1,1,1-TCA, all have characteristics similar to PCE. All are generally clear, man-made liquids that will readily vaporize to a gas upon exposure to air. Odors of these chemicals range from a sweet odor to a sharp, harsh odor. Some are flammable like 1,1-DCE, while others are not, like PCE (ATSDR 1994, 2014a).

Chemicals like PCE and TCE are suspected or known carcinogens. Others, like cis-1,2-DCE, and 1,1-DCE are not known to cause cancer (ATSDR 2014a, 2014b, ATSDR 1996, 1994).

Benzene will also be evaluated as part of this Public Health Assessment as it too was found at low levels in a sample collected from Well Plant #1 Well 103.

Specific Information for PCE

PCE, or tetrachloroethylene, is a manufactured chemical that is widely used for dry cleaning of fabrics and for metal-degreasing. It has been used as a drycleaning solvent since World War II. It is also used to make other chemicals and is used in some consumer products. Other names for PCE include perchloroethylene and tetrachloroethene. It is a nonflammable liquid at room temperature. It evaporates easily into the air and has a sharp, sweet odor (ATSDR 2014). If PCE is spilled on the ground, some will evaporate but some may travel down into the ground. When it rains, PCE can sink through the soils and into the ground and contaminate groundwater. With time and depth in an oxygen-poor environment, the buried PCE will break down into a different chemical, TCE. Then, over time, TCE can break down into another chemical, cis-1,2-DCE.

PCE Health Effects

Effects resulting from acute (short term) high-level inhalation exposure of humans to PCE include irritation of the upper respiratory tract and eyes, kidney dysfunction, and neurological effects such as reversible mood and behavioral changes, impairment of coordination, dizziness, headache, sleepiness, and unconsciousness. The primary effects from chronic (long term) inhalation exposure are neurological, including impaired cognitive and motor neurobehavioral performance. PCE exposure may also cause adverse effects in the kidney, liver, immune system and hematologic system, and on development and reproduction (ATSDR 2014).

Regarding cancer effects, the Department of Health and Human Services, National Toxicology Program classifies PCE as a reasonably anticipated human carcinogen, and the International Agency for Research on Cancer (IARC) has determined that PCE is a probable human carcinogen. These determinations are based on limited human epidemiological studies suggesting elevated risks for esophageal cancer, non-Hodgkin's lymphoma, cervical cancer, and sufficient animal studies showing PCE-induced leukemia in rats and liver cancers in mice (NTP 2011, IARC 1995, CEPA 2001). EPA considers PCE a likely human carcinogen based on epidemiological evidence showing associations between PCE and bladder cancer, non-Hodgkin's lymphoma, and multiple myeloma (EPA 2012b, ATSDR 2014).

It must be emphasized that currently, onsite groundwater is not a public health concern because it is not used and there is no human exposure. The source of the contaminants found in Well Plant #1 has not been confirmed. Groundwater represents a potential public health concern as site-related chemicals have already reached two of the three municipal wells used to produce water for Well Plant #1. However, treated finished water produced by the Town of Collierville from Well Plant #1 is tested quarterly and is safe for drinking. Water from all Collierville well plants is blended before it is distributed to customers to ensure that contaminants are not present at levels that may be harmful to people (J. Woods, personal communication, June 26, 2014). There is no threat to public health from the finished water produced by the Town of Collierville. Overall, EEP cannot fully evaluate the off-site groundwater pathway because the extent of off-site groundwater contamination has not been completely defined. Migration of site-related contaminants toward downgradient off-site municipal wells has occurred. The extent of off-site groundwater impact should be fully delineated.

Other Environmental Considerations

Vapor Intrusion

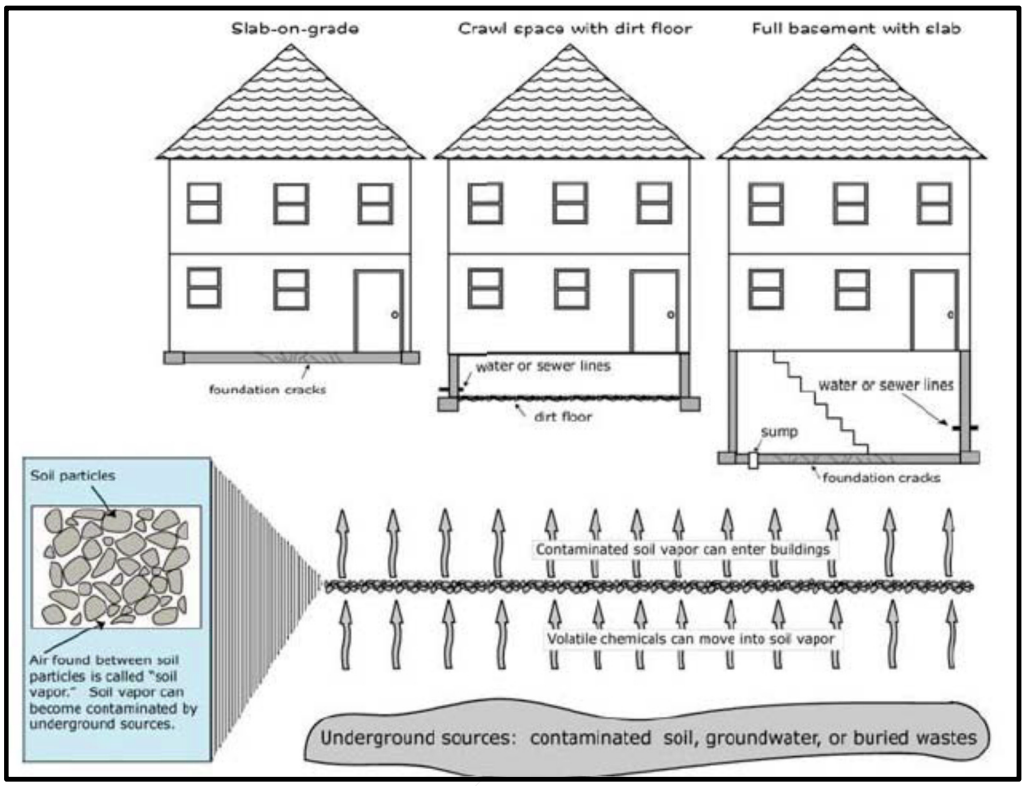
Groundwater has been shown to be impacted at the site by VOCs. The groundwater chemical plume appears to be traveling toward or being drawn to the Town of Collierville Well Plant #1. Off-site groundwater monitoring wells to the west of WMP show contaminants related to the WMP Site. Groundwater flow direction appears to be dependent on localized rainfall and season.

Vapor intrusion (VI), a rapidly developing field of science and policy, is the migration of VOCs from the subsurface into overlying buildings through the basement foundation and cracks (Figure 4). VOCs in buried wastes and/or contaminated groundwater can give off vapors that may migrate through subsurface soil and into air spaces of overlying buildings or homes through volatilization, and move to other levels and areas of the home. Inhalation exposures are not limited to buildings with basements, but can also occur for slab-on-grade and suspended floor (or crawl-space) designs as well. In most cases, chemical concentrations of VOCs are low, or depending on site-specific conditions, vapors may not be present at detectable concentrations. VI of PCE can be a public health concern because PCE is readily absorbed by the lungs (ATSDR 2006). It is important to note that exposure to VOCs due to VI does not necessarily mean that adverse health effects will occur. Whether or not a person experiences health effects depends on several factors, including the length of exposure (short-term or acute versus long-term or chronic), the amount of exposure (dose), the frequency of exposure, the toxicity of the chemical, and the individual's sensitivity to the chemical (EPA 2002).

A complicating factor in evaluating the potential risk from VI is the potential presence of some of the same chemicals from background at or above concentrations from VI. In addition to contaminants from groundwater, indoor air can be contaminated with VOCs due to the wide use in household chemicals and other products, such as cigarette smoke, paint, wood stoves, scented candles, floor wax, perfumes, pesticides, off-gassing from new furniture, and automotive exhaust from an attached garage. Similarly, VOCs can be in the outdoor air that enters a home or place of business from certain commercial and industrial facilities, such as gasoline stations and dry cleaners. Vehicle exhaust is another example of VOCs in outdoor air. Indoor and outdoor sources of VOCs can make evaluating VI migration complicated (EPA 2002).

Soil vapor, also referred to as soil-gas, is the air found in the pore spaces between soil particles. Soil vapor, containing VOCs, can enter a building through cracks or perforations in slabs or between basement floors and walls. Underground conduits, such as sewer lines and utility pipes, fractures in bedrock, or cracks in the basement slab can serve as preferential pathways for vapor migration into the home. In addition, heating, ventilation and air-conditioning (HVAC) systems and/or the operation of large mechanical appliances (e.g., exhaust fans, dryers, etc.) may create a negative pressure that can draw soil vapor into a building. Predicting the extent of soil vapor contamination from soil or groundwater contamination, as well as the potential for human exposure from soil VI into buildings, is complicated by factors that can affect soil vapor migration and intrusion. For example, soil vapor contaminant plumes may not mimic groundwater contaminant plumes since different factors affect the migration pattern of each medium (NYSDOH 2002).

Figure 4. Overview of the Vapor Intrusion Pathway



Indoor air sampling provides the most direct estimate of potential inhalation exposures to residents (EPA 2002). However; indoor air sampling data are subject to vast variation due to seasonal variations, changes in the HVAC, contaminant biodegradation processes, contaminant migration, and the presence of VOCs in indoor air from home products. Other types of sampling data that can be used to address VI issues include using sub-slab (i.e., soil vapor samples immediately beneath the foundation or slab of a building), soil vapor samples (i.e., soil vapor samples not beneath the foundation or slab of a building) or groundwater to indoor air attenuation models/factors. VI sampling data types provide chemical type, soil type, depth of the source, time of year, and a host of other factors. Potential vapors can be reduced or eliminated through engineered controls and containment systems (sub-slab depressurization, soil vacuum extraction, vapor barriers), ventilation systems (building pressurization, indoor air purifiers), avoidance (temporary or permanent receptor relocation), removal actions to reduce the concentrations of subsurface chemicals, sealing preferential pathways, and installation of sub-slab vapor mitigation system similar to the type used for radon gas control (EPA 2002).

Adults and children occupy commercial and residential buildings near the site. EPA is working to evaluate any potential exposures to occupants of nearby building, in particular WI which is in closest proximity to the WMP site and has children who visit the gymnastics business in the building for instructions and parties. No one lives immediately downgradient from the site. No VI sampling has been done off-site. EEP also determined that VI could become an issue onsite if

the site were redeveloped. This issue would need careful investigation before any redevelopment occurred. If additional buildings were constructed on the property, it would be prudent to consider incorporating a vapor mitigation system as part of their construction, if it was found that VI was a potential concern.

Previous soil-gas sampling was conducted in the area south of the main building for purposes of delineating any contamination in the southern area of the facility and the siting of groundwater monitoring wells. Levels of both PCE and TCE were found in the sub-slab soil-gas beneath the WMP building. As stated previously, a vapor intrusion mitigation system has been installed at the site. There have been two rounds of indoor air sampling since its installation. Indoor air levels of both PCE and TCE have decreased and are now low. Only one location has TCE levels remaining above its ATSDR comparison value. There are two locations that have PCE levels above its ATSDR comparison value. Further soil-gas and indoor air investigations are recommended to understand the potential for VI from chemicals off-gassing from the groundwater and migrating into the indoor air of the manufacturing building.

Child Health Considerations

A sensitive population may exhibit a different or enhanced response to hazardous chemicals than will most persons exposed to the same level of hazardous chemicals in the environment. Reasons for sensitivity might include genetic makeup, age, gender, health and nutritional status, and exposure to other toxic substances. In general the elderly, with declining organ function, and the young, with immature and developing organs, are more vulnerable to toxic substances than healthy adults.

The TDH EEP recognizes there are unique exposure risks concerning children that do not apply to adults. Children are at a greater risk than are adults to certain kinds of exposures to hazardous substances. Because they play outdoors and because they often carry food into contaminated areas, children are more likely to be exposed to contaminants in the environment. Children are shorter than adults and as a result, they are more likely to breathe more dust, soil, and heavy vapors that accumulate near the ground. They are also smaller than adults, resulting in higher doses of chemical exposure per body weight. If toxic exposures occur during critical growth stages, the developing body systems of children can sustain permanent damage. Children depend on adults for risk identification and risk management, housing, and access to medical care. Thus, adults should be aware of public health risks in their community, so they can guide their children accordingly. Child-specific exposure situations and health effects were carefully considered.

There are no children at the WMP Site. The site is not secure. There is no fence around the site. Children typically would not come into contact with any contaminants in onsite soils, groundwater, or air. Children would only come into contact with the onsite soil or air by trespassing. There does not appear to be levels of chemicals in onsite surface soils to warrant a health concern. However, there are children present daily in the former WI building. As discussed, EPA is investigating the vapor intrusion potential both on and off the site to ensure that children are not at risk for exposures to chemicals in indoor air in their homes that might harm their health.

Conclusions

EEP reached the following conclusions in this Public Health Assessment concerning the WMP Site:

1. Drinking, touching, and showering with drinking water from the Town of Collierville Well Plant #1 near the Walker Machine Products (WMP) Site is not expected to harm people's health. Based on the 2014 and 2015 quarterly sampling events, there is only a very small amount of tetrachloroethylene (PCE), less than 1 microgram per liter (µg/L) measured in the Town of Collierville Well Plant #1 drinking water distributed to customers as verified by the most recent quarterly testing. Exposures to this small amount of PCE are unlikely to be associated with any health impacts

2. It is unknown if vapor intrusion is occurring in buildings adjacent to the WMP Site because indoor air sampling has not been performed in other nearby buildings. Groundwater contamination extends from the WMP Site beneath the former Witt International (WI) building. The adjacent former WI building is known to house various businesses, one of which is a children's gymnastics studio. An evaluation of the potential for vapor intrusion (VI) is continuing at the WMP Site.

3. The health of workers performing excavation work on the site or off-site nearby should not be harmed if they come into contact with groundwater containing site-related chemicals. Groundwater is not used on the site and is inaccessible unless workers excavate a very deep trench that encounters groundwater. Groundwater is encountered at approximately 50 to 60 feet below ground surface in the vicinity of the site. The only likely way workers would come into contact with groundwater containing site-related chemicals is through sampling of onsite and off-site monitoring wells.

4. Current or future exposure to onsite surface soil contamination will not harm the health of those who work on or trespass on the site. Site-related contamination was not found in limited surface soil samples collected and tested.

5. Current or future exposure to onsite subsurface soil contamination will not harm the health of those who work on or trespass on the site. Potential site-related chemicals were found at very low estimated levels in limited subsurface soil samples collected and tested.

Recommendations

EEP recommends the following to protect the public health:

Continue monitoring and water treatment processes for the municipal water system as required by the US Safe Drinking Water Act. Continue untreated water monitoring at least quarterly to understand the fate and transport of the contaminated water plume from the WMP Site to municipal Well Plant #1 to protect the health of the water consumers.

1. EEP supports the continued evaluation of the vapor intrusion pathway conducted by EPA at the WMP Site. Specifically, EEP recommends sub-slab and indoor air sampling at the WI building to understand the potential for vapor intrusion to occur.

2. Adopt institutional controls and take proper health and safety precautions to protect any workers if site excavation activities are conducted.

Public Health Action Plan

The public health action plan for the WMP Site contains a list of actions that have been or will be taken by EEP and other agencies. The purpose of the public health action plan is to offer a plan of action designed to mitigate and prevent harmful health effects that result from exposure to hazardous substances in the environment. Included is a commitment on the part of EEP to follow up on this plan to ensure that it is implemented.

TDH EEP has:

1. Reviewed numerous reports summarizing activities performed and environmental data collected from this site.

2. Prepared this Public Health Assessment based on the previous environmental investigations conducted on the WMP Site.

3. Attended a public meeting in December 2014 with our EPA and TDEC partners and were available to answer questions of citizens at the meeting.

4. Prepared a Letter Health Consultation after reviewing results of indoor air and sub-slab soil-gas investigations done in October 2014 and March 2015. These investigations reflect sampling done before and after EPA's installation of a sub-slab mitigation system beneath the WMP building.

5. Met with employees of Langley and Town of Collierville Public Utilities Division personnel to discuss EEP's and ATSDR's work at the site.

TDH EEP will:

1. Be available to the Town of Collierville should they have questions regarding this PHA or its content.

2. EEP will review future sub-slab soil-gas and indoor air results if collected at the WMP Site and any off-site locations, if data is collected by EPA or TDEC.

3. Attend future public meetings to improve the understanding of the community and other stakeholders in the environmental regulatory process and in the improvements in the environment of the WMP Site as a result of the regulatory process.

4. Provide copies of this Public Health Assessment to state, federal, and local government.

5. Maintain dialogue with TDEC, ATSDR, EPA, other government agencies, and interested stakeholders to safeguard public health in the community of Collierville near the site.

6. Be available to review additional future environmental data and provide interpretation of the data, as requested.

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Glossary of Terms and Acronyms

acute exposure: Contact with a substance that occurs once or for only a short time (up to 14 days).

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).

ATSDR: Agency for Toxic Substances and Disease Registry.

background level: An average or expected amount of a substance in a specific environment, or typical amounts of substances that occur naturally in an environment.

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

cancer risk: The theoretical excess risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower. The excess cancer risk is often expressed as $1x10^{-6}$ for one excess cancer in 1 million people.

Cancer Risk Evaluation Guide (CREG): CREGs are environmental media (water, soil, air) specific comparison values that are used to identify amounts of cancer-causing substances that are unlikely to result in an increase of cancer rates in people that have been exposed to the media.

chronic exposure: Contact with a substance that occurs over a long time (more than 1 year).

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 health consultation process. Substances found in amounts greater than their CVs might be selected for further evaluation in the health consultation process.

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.

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

discharge: Flow of surface water in a stream or canal or the outflow of ground water from a flowing artesian well, ditch, or spring. Can also apply to discharge of liquid effluent from a facility or to chemical emissions into the air through designated venting mechanisms.

DoR: Division of Remediation.

Dense Non-Aqueous Phase Liquid (DNAPL): A DNAPL is one of a group of organic substances that are relatively insoluble in water and denser than water. DNAPLs tend to sink vertically through aquifers to an underlying, impenetrable layer.

EEP: Environmental Epidemiology Program.

Environmental Media Evaluation Guide (EMEG): EMEGs represent levels of substances in water, soil, and air, to which humans may be exposed during a specified amount of time (acute, intermediate, or chronic) without experiencing adverse health effects.

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 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: 1. a source of contamination (such as an abandoned business), 2. an environmental media and transport mechanism (such as movement through ground water), 3. a point of exposure (such as a private well), 4. a route of exposure (eating, drinking, breathing, or touching), and 5. 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.

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

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

inhalation: The act of breathing. A hazardous substance can enter the body this way.

intermediate exposure: Contact with a substance that occurs for more than 14 days and less than one year.

migration: Chemical movement from one location to another.

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

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

Oil/Water Separator: A device that allows oils mixed with water to become trapped in a holding section for removal, while the water is allowed to pass through for disposal.

ppb: parts per billion.

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.

public meeting: A public forum with community members for communication about 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.

release: A release is defined as any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing (including the abandonment or discarding of barrels, containers and other closed receptacles containing any hazardous substance, pollutant, or contaminant) into the to the air water or land.

remediation: Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a site.

risk: The probability that something will cause injury or harm. For non-carcinogen health effects, it is evaluated by comparing an exposure level over a period to a reference dose derived from experiments on animals. For carcinogenic health effects, risk is estimated as the incremental probability of an individual developing cancer over a lifetime (70 years) as a result of exposure to a potential carcinogen.

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. An environmental sample, such as a small amount of soil or water, might be collected to measure contamination in the environment at a specific location.

soil-gas: Gaseous elements and compounds in the small spaces between particles of earth and soil. Such gases can be moved or driven out under pressure.

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

source area: The location of or the zone of highest soil or ground water concentrations, or both, of the chemical of concern. The source of contamination is the first part of an exposure pathway.

surface water: Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs.

TDEC: Tennessee Department of Environment and Conservation.

TDH: Tennessee Department of Health.

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.

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

WMP: Walker Machine Products.

WI: Witt International

REPORT PREPARATION

This Public Health Assessment for the Walker Machine Products Site was prepared by the Tennessee Department of Health's Environmental Epidemiology Program under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with the approved agency methods, policies, procedures existing at the date of publication. Editorial review was completed by the cooperative agreement partner. ATSDR has reviewed this document and concurs with its findings based on the information presented.

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Appendix A. Site Photographs – December 16, 2013 and September 12, 2014

Photo 1 - The main building at the former Walker Machine Products Site, now Langley Wire Cloth Products, at 459 Washington Street. View looking south. (Photo credit: J. George, 9/12/14).

Photo 2 - View of east side of main building with paved and gravel parking areas. View looking west. (Photo credit: J. George, 9/12/14).

Photo 3 – Area of former oil/water separator that was operated by Walker Machine Products. Oil/water separator received waste water from Walker's operations. Groundwater monitoring well WM-MW-05 is located in upper center of photo. View is to the southwest. (Photo credit: J. George, 12/16/13).

Photo 4 - Photo from area of former oil/water separator. Groundwater monitoring well WM-MW-05 is located in extreme left center and well WM-MW-03 is located in upper center of photograph. View looking west. (Photo credit: J. George, 12/16/13).

Photo 5 – Southern area of Walker Machine Products property. Overgrowth and trees with Norfolk Southern railroad in background. Drum of TCE was found previously in the wooded area. View is south. (Photo credit: J. George, 12/16/13).

Photo 6 - Former Witt International property immediately west of the Walker Machine Products Site. Various businesses now occupy the property. View looking southwest. (Photo credit: J. George, 9/12/14).

Certification

This Public Health Assessment: *Evaluation of Environmental Health Concerns for the Walker Machine Products Superfund Site, Memphis, Shelby County, Tennessee*, was prepared by the Tennessee Department of Health's Environmental Epidemiology Program. It was prepared in accordance with the approved methodology and procedures that existed at the time the Public Health Assessment was prepared.