# Public Health Assessment

**Final Release**

**MIDESSA GROUNDWATER PLUME**
**MIDLAND COUNTY, TEXAS**

EPA FACILITY ID: TXN000606668

**Prepared by the**
**Texas Department of State Health Services**

MAY 21, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
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 30-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.

# PUBLIC HEALTH ASSESSMENT

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EPA FACILITY ID:  TXN000606668

Prepared by:

Texas Department of State Health Services
Epidemiology & Disease Surveillance Unite
Health Assessment & Toxicology Group
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

# Foreword

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the Superfund law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, the U.S. EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

**Exposure:** As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

**Health Effects:** If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high-risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate possible the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

**Community:** ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals, and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the public comments that related to the document are addressed in the final version of the report.

**Conclusions:** The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.
**Comments:** If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Manager, ATSDR Record Center Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-60), Atlanta, GA 30333.

## Executive Summary

The Midessa Groundwater Plume site was proposed to the United States Environmental Protection Agency (EPA) National Priorities List (NPL) on September 19, 2007. Through a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the Texas Department of State Health Services (DSHS) initiated this Public Health Assessment (PHA). The site is located between the cities of Midland and Odessa in Midland County, Texas, and consists of predominantly commercial/industrial properties and a recreational vehicle (RV) park. The environmental medium of concern is groundwater, in which 1,1-dichloroethene (1,1-DCE), tetrachloroethene (PCE), trichloroethene (TCE), and carbon tetrachloride have been identified. Multiple sources of contamination are apparent.

The contamination was first observed during routine monitoring in the Public Water Supply (PWS) for the Midessa Oil Patch RV Park which consists of two wells with 122 connections for a transient population. Private wells have been subsequently sampled. The initial round of sampling included 38 wells in March/April 2006, and a total of 45 wells were sampled in December 2007, based on available analytical data.

To evaluate the site, DSHS reviewed available data and site information to determine if the contaminated groundwater is currently, has in the past, or will in the future pose a public health hazard for residents who use groundwater.

Contaminants were detected in the PWS wells at the Midessa Oil Patch RV Park below health-based and regulatory screening values. However, 1,1-DCE, PCE, TCE, and carbon tetrachloride, were identified at concentrations equal to or above the regulatory and/or health-based screening levels in some of the nearby private wells. Exposure doses were estimated for those contaminants, and although concentrations exceeded the initial screening criteria, the calculated exposure doses based on the most likely concentrations ingested did not exceed the health guidelines for daily intake. Carbon tetrachloride was further evaluated using the published cancer slope factor; and based on subsequent conservative calculations, there is no increased theoretical lifetime cancer risk associated with carbon tetrachloride.

Although the estimated exposure dose calculations indicate that using the unfiltered water (on average) from private and PWS wells is not likely to cause adverse health effects, all wells with contaminants above the regulatory standards have been modified with filtration systems. Based on this information, the groundwater at the site currently poses **no apparent public health hazard.** There are no contaminants above the regulatory screening levels in the PWS. Based on this information, water from the PWS poses **no apparent public health hazard.**

There are no historic groundwater sampling data, and no biological testing has been conducted to evaluate past exposures to groundwater. Due to this data gap, exposure to contaminated groundwater in the past has been estimated. Based on the calculated estimates for exposures to maximum concentrations in the past, the site poses a **public health hazard** to those exposed to the highest concentrations found in one well near a known contamination source area. Some of the contaminants found on site are under reassessment by EPA, and the withdrawn Cancer Slope Factors were used to estimate theoretical cancer risk.

The Texas Commission on Environmental Quality (TCEQ) is maintaining filtration systems on affected wells while site investigation work is conducted and remediation strategies are

evaluated. Once the groundwater is remediated and the unfiltered water is safe to drink, the filtration systems will be removed. Based on this information, the water in the future will be categorized by DSHS and ASTSR as posing **no apparent public health hazard.** DSHS recommends the TCEQ and the EPA continue current efforts to pursue remediation strategies and to maintain filtration systems on affected wells to ensure clean water is available for affected businesses and residents.

# Table of Contents

Foreword ........ ii
Executive Summary ........ iv
Purpose and Health Issues ........ 1
Background ........ 1
Site History ........ 2
Land and Natural Resource Use ........ 2
Potential Source Areas ........ 3
Demographics ........ 3
Site Visit ........ 3
Environmental Contamination/Pathways Analysis/Public Health Implications ........ 3
Introduction ........ 3
Environmental Contamination ........ 5
Groundwater ........ 5
Pathways Analysis ........ 5
Toxicologic Evaluation ........ 6
Tetrachloroethene (PCE) ........ 6
Trichloroethene (TCE) ........ 9
1,1-Dichloroethene (1,1-DCE) ........ 12
Carbon Tetrachloride ........ 13
Chemical Mixtures ........ 16
Public Health Implications ........ 17
Community Concerns ........ 17
Health Outcome Data ........ 17
Children's Health Considerations ........ 18
Conclusions ........ 19
Recommendations ........ 19
Public Health Action Plan ........ 20
Actions Completed ........ 20
Actions Planned ........ 20
Authors, Technical Advisors ........ 22
References ........ 23
Tables and Figures ........ 26
Table 1 – Summary of Contaminant Concentrations (ppb) Prior to Filtration ........ 27
Table 2 – Average Groundwater Well Concentrations (ppb) Prior to Filtration from March/April 2006 through December 2007 ........ 28
Table 3 – ATSDR Public Health Conclusion Categories ........ 29
Table 4 – Estimated Exposure Dose Calculations ........ 30
Table 5 – Estimated Cancer Risk Calculations ........ 31
Figure 1 – Site Location and Demographic Information ........ 33
Figure 2 – Aerial Photograph with Well Locations ........ 34
Appendices ........ 35
Appendix A – Abbreviations ........ 36
Appendix B – Completed Exposure Pathway Evaluation of the Midessa Groundwater Plume NPL site ........ 37

Appendix C– Levels of Significant Chronic Oral Exposure to PCE Associated with Adverse Non-Cancer Health Effects ........ 38
Appendix D – ATSDR and EPA Comparison Values (ppb) ........ 39

## Purpose and Health Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) was established under the mandate of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. This act, also known as the "Superfund" law, authorized the U. S. EPA to conduct clean-up activities at hazardous waste sites. EPA was directed to compile a list of sites considered hazardous to public health. This list is termed the National Priorities List (NPL). The 1986 Superfund Amendments and Reauthorization Act (SARA) directed ATSDR to prepare a Public Health Assessment (PHA) for each proposed NPL site. In 1990, federal facilities were included on the NPL. [Note: Appendix A provides a list of abbreviations and acronyms used in this report.]

In conducting the PHA, three types of information are used: environmental data, community health concerns, and health outcome data. The environmental data are reviewed to determine whether people in the community might be exposed to hazardous materials from the NPL facility. If people are being exposed to these chemicals, ATSDR will determine whether the exposure is at levels that might cause harm. Community health concerns are collected to determine whether health concerns expressed by community members could be related to exposure to chemicals released from the facility. If the community raises concerns about specific diseases, health outcome data (information from state and local databases or health care providers) can be used to address those concerns. If ATSDR finds harmful exposures may have occurred, health outcome data also can be used to determine if illnesses are occurring and whether they could be associated with the hazardous chemicals released from the NPL facility.

In accordance with the Interagency Cooperative Agreement between ATSDR and the Texas Department of State Health Services (DSHS), this PHA was prepared for the Midessa Groundwater Plume site. This PHA presents conclusions about whether exposures are occurring, and whether a health threat is present. In some cases, it is possible to determine whether exposures occurred in the past. However, a lack of appropriate historical data often makes it difficult to quantify past exposures. If a threat to public health exists, recommendations are made to stop or reduce the threat to public health.

## Background

The Midessa Groundwater Plume site is located west of the city limits of Midland and east of the city limits of Odessa in Midland County, Texas [1]. The approximate center of the plume is located at the intersection of County Road (CR) 1290 and CR 128 between Interstate 20 to the south and US Highway 80 to the north (Figure 1) [2]. Local land use is predominantly commercial/industrial with four known residential dwellings, and city water is not available to the area.

DSHS in cooperation with ATSDR reviewed the environmental information available for the site. DSHS also evaluated the exposure pathways through which the public could contact contaminants from the site.

## Site History

In January 2006, PCE, TCE, and 1,1-DCE were detected in the PWS of the Midessa RV Park during regular monitoring by TCEQ. The system consists of a two-well blended system with 122 hookups. In March 2006, an additional 12 private drinking water wells were sampled. Two of these wells had elevated concentrations of PCE. The site was referred to the TCEQ Remediation Division for further evaluation. The Remediation Division installed filtration systems on affected wells in April 2006 and obtained access to sample additional wells. A total of ten wells have been identified with concentrations of PCE above the EPA Maximum Contaminant Level (MCL), the regulatory standard for public water systems[1]. Filtration systems were installed on these wells, including a system engineered specifically to handle the blended water at the Midessa RV Park [1, 4].

The site was transferred to the EPA Preliminary Assessment/Site Investigation Program for investigation in April 2006 [2]. During July and August 2006, 40 private drinking water wells, two PWS wells, and seven soil borings were sampled for laboratory analysis of semi-volatile organic compounds, mercury, cyanide, pesticides, polychlorinated biphenyls (PCBs), and metals, as well as volatile organic compounds (VOCs).

Groundwater is used as a source of drinking water in the mixed-use area, and more than one plume is affecting the groundwater. The primary plume, which consists of PCE, TCE, and 1,1-DCE, is generally centered at West CR 128 and CR 1290. A second plume consisting of carbon tetrachloride is centered at West CR 128 and South CR 1293. The extent and source areas of contamination are under investigation.

The Midessa Groundwater Plume site was proposed to the NPL on September 19, 2007, based on the presence of chlorinated solvents in private drinking water wells. Inclusion on the NPL allows federal funds and personnel to become available to further assess the nature and extent of the public health and environmental risks associated with the site.

## Land and Natural Resource Use

The groundwater plume is located within the Trinity Aquifer, which consists of the Antlers Formation/Trinity Sands. The water bearing zone is unconfined in this area, and overlain by the Ogallala Formation. Because there is no confining layer (i.e. clay or marl beds), the water from the Ogallala is interconnected with the Trinity [2]. The water table is recharged from rainfall and partially from discharges of the overlying formations. Based on well logs, the wells in the area are screened within 60 to 110 feet below grade surface (bgs); therefore, they are all receiving water from the same depth within the Trinity [2]. Depth to groundwater is approximately 60 feet bgs. Groundwater flows from the north-northwest to the south-southeast [1].

[1] In 1974, the U.S. Congress passed the Safe Drinking Water Act which required that EPA determine safe levels of chemicals in public drinking water (Maximum Contaminant Levels, or MCLs). The MCLs are enforceable standards that take into account technical feasibility and potential health risks.

### Potential Source Areas

As of the Screening Site Inspection Report and Hazard Ranking System (HRS) documents, both prepared by TCEQ in August and September 2007, the source(s) and extent of contamination were undefined [1, 2]. Passive soil gas sampling was conducted in March and June 2008. The primary plume, consisting of PCE, TCE, and 1,1-DCE, appears to originate from a nearby property, and it is affecting the drinking water well at the nearby Metering and Testing property, which was constructed in 2000. Other contaminants, including carbon tetrachloride are originating from areas northwest of the primary plume. No sources have been identified.

### Demographics

The Midessa Groundwater Plume site is located in an unincorporated area of Midland County, east of Odessa, Texas [Figure 1]. Based on 2000 US Census data, 11 residents live within a one-mile radius of the plume center. Based on site reconnaissance and demographic information, the land use is predominantly commercial/industrial, and there are only six housing units within one mile of the site. The Midessa RV park has potential for 122 water connections to serve its transient population. The length of visits to the park vary, as some visitors stay one night only and some stay for a few months.

### Site Visit

On April 2, 2008, DSHS personnel visited the site. There is more than one source area and more than one plume associated with the site. The main plume, which is evident in the contaminant concentrations in the drinking water well of the Metering and Testing building (GW-10), is located in a commercial/industrial area. The Midessa RV Park is located on the west side of CR 1290 near the plume center. The secondary plumes are located to the northwest in an industrial area.

DSHS, TCEQ, and EPA personnel spoke with the owner of the RV park and an employee at Metering and Testing to discuss the site and how they use their water.

## Environmental Contamination/Pathways Analysis/Public Health Implications

### Introduction

Chemical contaminants in the environment do not always result in adverse health effects in people. Adverse health effects only are possible when people actually come into contact with the chemicals. It is this contact (exposure) that people have with the contaminants that determines the potential health hazards and drives the public health assessment process.

People can be exposed to contaminants by breathing, eating, drinking, or coming into direct contact with a substance containing the contaminant. This section reviews available information to determine whether people in the community have been, currently are, or could in the future be exposed to contaminants associated with this site.

To determine whether people are exposed to site-related contaminants, investigators evaluate the environmental and human components leading to human exposure. This analysis consists of evaluating the five elements of an exposure pathway:

1.) The source of contamination,

2.) How the contaminant is transported through an environmental medium,
3.) Where the exposure occurs,
4.) How the contaminant gets into the body, and
5.) Identifying specific populations that might be exposed to contaminants.

Exposure pathways can be complete, potential, or eliminated. For a person to be exposed to a contaminant, the exposure pathway must be complete. A **completed pathway** is when all five elements in the pathway are present and exposure has occurred, is occurring, or will occur in the future. A **potential pathway** is missing at least one of the five elements, but could be complete in the future. An **eliminated pathway** is missing one or more elements and will never be completed. The following discussion incorporates only those pathways relevant and important to the site, as shown in Appendix B.

Because exposure does not always result in adverse health effects, we also must evaluate whether the exposure could be sufficient to pose a hazard to people in the community. The factors that influence whether exposure to a contaminant or contaminants could or would result in adverse health effects include:

- The toxicological properties of the contaminant,
- How much of the contaminant the individual is exposed to,
- How often and/or how long the exposure occurs,
- The manner in which the contaminant enters or contacts the body, and
- The number of contaminants involved in the exposure.

Once exposure occurs, characteristics such as age, sex, genetics, health, nutritional status, and lifestyle influence how that person absorbs, distributes, metabolizes, and excretes the contaminant.

When identifying plausible exposure scenarios, the first step is assessing the potential public health significance of the exposure. This is done by comparing contaminant concentrations to health assessment comparison (HAC) values for both noncarcinogenic and carcinogenic end points. HAC values are media-specific chemical concentrations used to screen contaminants for further evaluation. Exceeding an HAC value does not necessarily mean that a contaminant represents a public health threat, but does suggest that the contaminant warrants further consideration.

Noncancer comparison values are also known as *environmental media evaluation guides* (EMEGs) or *reference dose media evaluation guides* (RMEGs). They are based on ATSDR's minimal risk levels (MRLs) and EPA's reference doses (RfDs), respectively. MRLs and RfDs are estimates of daily human exposure to a contaminant that is unlikely to cause adverse noncancer health effects over a lifetime. Cancer risk comparison values are also known as *carcinogenic risk evaluation guides* (CREGs). They are based on EPA's chemical-specific cancer slope factors and an estimated excess cancer risk of 1-in-1-million persons exposed for a lifetime. Standard assumptions are used to calculate appropriate HAC values [3].

## Environmental Contamination

This section contains information about specific contaminants associated with the site; however, inclusion in this section does not imply that a particular contaminant represents a threat to public health. DSHS relied on the information provided in the referenced documents and assumed that adequate quality assurance/quality control (QA/QC) procedures were followed with regard to data collection, chain-of-custody, laboratory procedures, and data reporting.

Of the data reviewed, the following chemicals were detected at concentrations above the MCLs:

- PCE
- TCE
- 1,1-DCE
- Carbon tetrachloride

Ingestion of groundwater, inhalation due to indoor volatilization, and absorption through the skin are the exposure pathways of concern on site. Data to estimate the duration of exposure is not currently available. Default parameters, which assume a daily exposure, have been used to estimate exposure doses.

### Groundwater

Groundwater sampling data were collected from the Midessa RV Park PWS, private residential wells, and commercial wells. These samples were analyzed for VOCs to document the presence and extent of chlorinated solvent contamination. The concentrations of chemicals in the groundwater were compared to ATSDR's HAC values and EPA's MCLs.

The contaminants of concern are PCE, TCE, 1,1-DCE, and carbon tetrachloride. These were identified as contaminants of concern based on a comparison of available data with ATSDR and EPA human health screening values.

The only known affected public water system is the Midessa RV Park PWS (ID #1650029). The PWS currently has two active groundwater wells (GW-42 and GW-43), which empty into a common tank with a capacity to serve 122 connections at the park. A filtration system was engineered for the PWS system and is maintained by the TCEQ.

Groundwater samples from private wells at three residential addresses and 35 to 41 commercial addresses have been collected since the onset of sampling in March/April 2006 to the most recent sampling event in December 2007. The average, $95^{th}$ percentile, and highest concentrations of the contaminants of concern are shown in Table 1.

The TCEQ has installed filtration systems on ten wells to remove contaminants which exceeded the MCL [1, 2, 4]. Sampling is routinely conducted to verify that the filtration systems are effective at removing the contaminants. Contaminants were not detected after the affected groundwater passed through the final filter. The average contaminant concentration in each well prior to filtration is shown on Table 2.

## Pathways Analysis

Groundwater at the site is predominantly used for commercial business purposes, as well as limited drinking water. However, four residences have been identified, including one which is serviced by the Midessa RV Park PWS. At these locations, the water is also used for bathing and dishwashing. Sampling data indicate that water from private wells (both commercial and residential) have contained PCE, TCE, 1,1-DCE, and carbon tetrachloride in excess of current drinking water standards.

Contaminants, particularly volatile organic compounds that enter the home in potable water, present a situation in which residents could be exposed via multiple pathways. These include direct ingestion of the water, inhalation of the contaminant due to volatilization (when the contaminant becomes a gas and enters the air), and absorption of the contaminant through the skin during bathing or showering. Thus, we would consider these all to be past completed exposure pathways. Currently, filtration systems on the private drinking wells reduce contaminant concentrations to levels below analytical detection limits.

Data for air, surface soil, and surface water were not available for review. However, we do not expect exposure to these media at this site to be a significant exposure pathway. The probability of regular inhalation, ingestion or dermal contact with the contaminants from air, soil or surface water exposures is low. There are no surface water features in the area. In addition, the concentrations of contaminants in air, surface water and surface soils would be low due to the arid climate and highly permeable soils resulting in rapid evaporation and/or percolation. There is no known perched groundwater or shallow saturated zone at the site, which might allow vapor intrusion from contaminated groundwater to enter residential or commercial structures. Based on this information, indoor air quality is unlikely to be affected by the groundwater contamination.

Exposure might have occurred in the past during the initial chemical release (i.e. when the chemicals were spilled), but it is not expected to cause any adverse health effects due to the likely short duration of exposure. Therefore we believe that the outdoor air, soil, and surface water pathways pose no apparent public health hazard. The conclusion category definitions, which are used to determine what type of, if any, health hazard exists, are shown on Table 3. The exposure pathway analysis is summarized in Appendix B.

## Toxicologic Evaluation

### *Tetrachloroethene (PCE)*

PCE is a man-made solvent most commonly used in dry cleaning and as a degreaser to clean mechanical parts. There are several names for PCE, including tetrachloroethylene, perchloroethene, perc, and perchlor. PCE, like other chlorinated solvents, is a VOC with a distinctive sweet odor that can be detected by most people at concentrations of one part PCE per one million parts of air (1 part per million or 1 ppm). Some people can smell PCE at concentrations as low as 0.3 ppm [5].

A release of PCE from dry cleaners, industrial operations, or waste sites can affect soil, air, or water. Background levels of PCE are found in food and drinking water. When PCE is released, it quickly evaporates in air and is broken down by sunlight. However, if PCE gets into subsurface soils or groundwater, it can persist until it is broken down by bacteria or other attenuating processes. Degradation or “breakdown” products of PCE include TCE and DCE.

People are usually exposed to PCE by ingesting contaminated food or water. PCE does not readily pass through the skin. At the Midessa site, the most common exposure pathway is from drinking the water or breathing contaminated air during showering or washing dishes prior to the installation of filtration systems.

PCE exposure can be determined by measuring PCE in the breath for weeks following a heavy exposure. PCE and trichloroacetic acid (TCA), a breakdown product of PCE, can be detected in the blood. Although these are simple tests to perform, they are not available at most doctors' offices. Exposure to other chemicals can produce the same breakdown products in the urine and blood, and these tests cannot determine if you have been exposed to PCE or other chemicals that may produce the same breakdown products.

PCE has been detected above the US EPA MCL in five wells. The average concentration at individual wells indicated only one well has concentrations above HAC values. Exposure doses were estimated using the average concentration from the most contaminated well. The estimated dose was below the acute MRL but slightly exceeded the chronic RfD. Based on this information, adverse non-cancer health effects are not anticipated in the general population. Because of safety factors built into the RfD, health effects are not likely in those exposed to the highest possible concentration. The calculated theoretical lifetime cancer risk to PCE exposure indicated a low to moderate increased risk of cancer, based on 1 to 2 L/day water intake at the affected well. Currently, wells with PCE above the MCL are on filtration systems, which eliminate the exposure to PCE and the potential for adverse health effects from PCE exposure.

Studies have shown that high concentrations of PCE in air (100s to 1,000s ppm in air) can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Observations of dry cleaning workers, exposed to an average concentration of 15 ppm in air, indicated that response times to stimuli were longer after exposure for approximately 10 years [5]. Studies with pregnant rats have shown behavioral changes, consisting of decreased neuromuscular ability, in offspring when the mother is exposed to 900 ppm PCE in air during the first 20 days of gestation. No changes were observed in rats exposed to 100 ppm PCE in air.

An increase in liver weight and enzymes was observed in mice fed 1,000 to 2,000 milligrams of PCE per kilogram of body weight per day (mg/kg/day) and 500 mg/kg/day for five days. In a similar study, liver weight was increased in mice fed 100 mg/kg/day for six weeks. Changes in kidney weights of male rats were observed at 400 mg PCE/kg/day after 90 days.

Repeated or extended skin contact with high concentrations of PCE, as seen in accidental exposures to workers or hobbyists, may result in skin irritation.

The health effects of breathing or drinking low concentrations of PCE are unknown. The Department of Health and Human Services (DHHS) has determined that PCE may be "reasonably anticipated" to be a carcinogen [5]. The International Agency for Research on Cancer (IARC) has determined that PCE is "probably carcinogenic to humans" based on limited human evidence and sufficient animal evidence. The EPA is currently reviewing the toxicological data associated with PCE.

Once in the body, one to three percent of the PCE is converted to trichloroacetic acid, which is excreted in urine. Unmetabolized PCE is exhaled through the lungs. The half-lives of PCE in vessel-rich tissue, muscle, and adipose tissue of humans have been estimated to be 12 to 16 hours, 30 to 40 hours, and 55 hours, respectively [5].

Based on available data from 2006 and 2007, PCE concentrations in five groundwater wells in the Midessa Groundwater Plume area have exceeded the MCL (5 ppb) for at least one sampling event. An average PCE concentration was calculated (33.37 ppb) using half the detection limit for non-detected concentrations from the March 2006 through December 2007 data sets [Table 1]. The 95$^{th}$ percentile value was considerably less than the average, which indicates that the data set contains outliers.

When the average from each well is calculated, it is evident that only three wells exceed the MCL [Table 2]. Of these wells, only one exceeds the HAC values for PCE. Based on this information, the average PCE concentration was deemed inappropriate to assess human health effects.

The well with the highest concentrations of PCE (GW-10) is located near an identified source area and serves a light industrial company. This company purchased the property in 2000 and moved into the building in 2001. Filtration systems were installed in 2006. Concentrations of PCE in this well ranged from 1,000 ppb to 1,600 ppb. All of these concentrations exceed the RMEG for children and adults. The average concentration for this well (1,300 ppb) was used to determine if adverse non-cancer health effects could be anticipated in workers exposed to water from that well. Because of the light industrial nature of the site, it is not likely that children will be exposed to the water. An exposure dose was estimated using the following default parameters: intake rate of water for adults, two liters of water per day (2 L/day); availability factor, 1; exposure frequency, 1 to reflect daily exposure; and adult body weight, 70 kg. The estimated exposure dose for adults is 0.037 mg/kg/day. This is less than established MRL for acute effects, but it exceeds the chronic oral RfD (0.01 mg/kg/day). When the water intake is changed from the default 2 L/day to 1 L/day to account for the shorter 8-hour work day, the estimated exposure dose changes to 0.019 mg/kg/day, which remains slightly higher than the RfD.

The MRL for acute oral exposure is based on animal studies in which mice exposed to 5 mg PCE/kg/day through a feeding tube exhibited hyperactivity. The exposure concentration was extrapolated by dividing the animal exposure by 100 to account for uncertainties, including use of a Lowest Observed Adverse Effect Level (LOAEL), use of animal effects to predict human effects, and variability among humans [5]. The RfD is based on No Observed Adverse Effect Level (NOAEL) and results from 6-week long animal studies in which liver toxicity and weight gain were observed. The exposure concentration (14 mg/kg/day) was multiplied by an uncertainty factor of 1,000 [6].

Showering with the water that has the highest PCE concentration was considered; however, the business at GW-10 does not have a shower facility. To address dermal contact from hand and arm-washing, the dermal exposure dose (ED) was estimated using the following calculation:

$$ED = (C \times P \times SA \times ET \times CF)/BW$$

The concentration (C, 1600 ppb) is multiplied by the permeability coefficient (P, 0.33 cm/hr), surface area (SA, 2,300 $cm^2$ and 820 $cm^2$, the default values for an 18 to 70 year old male's arms and hands), exposure time (ET, 10 minutes a day), and a conversion factor (CF). The value is divided by body weight (BW, 70 kg, default body weight for an adult). The resulting cumulative exposure dose is estimated at 0.00039 mg/kg/day [5, 7]. The additive effect of the dermal exposure to total exposure from ingestion is negligible (0.04639 mg/kg/day), and does not greatly change the outcome of the estimated exposure dose.

The chronic RfD is fairly conservative, given that it is based on the NOAEL and given the additional protectiveness of the uncertainty factor (1,000). The calculated cumulative exposure dose (ingestion and dermal contact) is based on the known worst-case scenario. It is unlikely that those exposed to the highest concentration of PCE in the past have experienced adverse non-cancer health effects. [See Appendix C for a graphic of chronic health effects.]

The EPA has withdrawn the CSF for PCE, and a new one has not been adopted to estimate theoretical cancer risk. DSHS calculated the theoretical excess lifetime cancer risk using the withdrawn EPA CSF. CSFs are based on mathematical models that are applied to epidemiologic or experimental data for carcinogenic effects. The CSF incorporates assumptions and thresholds so that they generally overestimate the theoretical risk value [3].

The average PCE concentration from GW-10 (1,300 ppb) was used to calculate the theoretical cancer risk estimate [Table 5]. A seven-year exposure period was used to conservatively calculate estimated cancer risk from past exposures for this well. The US EPA considers a theoretical cancer risk estimate from $1 \times 10^{-4}$ to $1 \times 10^{-6}$ to be "acceptable". The theoretical cancer risk estimate for the people drinking from the effected well is $1.4 \times 10^{-3}$. This indicates "moderate increased risk" from PCE exposure, based on the default water intake of 2 L/day. When the industrial property use at GW-10 is considered and the water intake of 1 L/day is used, the theoretical lifetime cancer risk is $7.14 \times 10^{-4}$, which is a "low" to "moderate increased risk." Water ingestion varies by person, and it is possible that people consumed more than 1 L of water per day at this site, given the local climate.

PCE is under reassessment by EPA. Based on theoretical lifetime cancer risk estimates using the withdrawn CSF, past exposure to PCE posed a **public health hazard.**

The wells affected by PCE above the USEPA's MCL are on filtration systems, maintained by the TCEQ. TCEQ plans to maintain the filtration systems in the future or until the source of the contamination is remediated. Based on this information, the contaminated water currently and in the future poses **no apparent public health hazard.**

***Trichloroethene (TCE)***

TCE is a man-made chlorinated solvent that is commonly used to clean metal machine parts. It is contained in many consumer products including adhesives, spot removers, paint removers, and type writer correction fluid. It is a colorless, sweet-smelling liquid that reportedly has a burning taste. Most people will begin to smell TCE at 100 ppm in air.

When TCE enters the environment, it can volatilize quickly, and it will breakdown in one week. It can travel through soil to groundwater. Once in groundwater, it will sink to the bottom of the aquifer, and very little amounts of TCE will dissolve in the water column. It does not build up in plants or animals, and it does not build up in the body [8].

> TCE has been detected above the US EPA MCL in two wells. The average TCE concentration in all but one well was below the MCL. Exposure doses were estimated using the average concentration from the most affected well, and the calculated dose for adults and children were below ATSDR's MRL for acute exposure. There are no health-based screening values to evaluate long-term exposure effects. Based on this information, adverse non-cancer health effects are not anticipated in the general population, and acute health effects are not anticipated in those exposed to the highest TCE concentration. Wells with TCE levels above the MCL are on filtration systems.

People are exposed by breathing air or drinking or using water contaminated with TCE. These exposures generally occur in areas near factories that use TCE or near hazardous waste sites with TCE contamination. Workers at facilities that use TCE may be routinely exposed to the chemical. Half the TCE that is inhaled is removed from the body through exhaling, while the remaining portion gets into the bloodstream. TCE that is ingested also will travel to the blood. Once in the blood, TCE may be eliminated from the body or may be stored in body fat. TCE is eliminated by exhaling, or it travels to the liver where it is broken down into other compounds that are excreted in urine within a day. Breakdown products of TCE are stored in body fat [8].

TCE was once used as an anesthetic for surgery because inhalation of large amounts of TCE makes people dizzy or sleepy and could result in a loss of consciousness. Inhalation of moderate levels of TCE may result in headaches or dizziness, while exposure to higher concentrations may result in damage to facial nerves, liver and kidney damage, changes in heart beat, or possibly death. Dermal exposure to concentrated solutions of TCE may result in skin rashes [8].

Some studies have suggested that long term exposure to high levels of TCE in drinking water may result in an increase in adverse birth outcomes such as childhood leukemia, heart defects, a rare defect in the respiratory system, eye defects, neural tube defects, oral cleft palates, and hearing and speech impairments; however, the results of these studies are not conclusive [8].

Experimental studies in animals have shown an increase incidence of malignant and/or a combination of malignant and benign tumors at multiple tissue sites in multiple species of animals after exposure to TCE via inhalation. In mice TCE induced tumors of the liver, lung, and blood at 1,000 mg/kg/d. In rats, exposure to the same TCE dose resulted in kidney cancer, interstitial-cell tumors of the testis, and possible leukemia [8].

The National Toxicology Program (NTP) has classified TCE as "reasonably anticipated" to be a human carcinogen based on limited evidence on carcinogenicity in human studies. The IARC has determined that TCE is "probably carcinogenic" to humans, based on limited human evidence. TCE is currently "under review" by the EPA.

Tests to determine if people have been exposed to TCE are available; however, they are not routinely performed in a doctor's office. Breath tests conducted soon after exposure can indicate if people have been exposed to a large or small amount of TCE. Breakdown products of TCE can be measured in the urine. Urine tests can produce the same results up to a week after exposure; however, other chemicals can produce the same breakdown products making exposure to TCE difficult to determine [8].

Based on available data from 2006 and 2007, TCE concentrations in two groundwater wells in the Midessa Groundwater Plume area have exceeded the MCL (5 ppb) during at least one sampling event. When the sampling data from each well was averaged, only one well (GW-10) had a concentration above the MCL. There are no other HAC values for comparison. Based on this, the general population is unlikely to experience adverse non-cancer health effects from TCE exposure. Because only one well is elevated, it is inappropriate to use the average of all wells (1.62 ppb) to assess the potential for adverse health effects.

The well with the highest concentrations of TCE (GW-10) is the same well mentioned above, which is located within the identified source area that serves a light industrial company. Concentrations of TCE in this well ranged from 42 ppb to 64 ppb. All of these concentrations exceed the MCL. The average concentration for this well (53 ppb) was used to determine if adverse health effects could be anticipated.

Using the average, the estimated doses for adults (0.0015 mg/kg/day) and for children (0.0033 mg/kg/day) were determined to be 100 times less than the established MRL (0.2 mg/kg/day) for acute (0 to 14 days) exposure [Table 4]. The dermal exposure estimate was calculated using the same methods as discussed for PCE, the highest TCE concentration (64 ppb), and the permeability coefficient for TCE (0.012 cm/hr) [7]. The estimated dermal exposure dose ($5.7 \times 10^{-6}$ mg/kg/day) results in a negligible change in cumulative exposure (0.0018057 mg/kg/day, compared to 0.018 mg/kg/day for ingestion).

The acute MRL is based on a LOAEL at which neurological effects were observed. An uncertainty factor of 300 was incorporated into the MRL [8]. There are no other health-based screening values to compare chronic exposure. Based on these calculations, adverse non-cancer health effects are not anticipated even at the highest possible exposure dose.

The EPA has withdrawn the CSF for TCE, and a new one has not been adopted to estimate theoretical cancer risk. In an effort to evaluate past exposures, the withdrawn CSF was used.

The average TCE concentration from GW-10 (53 ppb) was used to calculate the theoretical cancer risk estimate [Table 5]. The US EPA considers a theoretical cancer risk estimate from $1 \times 10^{-4}$ to $1 \times 10^{-6}$ to be "acceptable". The theoretical cancer risk estimate based on the default water intake of 2 L/day is $4.31 \times 10^{-5}$. This indicates "no apparent increased risk" from TCE exposure. When the industrial property use at GW-10 is considered and the water intake of 1 L/day is used, the theoretical lifetime cancer risk does not change significantly. Water ingestion varies by person, and it is possible that people consumed more than 1 L of water per day at this site, given the local climate.

TCE is under reassessment by EPA. Based on known non-carcinogenic health effects levels and the withdrawn CSF, past exposure to TCE posed **no apparent public health hazard.**

The wells affected by TCE above the USEPA's MCL are on filtration systems, maintained by the TCEQ. TCEQ plans to maintain the filtration systems in the future. Based on this information, the contaminated water currently and in the future poses **no apparent public health hazard.**

### *1,1-Dichloroethene (1,1-DCE)*

1,1-DCE is a man-made chlorinated compound that is used in the manufacture of flexible plastics, flame-retardant coatings, and polyvinyl chloride. 1,1-DCE is a colorless liquid with a mild sweet odor that evaporates quickly. When small amounts are released to soil or water, it can evaporate, but if released in large quantities, it can contaminate soil and water. In the air, it can be broken down in four days. If the 1,1-DCE does not evaporate from surface water, it will be slowly broken down. It is not taken up by birds or fish. When it enters soil, the 1,1-DCE that does not evaporate can contaminate groundwater [9].

> 1,1-DCE was detected above the US EPA MCL in four wells. The average 1,1-DCE concentration at individual wells was below the MCL in all but one well. The concentrations in that well were compared to the available HAC values which indicates no adverse health effects are anticipated from ingestion of the water at that location.

Potential exposure pathways for 1,1-DCE in general include inhalation, ingestion, or dermal contact. Specifically, these exposures can occur during cooking, bathing, washing dishes, or showering with contaminated water. People living very near factories that make 1,1-DCE or use it in manufacturing processes can also be exposed to 1,1-DCE in the air.

When a person inhales air contaminated with 1,1-DCE, some of the chemical leaves the body in the exhaled breath. If contaminated food is ingested, the DCE leaves the body in the urine within approximately one to two days. The way the body rids itself of DCE depends on the concentration to which it was exposed. The higher the concentration of DCE, the more of it is released from the lungs.

Breathing high levels of DCE can cause fainting. Breathing very high levels can result in death. Animals exposed to high levels had liver and kidney damage. Pregnant animals exposed to DCE in air gave birth to offspring with birth defects, but animals exposed to DCE in drinking water did not experience birth defects. In other animal studies, rats that were exposed to 9 mg/kg/day (50 ppm in water) in utero, during lactation, through weaning, and into adulthood developed liver cell changes. This is the basis for the chronic MRL.

DCE exposures can be detected in breath, blood, body tissues, and urine. These tests can only detect very high levels of chemical exposure. They are not routinely performed at a doctor's office because they require special equipment.

The EPA has determined that 1,1-DCE is a "possible human carcinogen" based on no human and limited animal studies. The IARC has determined that 1,1-DCE is "not classifiable" as to human carcinogenicity. The US Department of Health and Human Services has "not classified" 1,1-DCE with respect to carcinogenicity [9]. No information is available to evaluate the cancer risk due to DCE exposure.

Based on available data from 2006 and 2007, DCE concentrations in four groundwater wells in the Midessa Groundwater Plume area have exceeded the MCL (7 ppb) during at least one sampling event. An average DCE concentration was calculated (1.12 ppb) using half the detection limit for non-detected concentrations from the March 2006 through December 2007 data sets. The average concentration is less than the MCL. Based on this, the general population is unlikely to experience adverse non-cancer health effects from DCE exposure.

As observed for PCE and TCE, when the average concentration of 1,1-DCE was calculated for each well, only one well (GW-01) had an average concentration (11.5 ppb) above the MCL. This concentration does not exceed the HAC values available for 1,1-DCE. Based on these calculations, adverse non-cancer health effects are not anticipated even at the most contaminated well.

The highest 1,1-DCE concentrations were identified in a residential well. This area of contamination may be from a different source than the one affecting GW-10. To address the effects of showering on residents, dermal contact was considered. Using the previously mentioned equation, the permeability coefficient for 1,1-DCE ($1.2 \times 10^{-2}$ mg/kg/day), and a default body area of 19,400 $cm^2$ a dermal exposure dose was calculated for showering ($8.9 \times 10^{-6}$ mg/kg/day).

Additionally, the exposure to air while showering was considered as a possible exposure source. Using the following equation, the concentration of shower stall air ($C_{air}$) was calculated:

$$C_{air} = C_{water} (HV_{water}/HV_{air} + V_{water})$$

$C_{water}$ is the highest concentration in water (16.1 ppb); H is the Henry's Law constant at 40° C, or 104° F (1.68); $V_{air}$ is the volume of air in a typical shower stall (1.5 $m^3$); and $V_{water}$ is the volume of water used during a 10-minute shower with a 10L/minute flow rate. This mathematical model assumes no contaminant ever leaves the shower (through draining) [10, 11]. The resulting air concentration (1.03 ppb) is significantly lower than the available health assessment screening criteria, which is the intermediate MRL (20 ppb), and when considered with the dermal exposure doses, the inhalation pathway exposure is negligible.

Based on the exposure dose calculations of past exposures and the plans of TCEQ to maintain filtrations systems, the concentrations of 1,1-DCE in the past, present and future pose **no apparent public health hazard.**

### *Carbon Tetrachloride*

Carbon tetrachloride is a man-made chemical that evaporates very quickly and is typically found as a gas. People can begin to smell the sweet odor of carbon tetrachloride at 10 ppm in air. Carbon tetrachloride has been used in the past as refrigeration fluid and aerosol propellant, but the use and manufacture of carbon tetrachloride has declined due to the adverse impact of carbon tetrachloride on the ozone layer. In the 1960s, the use of carbon tetrachloride as a dry cleaning solvent, in degreasers, in fire extinguishers and as a grain fumigant was discontinued. The use of carbon tetrachloride in pesticides was discontinued in 1986 [12].

When carbon tetrachloride gets into the environment, it usually forms a gas. Carbon tetrachloride can remain in the air for several years before it is broken down to other chemicals. It will quickly evaporate from surface water, but it can remain in groundwater for months. It is not expected to build up in fish, but the accumulation in plants is unknown. People can be exposed to low background levels in soil, air, and/or water due to the historical uses.

> Carbon tetrachloride was detected above the US EPA MCL in one well. Exposure doses were estimated using the average concentration from the affected well, and the calculated dose for adults and children were below ATSDR's MRL for acute and intermediate exposure. The children's estimated exposure dose exceeded the EPA's chronic RfD, but it is unlikely that a child would consume a full daily water intake at the light industrial location. No adverse non-cancer health effects are anticipated from exposure to carbon tetrachloride at the highest concentration observed. The theoretical estimated cancer risk indicates "no apparent increased risk" of cancer from the carbon tetrachloride in the water.

Based on available data from 2006-2007, carbon tetrachloride was above the USEPA MCL in one well. This well is located at a light industrial property, so the exposure on site is limited to ingestion, dermal contact, and some inhalation from running tap water or coffee makers.

Studies indicate that when you inhale carbon tetrachloride, 30-40% enters your body, where it can accumulate in body fat temporarily. Some can enter other organs and skeletal muscle. When you breathe or drink carbon tetrachloride, most of the chemical leaves the body very quickly, typically through the exhaled breath (34-75%) within a few hours. Some (20-62%) of carbon tetrachloride leaves the body in feces, while very little is excreted in urine.

Medical tests are available to determine if a person has been exposed to carbon tetrachloride. However, the tests require special equipment, and because carbon tetrachloride leaves the body quickly, the test would have to be conducted within days of exposure. If conducted quickly, the test will only be able to determine if a person was exposed, but it will not be able to tell if health effects will occur.

The EPA has determined that carbon tetrachloride is a "probable human carcinogen," based on sufficient animal studies but inadequate human studies. The DHHS considers carbon tetrachloride to be "reasonably anticipated" to cause cancer, and the IARC has determined that it is "possibly carcinogenic", based on limited human evidence and less than sufficient evidence in animals.

Human health effects have been observed after acute exposure to 80 to 180 mg/kg carbon tetrachloride, and liver toxicity was observed. Depression of the nervous system has been observed at doses of 114 mg/kg and 10,800 mg/kg. Nausea in humans was observed after ingestion of single doses greater than 100 mg/kg. In lab animals, mild liver effects were observed after doses of 40 to 80 mg/kg. Kidney effects were observed in dogs given 3,200 to 6,400 mg/kg doses.

The EPA has established an MCL of 5 ppb for carbon tetrachloride. One well had concentrations that exceed the MCL. The same well also exceeds the RMEG for children (7 ppb) and the CREG of (0.13 ppb) (Appendix D). CREGs are established at concentrations which are unlikely to cause "increased" risk of cancer (less than one in 1,000,000). The analytical method detection limit for all sampling events was above the CREG.

The average carbon tetrachloride concentration at each well was calculated by taking half of the detection limit, where applicable. Because the analytical detection limit was higher than the CREG, most of the averages exceeded the CREG. This does not mean that carbon tetrachloride is present in these wells. More likely, if present, carbon tetrachloride would have been "estimated" using analytical methods below the detection limit. None of the wells had estimated concentrations of carbon tetrachloride. The calculated averages at all but one well were less than the MCL. Based on this, the general population is unlikely to experience adverse non-cancer health effects from carbon tetrachloride exposure.

The well which has an average concentration above the MCL is located northwest of the RV park at an industrial property (GW-40). To determine if adverse non-cancer health effects are likely from drinking water at this location, an exposure dose was calculated using default parameters previously mentioned and the average concentration from the affected well (16.2 ppb) [Table 4].

The estimated doses for adults (0.00046 mg/kg/day) and children (0.0010 mg/kg/day) were below the established MRL (0.02 mg/kg/day) for acute (less than 14 days) exposure. The estimated dose for adults and children is also less than the intermediate MRL (0.007 mg/kg/day). No chronic MRL has been established. The EPA has set a chronic oral RfD of 0.0007 mg/kg/day. The adult exposure dose does not exceed the chronic RfD. The children's exposure dose exceeds the chronic RfD, but it is unlikely that a child would drink the default quantity of water (1 L/day) at that light industrial location.

The dermal exposure estimate was calculated using the same methods previously discussed, the highest concentration at the location (24 ppb), and the permeability coefficient for carbon tetrachloride (0.016 cm/hr) [7]. The estimated dermal exposure dose ($2.9 \times 10^{-6}$ mg/kg/day) results in a negligible change in cumulative exposure (0.0006829 mg/kg/day, compared to 0.00068 mg/kg/day for ingestion).

The acute MRL is based on a LOAEL of 5 mg/kg/day administered to rats that developed mild liver problems. An uncertainty factor of 300 is incorporated into the acute MRL. The intermediate LOAEL is based on a study which provided the lowest LOAEL of similar studies. In the study, 0, 1, 10, or 33 mg/kg carbon tetrachloride were given by gavage for 5 days/week for 12 weeks. No kidney effects were observed at any level. Slight changes in the liver were observed at 10 mg/kg but not at 1 mg/kg (the NOAEL). The NOAEL was adjusted for the exposure period, and divided by an uncertainty factor of 100 [12]. The same study was used to derive the chronic RfD, which is based on the adjusted NOAEL of 0.71 mg/kg/day and incorporates an uncertainty factor of 1,000 [13].

Carbon tetrachloride is the only contaminant associated with the groundwater plume that has a current CSF. CSFs are based on mathematical models that are applied to epidemiologic or experimental data for carcinogenic effects. The CSF incorporates assumptions and thresholds so that they generally overestimate the theoretical risk value [3]. The US EPA considers a theoretical cancer risk estimate from $1 \times 10^{-4}$ to $1 \times 10^{-6}$ to be "acceptable".

The highest carbon tetrachloride concentration (24 ppb) and a default residency time of 30 years were used to calculate the theoretical cancer risk estimate [Table 5]. The theoretical cancer risk estimate is $1.9 \times 10^{-5}$. This indicates "no apparent increased risk of cancer" from carbon tetrachloride exposure.

Based on the exposure dose calculations of past exposures and the plans of TCEQ to maintain filtrations systems, the concentrations of carbon tetrachloride in the past, present and future pose **no apparent public health hazard.**

**Chemical Mixtures**

The term "chemical mixtures" refers to the concept of simultaneous exposure to multiple chemicals, as seen with PCE, TCE, DCE, and carbon tetrachloride at this site. It is possible that chemicals with the same target organ may have additive effects on that target organ. The *Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures*, prepared by ATSDR, was used to evaluate the potential health effects from exposure to mixtures of chemicals [14].

Dose additivity and non-cancer health effects are evaluated by calculating hazard quotients (HQ) using the estimated exposure doses and available health guideline values. If two of the calculated HQs for chemicals with the same target organ exceed 0.1 then further evaluation of the mixture is warranted [14].

The contaminants of concern have common target organs, specifically the nervous system and liver. There is no evidence to indicate that the levels present will cause an additive nervous system effect. None of the HQs calculated for this site were near or above 0.1 for adult or child nervous system exposure.

The combined HQs for liver effects exceeded 0.1, mainly due to the EPA's RfD, which is based on liver effects in rodents. However, the liver has not been shown to be a target organ in humans [5]. Based on this information, non-cancer health effects are not anticipated for the chemical mixture.

TCE and PCE were of concern in the past at GW-10. The health effects of these two contaminants are specifically discussed in an ATSDR *Interaction Profile* [15]. As previously discussed, TCE is eliminated through urine, and PCE is predominantly eliminated through the lungs while breathing. In general, the body will metabolize (break down) chemicals after an exposure. Sometimes, the metabolites (breakdown products) are more hazardous than the parent compound. TCE and PCE are metabolized by the same metabolic pathway in the body, and there is evidence that suggests PCE interferes with the metabolism of TCE. This may decrease the non-cancer and cancer health effects of TCE. The affect of TCE on PCE metabolism and toxicological effects is not anticipated to be of toxicological significance [15].

TCE and PCE are known to affect kidney weight. Animal studies have shown that daily doses of 500 mg/kg/day TCE and 600 mg/kg/day of PCE when administered orally to rats have caused a decrease in kidney weight [15]. These doses are orders of magnitude higher than those calculated for exposures at GW-10 [Table 4].

These chemicals are currently being reassessed for carcinogenicity by the EPA. However, to evaluate the past exposures at GW-10, the withdrawn CSFs were used. Based on the *Interaction Profile,* the theoretical lifetime cancer risk of the mixture might be less than additive because PCE interferes with the metabolism of TCE, and PCE is poorly metabolized [15].

## Public Health Implications

In the past, residents who drank contaminated groundwater were likely exposed to contaminants (PCE, TCE, 1,1-DCE, and carbon tetrachloride) at levels above current regulatory and/or health standards. Exposure doses were calculated to estimate the potential for adverse health effects. Default parameters and a daily intake were assumed. Based on the currently available data, calculated exposure doses, and current toxicological information, in the past, the use of this groundwater posed an apparent public health hazard to people exposed to the highest concentrations of contaminants.

Filtration systems have been placed on the wells with contaminants above the MCLs, making the previously completed exposure pathways no longer "complete". Because filtration systems are installed and exposure is not at concentrations expected to cause any adverse health effects; we have concluded that contaminants in the water currently pose no apparent public health hazard. At this time the TCEQ plans to maintain the filtration systems on affected wells while they investigate the contamination source areas and plan for remediation. Once remediated, the groundwater will not require filtration prior to ingestion. Based on the maintenance of filtration systems and the future potential for remediation, the site poses no apparent public health hazard in the future.

### Community Concerns

In April 2008, DSHS made efforts, either in-person or via telephone, to contact those businesses and residents affected by the groundwater plume. On June 30, 2008, DSHS sent a letter to affected businesses and residents advising of the DSHS/ATSDR data review, requesting concerns and comments to be directed to DSHS staff, and including fact sheets about the Public Health Assessment process.

On August 7, 2008, TCEQ, EPA, and DSHS participated in an availability session at the RV park. DSHS provided information about the PHA process and potential health effects associated with exposure to the contaminants on site. One resident had concerns about the dissolved minerals in her water, which EPA determined may indicate that one of the filters should be changed more frequently than every 30 days. The same resident asked if her mother's lymphoma and her husband's myeloma were associated with the site. Her well is not impacted with a known human carcinogen, and although it is not possible to determine the cause of her family members' illness, it is not attributable to the site contaminants.

### Health Outcome Data

Health outcome data record certain health conditions that occur in populations. These data can provide information on the general health of communities living near a hazardous waste site. They also can provide information on patterns of specified health conditions. Some examples of health outcome databases are tumor registries, birth defects registries, and vital statistics.

Information from local hospitals and other health care providers also can be used to investigate patterns of disease in a specific population.

Although the available data indicate some contaminants are above the screening values, estimated exposure doses, which were calculated using worst-case scenario default parameters, are below MRLs and/or RfDs for the majority of the wells. Theoretical lifetime cancer risk calculations, which were calculated for a 30-year exposure period and a 70-year lifetime, indicated that there is "no increased risk" of developing cancer from exposure to carbon tetrachloride from (GW-40, the only well above the MCL), but there the estimated increased risk of lifetime cancer from PCE exposure in GW-10 is "unacceptable."

Health outcome data are based on residential addresses. The people who may have been affected by the PCE exposure work in the area, but they do not reside there. The health outcome data for the business zip code would not reflect the health of the worker population. Based on this information, a review of health outcome data is not warranted at this time.

## Children's Health Considerations

DSHS and ATSDR recognize that the unique vulnerabilities of infants and children demand special consideration. Children may be at greater risk than adults for certain kinds of exposures to hazardous substances emitted from waste sites and emergency events. Children may be more likely to be exposed because they play outdoors and often bring food into contaminated areas. They are shorter than adults, which mean they breathe dust, soil, and heavy vapors close to the ground. Children also are smaller, resulting in higher doses of chemical exposure per body weight. Children's developing bodies may sustain permanent damage if toxic exposures occur during critical growth stages. Children depend completely on adults for risk identification, their personal welfare, housing decisions, and access to medical care.

To address the potential health effects of the on-site contaminants to children, exposure doses were calculated using conservative default parameters, including a 16 kg body weight, 1 L/day ingestion rate, and a daily exposure. The estimated doses either fell below the screening values established for the onsite contaminants or were elevated at industrial sites where children are not likely to be present.

## Conclusions

1. Data indicate that one well has been affected by close proximity to a contaminant source area. The industrial property at that location began operations in 2001. There are no historical data or QA/QC information since the onset of pumping of the well through 2006. To evaluate the effects of past exposure, averages of recent data were used. Based on available toxicological information and data, as well as the most recent Cancer Slope Factors to estimate theoretical cancer risk, the site posed a **public health hazard** in the past for those individuals exposed to water from the affected well (GW-10).

2. Data indicate PCE, TCE, 1,1-DCE, and/or carbon tetrachloride levels in public and private wells exceeded their respective MCLs or health comparison values. Calculated exposure doses indicate health effects are unlikely to occur from ingesting the water at these locations. Based on current toxicological data, the site posed **no apparent public health hazard** to residents and well users at other locations in the past.

3. Currently, the filtration systems installed on the private and PWS water wells appear to be effective at keeping contaminant levels below current health-based standards. Based on this information, we have concluded that the contaminants in the private and PWS water wells currently pose **no apparent public health hazard**.

4. The TCEQ plans to continue the maintenance and service of the existing filtration systems on the public and private wells until the groundwater is remediated. Based on this information, the water in the future will pose **no apparent public health hazard.**

## Recommendations

1. EPA and TCEQ should continue to monitor and maintain filtration systems to insure proper operation unless an alternative drinking water source is available.

2. EPA and TCEQ should continue to investigate the source and extent of the groundwater contamination.

3. Once the source of the groundwater contamination is identified, it should be remediated under the oversight of EPA and TCEQ.

## Public Health Action Plan

### Actions Completed

1. In January 2006, TCEQ identified PCE, TCE, and DCE at detectable levels in the Midessa Oil Patch RV Park PWS. In March 2006, TCEQ obtained access to private wells and began sampling the private wells in the area.

2. The TCEQ installed filtration systems on wells that exceeded the MCLs for PCE, TCE, DCE and/or carbon tetrachloride in April, 2006.

3. In April 2006, the site was forwarded to the EPA Preliminary Assessment/Site Investigation Program for additional investigation. Forty private wells and two PWS wells were sampled in July and August 2006.

4. In September 2007, the TCEQ completed a Hazard Ranking System (HRS) report for the Midessa Groundwater Plume, and the site was proposed to the NPL on September 19, 2007.

5. On April 2, 2008, representatives of EPA, TCEQ, and DSHS met with the RV park owner to answer questions about potential health effects associated with the contaminants on site. Fact sheets about the site, the known contaminants, and health effects were provided to the RV park.

6. During April 2008, DSHS staff contacted individuals or representatives of businesses affected by the site either in person or via the telephone.

7. On June 30, 2008, DSHS staff mailed information to affected residents and businesses to inform them of the Public Health Assessment process and to solicit health concerns.

8. On August 7, 2008, DSHS staff participated in an availability session with the EPA and TCEQ at the RV Park. Fact sheets about the PHA process and contaminants of concern were provided.

9. From October 27 through November 27, 2008, the public was given the opportunity to make comments regarding the conclusions and recommendations of this health assessment document. No comments or concerns were received by the Texas DSHS.

### Actions Planned

1. This document will be provided to the community and local governments in order to provide information regarding the public health assessment of this site.

2. DSHS and ATSDR will review any additional environmental sampling results as they become available.

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## References

1. Texas Commission on Environmental Quality. Screening Site Inspection Report. Midessa Groundwater Plume. August 2007.
2. Texas Commission on Environmental Quality. Hazard Ranking System Documentation Record. Midessa Ground Water Plume. September 2007.
3. Agency for Toxic Substances and Disease Registry. Public Health Assessment Guidance Manual. Appendix B: Standards and Health Guidelines Values. 1993.
4. US Environmental Protection Agency. Site Update for Midessa Groundwater Plume, July 2008. Available at http://www.epa.gov/earth1r6/6xa/pdf/midessa_080408.pdf
5. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Tetrachloroethene. ATSDR. September 1997.
6. US Environmental Protection Agency Integrated Risk Information System. Tetrachloroethene. http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showQuickView&substance_nmbr=0106#reforal last accessed July 7, 2008.
7. US Environmental Protection Agency. Risk Assessment Guidance for Superfund, Part E: Supplemental Guidance for Dermal Risk Assessment. Available at http://www.epa.gov/oswer/riskassessment/ragse/index.htm with data tables available at http://www.epa.gov/oswer/riskassessment/ragse/pdf/org04_01.pdf last accessed July 11, 2008.
8. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Trichloroethene. ATSDR. September 1997.
9. Agency for Toxic Substances and Disease Registry. Toxicological Profile for 1,1-Dichloroethene. ATSDR. May 1994.
10. Sanders, Paul F. A screening model for predicting concentrations of volatile organic chemicals in shower stall air. New Jersey Department of Environmental Protection. May 2002.
11. US Environmental Protection Agency. EPA On-line Tools for Site Assessment Calculation: Estimated Henry's Law Constant. http://www.epa.gov/ATHENS/learn2model/part-two/onsite/esthenry.htm last accessed July 15, 2008.
12. Agency for Toxic Substances and Disease Registry. Toxicological Profile for Carbon Tetrachloride. ATSDR. August 2005.
13. US Environmental Protection Agency Integrated Risk Information System. Carbon Tetrachloride. http://cfpub.epa.gov/ncea/iris/index.cfm?fuseaction=iris.showQuickView&substance_nmbr=0020 last accessed July 9, 2008.
14. Agency for Toxic Substances and Disease Registry. Guidance Manual for the Assessment of Joint Toxic Action of Chemical Mixtures. ATSDR. May 2004.

15. Agency for Toxic Substances and Disease Registry. Interaction Profile for: 1,1-Trichloroethane, 1,1-Dichloroethane, Trichloroethylene, and Tetrachloroethylene. ATSDR. May 2004

## Certification

This public health assessment for the Midessa Groundwater Plume site located in Odessa, Midland County, Texas was prepared by the Texas Department of State Health Services (DSHS) under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) in accordance with approved methodologies and procedures existing at the time this health assessment was initiated. Editorial review was completed by the Cooperative Agreement partner.

Technical Project Officer, CAT, CAPEB, DHAC, ATSDR

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

Gregory V. Ulirsch for AY

Team Lead, CAT, CAPEB, ATSDR

# Tables and Figures

**Table 1 – Summary of Contaminant Concentrations (ppb) Prior to Filtration**

| Contaminant | Average Concentration | 95th Percentile | Highest Concentration |
|---|---|---|---|
| Tetrachloroethene (PCE) | 33.37 | 13.5 | 1600 |
| Trichloroethene (TCE) | 1.62 | 3.2 | 64 |
| 1,1-Dichloroethene (1,1-DCE) | 1.12 | 6.6 | 16.1 |
| Carbon tetrachloride | 0.60 | 1.4 | 24 |

## Table 2 – Average Groundwater Well Concentrations (ppb) Prior to Filtration from March/April 2006 through December 2007

| | Contaminant of Concern | | | |
|---|---|---|---|---|
| **Well ID** | **PCE** | **TCE** | **1,1-DCE** | **Carbon Tetrachloride** |
| **MCL** | 5 | 5 | 7 | 5 |
| **CREG** | na | na | na | 0.13 |
| **Chronic EMEG c/a** | na | na | 90/30 | na |
| **RMEG c/a** | 100/400 | na | 500/2000 | 7/na |
| **GW-01F** | 3.79 | 0.24 | 11.50 | 0.17 |
| **GW-02** | 1.93 | 0.19 | 6.32 | 0.17 |
| **GW-03F** | 10.04 | 0.34 | 0.16 | 0.17 |
| **GW-04** | 0.37 | 0.16 | 0.16 | 0.17 |
| **GW-05** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-05a** | 0.17 | 0.16 | 0.16 | 0.18 |
| **GW-06** | 0.18 | 0.18 | 0.17 | 0.16 |
| **GW-07** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-08** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-09 F** | 58 | 1.18 | 0.16 | 0.17 |
| **GW-10 F** | 1300 | 53.00 | 2.76 | 2.60 |
| **GW-11** | 0.21 | 0.16 | 0.16 | 0.17 |
| **GW-12** | 0.18 | 0.16 | 0.16 | 0.17 |
| **GW-13** | 0.19 | 0.16 | 0.16 | 0.18 |
| **GW-14** | 0.21 | 0.21 | 0.21 | 0.21 |
| **GW-15** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-16** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-17** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-18** | 0.17 | 0.16 | 0.16 | 1.11 |
| **GW-19** | 0.28 | 0.16 | 0.16 | 0.17 |
| **GW-20 F** | 4.74 | 0.16 | 0.16 | 0.17 |
| **GW-21** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-22** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-23** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-24** | 0.17 | 0.16 | 0.16 | 1.54 |
| **GW-25** | 0.20 | 0.16 | 0.16 | 0.17 |
| **GW-26** | 0.17 | 0.16 | 0.16 | 0.17 |
| **GW-27** | 0.19 | 0.18 | 0.19 | 0.19 |
| **GW-28** | 0.13 | 0.12 | 0.12 | 0.12 |
| **GW-29** | 0.19 | 0.18 | 0.19 | 0.19 |
| **GW-30** | 0.19 | 0.18 | 0.19 | 0.19 |
| **GW-31** | 0.22 | 0.16 | 0.38 | 0.17 |
| **GW-32** | 0.18 | 0.16 | 0.25 | 0.17 |
| **GW-33** | 0.91 | 0.43 | 1.04 | 0.17 |
| **GW-34** | 2.01 | 0.33 | 4.78 | 0.17 |
| **GW-35** | 0.16 | 0.16 | 0.16 | 0.17 |
| **GW-36** | 1.38 | 0.16 | 0.16 | 0.17 |
| **GW-37** | 1.60 | 0.75 | 2.46 | 0.17 |
| **GW-38** | 0.16 | 0.18 | 0.28 | 0.17 |
| **GW-39** | 0.18 | 0.17 | 0.17 | 0.18 |
| **GW-40 F** | 0.18 | 0.17 | 0.17 | 16.20 |
| **GW-41 F** | 2.03 | 0.18 | 5.38 | 0.20 |
| **GW-42 F** | 2.29 | 3.53 | 4.76 | 0.21 |
| **GW-43** | 3.00 | 3.54 | 4.74 | 0.18 |
| **GW-44** | 0.17 | 0.16 | 0.16 | 0.18 |
| **GW-45** | 0.17 | 0.16 | 0.16 | 0.18 |
| **GW-46** | 0.93 | 0.79 | 1.20 | 0.18 |
| **GW-47** | 0.25 | 0.25 | 0.25 | 0.25 |
| **GW-48** | 0.17 | 0.16 | 0.16 | 0.18 |
| **GW-49** | 0.12 | 0.12 | 0.12 | 0.15 |
| **GW-50** | 0.14 | 0.13 | 0.11 | 0.10 |
| **GW-51** | 0.14 | 0.13 | 0.11 | 0.10 |

Notes: Average concentrations shaded in yellow exceed the USEPA MCL.

Wells with a filtration system are designated with an "F"

Abbreviations used – Maximum Contaminant Level (MCL), Cancer Risk Evaluation Guide (CREG), Environmental Media Evaluation Guide (EMEG), for children/adults (c/a), Reference Dose Media Evaluation Guide (RMEG), not available (na)

## Table 3 – ATSDR Public Health Conclusion Categories

| CATEGORY A.<br>URGENT PUBLIC HEALTH HAZARD[*] | CATEGORY B.<br>PUBLIC HEALTH HAZARD[*] | CATEGORY C.<br>INDETERMINATE PUBLIC HEALTH HAZARD | CATEGORY D.<br>NO APPARENT PUBLIC HEALTH HAZARD[*] | CATEGORY E.<br>NO PUBLIC HEALTH HAZARD |
|---|---|---|---|---|
| This category is used for sites where short-term exposures (<1 year) to hazardous substances or conditions could result in adverse health effects that require rapid intervention. | This category is used for sites that pose a public health hazard due to the existence of long-term exposures (>1 year) to hazardous substances or conditions that could result in adverse health effects. | This category is used for sites in which critical data are *insufficient* with regard to extent of exposure and/or toxicologic properties at estimated exposure levels. | This category is used for sites where human exposure to contaminated media might be occurring, might have occurred in the past, and/or might occur in the future, but the exposure is not expected to cause any adverse health effects. | This category is used for sites that, because of the absence of exposure, do NOT pose a public health hazard. |
| **Criteria**:<br>Evaluation of available information[†] indicates that site-specific conditions or likely exposures have had, are having, or are likely to have in the future, an adverse effect on human health and requires immediate action or intervention. Such site-specific conditions or exposures might include the presence of serious physical or safety hazards, such as open mine shafts, poorly stored or maintained flammable/explosive substances, or medical devices which, upon rupture, could release radioactive materials. | **Criteria**:<br>Evaluation of available relevant information[†] suggests that, under site-specific conditions of exposure, long-term exposures to site-specific contaminants (including radionuclides) have had, are having, or are likely to have in the future, an adverse effect on human health that requires one or more public health interventions. Such site-specific exposures might include the presence of serious physical hazards, such as open mine shafts, poorly stored or maintained flammable/explosive substances, or medical devices, which, upon rupture, could release radioactive materials. | **Criteria**:<br>The health assessor must determine, using professional judgment, the criticality of such data and the likelihood that the data can be obtained and will be obtained in a timely manner. Where some data are available, even limited data, the health assessor is encouraged to the extent possible to select other hazard categories and to support their decision with clear narrative that explains the limits of the data and the rationale for the decision. | **Criteria**:<br>Evaluation of available information[†] indicates that, under site-specific conditions of exposure, exposures to site-specific contaminants in the past, present, or future are not likely to result in any adverse effects on human health. | **Criteria**:<br>Sufficient evidence indicates that no human exposures to contaminated media have occurred, none are now occurring, and none are likely to occur in the future. |

[*] Each of these designations represents a professional judgment made on the basis of critical data that ATSDR regards as sufficient to support a decision. It does not imply, however, that the available data are necessarily complete. In some cases, additional data may be required to confirm or further support the decision.

[†] Examples include environmental and demographic data; health outcome data; community health concerns information; and toxicologic, medical, and epidemiologic data.

## Table 4 – Estimated Exposure Dose Calculations

**Estimated PCE exposure doses for the Midessa GW Plume**

| | | |
|---|---|---|
| ATSDR Acute Oral MRL: | 0.05 | mg/kg/day |
| EPA Chronic Oral RfD: | 0.01 | mg/kg/day |

| | **adults** | **children** |
|---|---|---|
| Dose=C*CF*IR*EF/BW (mg/kg/day) | 0.037141 | 0.08125 |
| C=contaminant concentration (µg/L) | 1300 | 1300 |
| CF=conversion factor (convert µg/L to mg/L) | 0.001 | 0.001 |
| IR=intake rate of water (L/day) | 2 | 1 |
| AF=bioavailability factor (%, assumed 100% or 1) | 1 | 1 |
| EF=exposure factor (unitless) | 1 | 1 |
| BW=body weight (kg) | 70 | 16 |

**Estimated TCE exposure doses for the Midessa GW Plume**

| | | |
|---|---|---|
| ATSDR Acute Oral MRL: | 0.2 | mg/kg/day |

| | **adults** | **children** |
|---|---|---|
| Dose=C*CF*IR*EF/BW (mg/kg/day) | 0.001514 | 0.003313 |
| C=contaminant concentration (µg/L) | 53 | 53 |
| CF=conversion factor (convert µg/L to mg/L) | 0.001 | 0.001 |
| IR=intake rate of water (L/day) | 2 | 1 |
| AF=bioavailability factor (%, assumed 100% or 1) | 1 | 1 |
| EF=exposure factor (unitless) | 1 | 1 |
| BW=body weight (kg) | 70 | 16 |

**Estimated Carbon Tetrachloride exposure doses for the Midessa GW Plume**

| | | |
|---|---|---|
| ATSDR Acute Oral MRL: | 0.02 | mg/kg/day |
| ATSDR Intermediate Oral MRL: | 0.007 | mg/kg/day |
| EPA Chronic Oral RfD: | 0.0007 | mg/kg/day |

| | **adults** | **children** |
|---|---|---|
| Dose=C*CF*IR*EF/BW (mg/kg/day) | 0.000463 | 0.001013 |
| C=contaminant concentration (µg/L) | 16.2 | 16.2 |
| CF=conversion factor (convert µg/L to mg/L) | 0.001 | 0.001 |
| IR=intake rate of water (L/day) | 2 | 1 |
| AF=bioavailability factor (%, assumed 100% or 1) | 1 | 1 |
| EF=exposure factor (unitless) | 1 | 1 |
| BW=body weight (kg) | 70 | 16 |

## Table 5 – Estimated Cancer Risk Calculations

**Estimated Cancer Risk Based on Adult exposure to PCE**

ER=CSF*dose
Dose=C*IR*EF/BW
ER=((C*IR*AF*EF)/BW)*CSF

| | **1 liter per day** | **2 liters per day** |
|---|---|---|
| ER=estimated theoretical risk (unitless) | 7.14E-04 | 1.43E-03 |
| dose=C*IR*EF/BW | 1.32E-03 | 2.65E-03 |
| C=contaminant concentration (µg/L) | 1,300 | 1,300 |
| CF=conversion factor (convert µg/L to mg/L) | 0.001 | 0.001 |
| IR=intake rate of water (L/day) | 1 | 2 |
| EF=exposure factor (unitless) | 0.071232877 | 0.071232877 |
| years of residence | 7 | 7 |
| days per week | 5 | 5 |
| weeks per year | 52 | 52 |
| years in a lifetime | 70 | 70 |
| days in a year | 365 | 365 |
| BW=body weight (kg) | 70 | 70 |
| CSF=cancer slope factor (mg/kg/d)-1 | 0.54 | 0.54 |

**Estimated Cancer Risk Based on Adult exposure to TCE**

ER=CSF*dose
Dose=C*IR*EF/BW
ER=((C*IR*AF*EF)/BW)*CSF

| | **1 liter per day** | **2 liters per day** |
|---|---|---|
| ER=estimated theoretical risk (unitless) | 2.16E-05 | 4.31E-05 |
| dose=C*IR*EF/BW | 5.39E-05 | 1.08E-04 |
| C=contaminant concentration (µg/L) | 53 | 53 |
| CF=conversion factor (convert µg/L to mg/L) | 0.001 | 0.001 |
| IR=intake rate of water (L/day) | 1 | 2 |
| EF=exposure factor (unitless) | 0.071232877 | 0.0712329 |
| years of residence | 7 | 7 |
| days per week | 5 | 5 |
| weeks per year | 52 | 52 |
| years in a lifetime | 70 | 70 |
| days in a year | 365 | 365 |
| BW=body weight (kg) | 70 | 70 |
| CSF=cancer slope factor (mg/kg/d)-1 | 0.4 | 0.4 |

**Estimated Cancer Risk Based on Adult exposure to Carbon Tetrachloride**

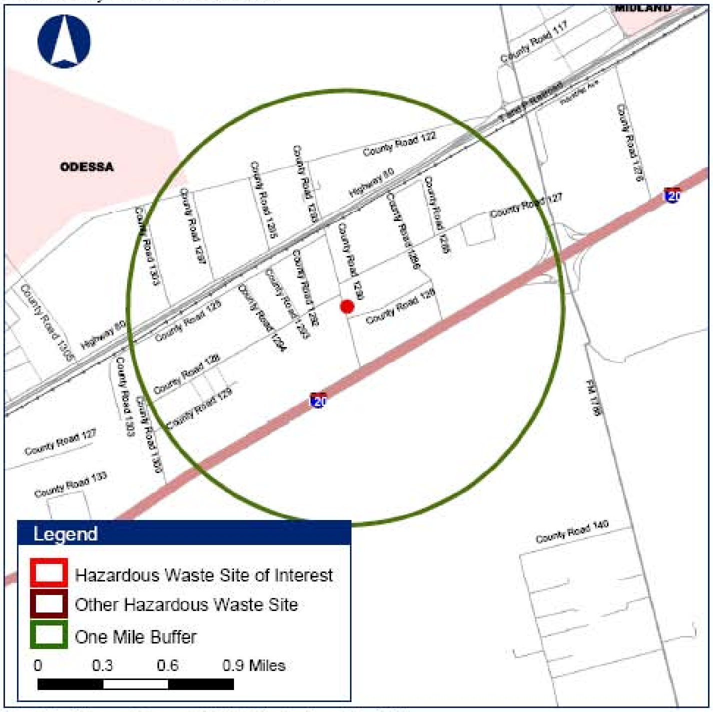
ER=CSF*dose
Dose=C*IR*EF/BW
ER=((C*IR*AF*EF)/BW)*CSF

| | 1 liter per day | 2 liters per day |
|---|---|---|
| ER=estimated theoretical risk (unitless) | 1.90E-05 | 3.81E-05 |
| dose=C*IR*EF/BW | 1.47E-04 | 2.93E-04 |
| C=contaminant concentration (µg/L) | 24 | 24 |
| CF=conversion factor (convert µg/L to mg/L) | 0.001 | 0.001 |
| IR=intake rate of water (L/day) | 1 | 2 |
| EF=exposure factor (unitless) | 0.42739726 | 0.4273973 |
| years of residence | 30 | 30 |
| days per week | 7 | 7 |
| weeks per year | 52 | 52 |
| years in a lifetime | 70 | 70 |
| days in a year | 365 | 365 |
| BW=body weight (kg) | 70 | 70 |
| CSF=cancer slope factor (mg/kg/d)-1 | 0.13 | 0.13 |

# Figure 1 – Site Location and Demographic Information

## Midessa Ground Water Plume
Odessa, TX

EPA Facility ID: TXN000606668



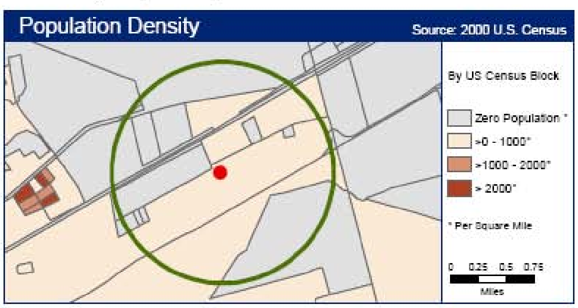


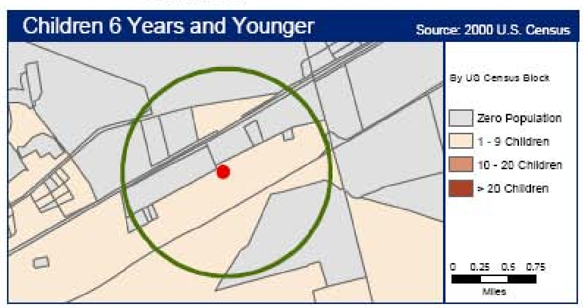
**Demographic Statistics**
Within One Mile of Site*

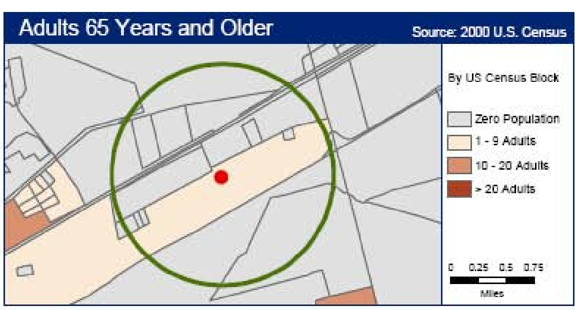
| | |
|---|---|
| Total Population | 11 |
| White Alone | 6 |
| Black Alone | 0 |
| Am. Indian & Alaska Native Alone | 0 |
| Asian Alone | 0 |
| Native Hawaiian & Other Pacific Islander Alone | 0 |
| Some Other Race Alone | 4 |
| Two or More Races | 1 |
| Hispanic or Latino** | 5 |
| Children Aged 6 and Younger | 2 |
| Adults Aged 65 and Older | 1 |
| Females Aged 15 to 44 | 2 |
| Total Housing Units | 6 |

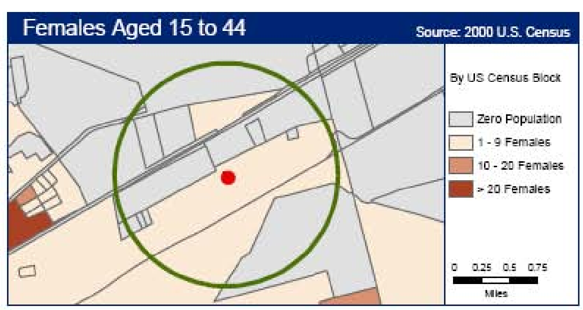
Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane Texas Central FIPS 4203 Feet

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




<project=03231><userid=JXAD><geo=Midland County, TX><keywords=TXN000606668, Midessa, Groundwater>

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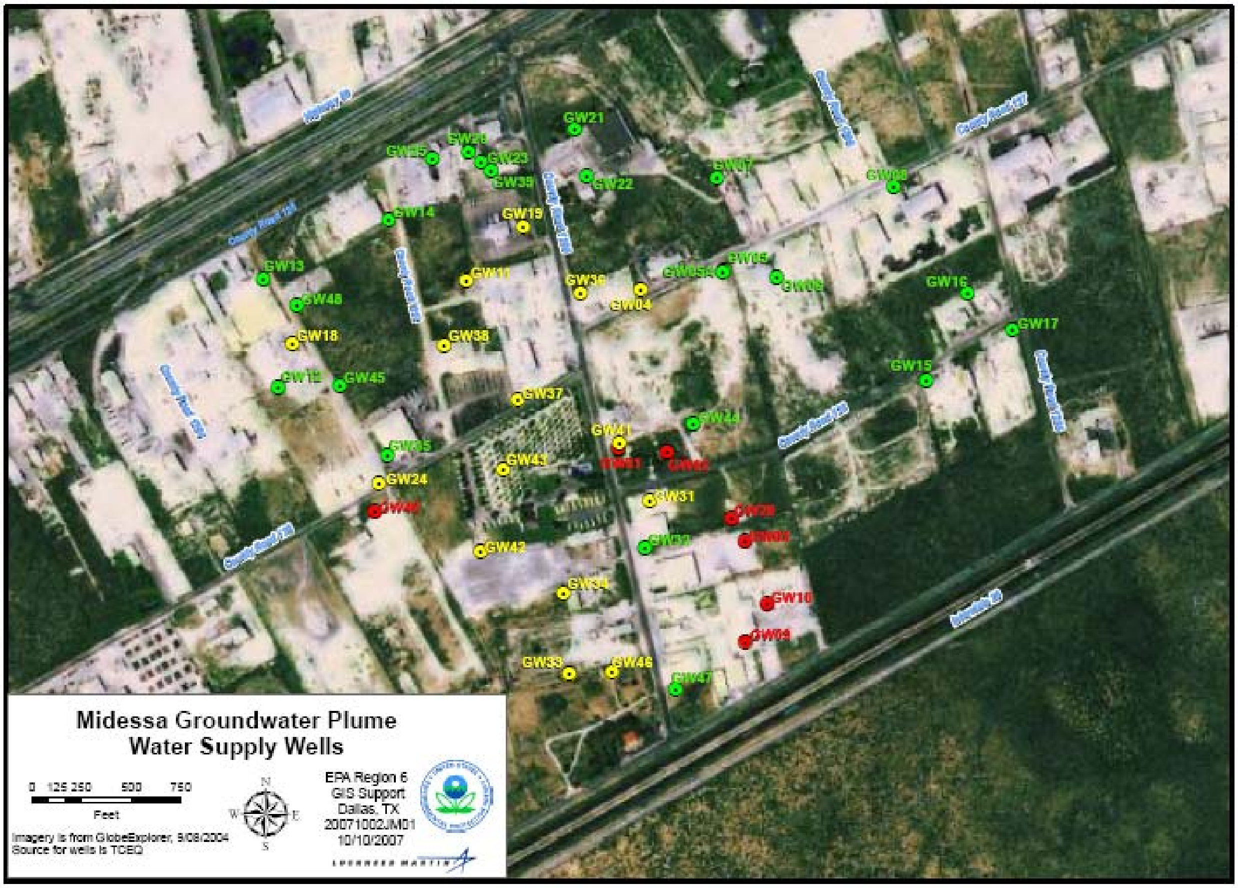
## Figure 2 – Aerial Photograph with Well Locations




Adapted from USEPA Site Status Summary, available at http://www.epa.gov/earth1r6/6sf/pdffiles/0606668.pdf

Legend:

- Indicates a well where contaminants were not detected
- Indicates a well where contaminants were detected, but do not exceed the MCL
- Indicates a well with contaminants above the MCL

# Appendices

## Appendix A – Abbreviations

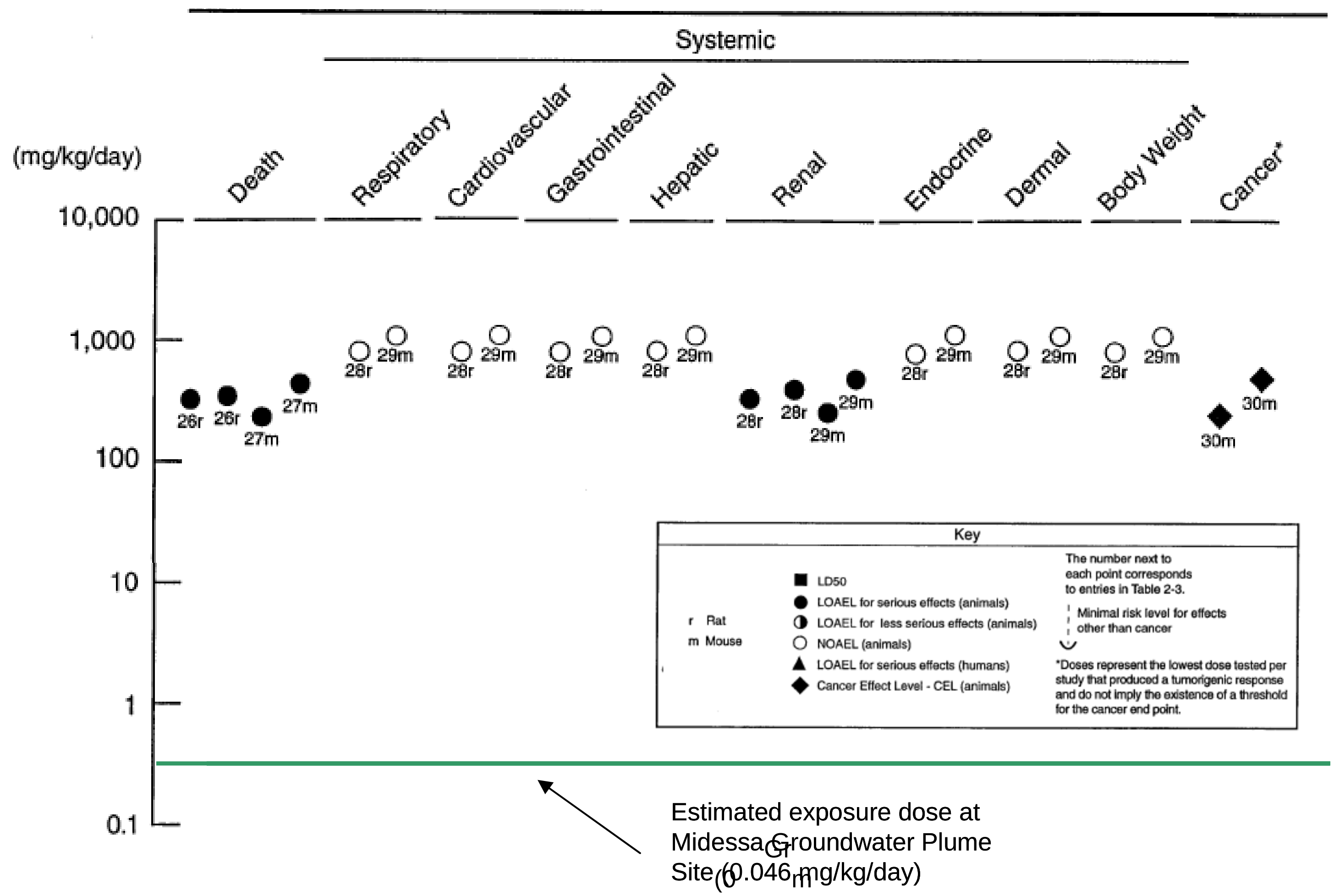
| | |
|---|---|
| ATSDR | Agency for Toxic Substances and Disease Registry |
| bgs | Below grade surface |
| CERCLA | Comprehensive Environmental Response, Compensation and Liability Act (1980) |
| CR | County Road |
| CREG | Cancer Risk Evaluation Guide |
| CSF | Cancer Slope Factor |
| DCA | 1,1-dichloroethane |
| DCE | 1,1-dichloroethene1,1-dichloroethylene |
| DHHS | Department of Health and Human Services |
| DSHS | Department of State Health Services |
| EMEG | Environmental Media Evaluation Guide |
| EPA | Environmental Protection Agency |
| HAC | Health Assessment Comparison value |
| HQ | Hazard Quotient |
| HRS | Hazard Ranking System |
| IARC | International Agency for Research on Cancer |
| IRIS | Integrated Risk Information System |
| kg/day | Kilograms per day |
| L/day | Liters per day |
| LOAEL | Lowest Observed Adverse Effect Level |
| LPST | Leaking Petroleum Storage Tank |
| MCL | Maximum Contaminant Level |
| MCLG | Maximum Contaminant Level Goal |
| µg/L | Micrograms per liter or ppb |
| mg/kg/day | Milligrams of substance per kilogram of body weight per day |
| MRL | Minimal Risk Level |
| NOAEL | No Observed Adverse Effect Level |
| NPL | National Priorities List |
| NTP | National Toxicology Program |
| PCB | Polychlorinated biphenyls |
| PCE | Tetrachloroethene, perchloroethene |
| PHA | Public Health Assessment |
| ppb | Parts per billion or µg/L |
| ppm | Parts per million |
| PWS | Public Water System |
| QA/QC | Quality Assurance/Quality Control |
| RfD | Reference Dose |
| RMEG | Reference Dose Media Evaluation Guide |
| RV | Recreational Vehicle |
| SARA | Superfund Amendments and Reauthorization Act (1986) |
| TCE | Trichloroethene, trichloroethylene |
| TCEQ | Texas Commission on Environmental Quality |
| VOC | Volatile Organic Compound |

# Appendix B – Completed Exposure Pathway Evaluation of the Midessa Groundwater Plume NPL site

| EXPOSURE PATHWAY ELEMENTS | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Pathway Name | Contaminants of Concern | Source | Transport Media | Point of Exposure | Route of Exposure | Exposed Population | Time | Conclusions |
| Groundwater | | | | | | | | [redacted] |
| Private well GW-10 | PCE,TCE | chemical release (from a nearby property) | groundwater | in business using the affected groundwater | ingestion, inhalation*, dermal contact | Employees at that location | past<br>present future | **Public health hazard**<br>**No apparent public health hazard:** with properly installed, operating, and maintained filtration systems or an alternative water supply. |
| Private wells | PCE,TCE, 1,1-DCE, carbon tetrachloride | chemical release (location unknown) | groundwater | in residences and businesses using the affected groundwater | ingestion, inhalation*, dermal contact | affected area residents and businesses | past<br>present future | **No apparent public health hazard:** with properly installed, operating, and maintained filtration systems or an alternative water supply. |
| public water supply | Chlorinated VOCs | chemical release (location unknown) | groundwater | in residence and patrons of the RV park using affected groundwater | ingestion, inhalation*, dermal contact | affected area residents | past<br>present future | **No apparent public health hazard:** with properly installed, operating, and maintained filtration systems or an alternative water supply. |

* = volatilization (changing to a gas) during the use of tap water

## Appendix C– Levels of Significant Chronic Oral Exposure to PCE Associated with Adverse Non-Cancer Health Effects




Adapted from the ATSDR Toxicological Profile for PCE [5]

# Appendix D – ATSDR and EPA Comparison Values (ppb)

| Chemical Name | Hierarchy Level 1 | | | Hierarchy Level 2 | | | | | Hierarchy Level 3 | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Chronic EMEG | | CREG | Intermediate EMEG | | RMEG | | LTHA | MCL | MCLG |
| | Child | Adult | | Child | Adult | Child | Adult | | | |
| Tetrachloroethene | – | – | – | – | – | 100 | 400 | 10 | **5** | 0 |
| Trichloroethene | – | – | – | – | – | – | – | – | **5** | 0 |
| 1,1-dichloroethene | 90 | 300 | – | – | – | 500 | 2,000 | – | **7** | 7 |
| Carbon Tetrachloride | – | – | **0.3** | 70 | 200 | 7 | – | – | 5 | – |

NOTES

EMEG: Environmental Media Evaluation Guide (ATSDR)

CREG: Cancer Risk Evaluation Guide for 1 x 10-6 cancer risk

RMEG: Reference Dose Media Evaluation Guide

LTHA: Lifetime Health Advisory for drinking water (EPA)

MCL: Maximum Contaminant Level (EPA)

MCLG: Maximum Contaminant Level Goal (EPA)

**BOLD**: Indicates the most conservative value

– : Indicates that no value is currently available