

Health Consultation

WALDEN'S RIDGE UTILITY DISTRICT

SIGNAL MOUNTAIN, HAMILTON COUNTY, TENNESSEE

NOVEMBER 9, 2005

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

Health Consultation: A Note of Explanation

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

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH CONSULTATION

WALDEN'S RIDGE UTILITY DISTRICT

SIGNAL MOUNTAIN, HAMILTON COUNTY, TENNESSEE

Prepared by:

Tennessee Department of Health
Under a Cooperative Agreement with
The Agency for Toxic Substances and Disease Registry

Introduction

On August 16, 2005, the Chattanooga-Hamilton County Health Department (CHCHD), contacted the Tennessee Department of Health, Environmental Epidemiology (TDH-EEP) pertaining to recent public concerns about chemical and bacteriological contamination in the drinking water distributed by the Walden's Ridge Utility District (WRUD), Signal Mountain, Hamilton County, Tennessee. The TDH-EEP was asked to evaluate any potential public health effects that could result from the contamination present in the drinking water supply. TDH-EEP was also asked to respond to other environmental public health concerns.

In June 2005, a resident of the Timesville community contacted the CHCHD with concerns about environmental health matters in their neighborhood. The main concerns involved questions regarding the drinking water provided by the WRUD, and whether reports of illnesses among several residents in the Timesville community were related to the drinking water quality. The same resident also expressed concerns that other environmental problems were potentially causing human illnesses in the community. The concerns were the perceived presence of sewage in Middle Creek and a broken water line (i.e. environmental contamination entering the broken water pipe and reaching nearby homes) at the intersection of Timesville Road at Lewis Mine Road (Figure 1).

As CHCHD personnel spoke with Timesville community members during their investigation, they found that some were confused by the public notifications and did not fully understand what the information distributed by the utility was trying to tell them about the drinking water contamination. A WRUD newsletter (i.e. the information letter sent out with utility billing statements) discussing the status of the tetrachloroethylene contamination in the drinking water, inadvertently combined information concerning biological contaminates with the discussion of the chemical contamination.

In response to citizen concerns and the CHCHD request, this public health consultation will address four issues:

- 1) chemical contamination;
- 2) bacterial contamination;
- 3) citizen concern about sewage contaminating water supply;
- 4) citizen concern about a suspected water line break and possible contamination.

Background

The WRUD is a small public water system located in Hamilton county, Tennessee. They provide water service to the Town of Walden, which is located to the east of the City of Chattanooga, atop the Cumberland Plateau (Figure 1). The utility also provides water service to some areas outside the town limits, including the Timesville community.

The source of water for the WRUD is groundwater. The utility has three wells from which they pump groundwater to process at their water treatment facility (Figure 2). The groundwater source utilized by the WRUD is defined by the Tennessee Department of Environment and Conservation, Division of Water Supply (TDEC-DWS) as *groundwater under the direct influence of surface water* (GWUDISW). This designation indicates that the source of groundwater is physically connected to the local surface waters such as creeks and streams. The GWUDISW designation also indicates that this type of groundwater source could be adversely impacted by any contaminants dumped on the ground or into local surface water streams (TDEC-DWS 2005b).

To assure drinking water quality and protect public health, the rules of the TDEC-DWS require that regulated water utilities perform routine chemical and biological testing of the water distributed to their customers. Should any drinking water quality parameter exceed a specific legal limit, the utility is required by law to report the exceedance to both TDEC-DWS and the utility's customers. As a result of routine testing, two separate incidences of reportable violations (one for chemical and one for biological) occurred in the fall of 2004 at the WRUD.

The presence of tetrachloroethylene (a commonly used drycleaner solvent/fluid and metal degreaser) was first detected in the WRUD water supply in February 2003. The concentration level of tetrachloroethylene was above the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) of 5 parts per billion (ppb) in the drinking water that was distributed to customers. All customers served by the utility district, including the residents along Timesville Road, were advised by public notification of the tetrachloroethylene levels exceeding the MCL in the winter and spring of 2003 (TDEC-DWS 2005b).

NOTE ABOUT MAXIMUM CONTAMINANT LEVELS (MCL)

MCLs are drinking water standards set by EPA in accordance with the Safe Drinking Water Act. MCLs are not health-threshold levels. Instead, the MCLs incorporate safety factors to account for uncertainties in the toxicity and health studies used to derive the MCLs. Therefore, people ingesting chemicals at or slightly above MCLs may not experience any illness or other adverse health effects. For more information on MCLs and the EPA standard setting process, visit the EPA website at: <http://www.epa.gov/safewater/mcl.htm>.

Another exceedance of the tetrachloroethylene MCL occurred in December 2004 and a subsequent public notification was again sent to WRUD customers. Also in December 2004, the utility district customers were notified about the positive results of coliform bacteria tests which occurred in November 2004.

TDH-EEP conducted a site visit on August 31, 2005. During the visit, EEP staff, accompanied by staff from the Tennessee Department of Environment and Conservation, Division of Water Pollution Control (TDEC-WPC), TDEC-DWS, and CHCHD visited the WRUD water treatment facility and the Timesville community.

Chemical Contamination

In February 2003, the presence of tetrachloroethylene was discovered in the water being distributed by the WRUD. Prior to that time, there had never been a detection of this chemical in the water. The wells used by the utility are located in a residential area and are generally considered to be protected from environmental contamination because of their location. There are no known drycleaner or auto repair businesses in the vicinity of the wells. Thus, the source for the tetrachloroethylene could not be readily located. Tetrachloroethylene is also known as perchloroethylene and is frequently referred to as "perc" with common abbreviation of PCE (See Appendix A for toxicological information on PCE).

Through the investigative efforts of personnel from both the WRUD and TDEC-DWS, a suspicious drum was found on a residential property near one of the wells. This drum was later found to have contained tetrachloroethylene (Note: all drums and solid wastes have since been removed from this property). The investigation found that the contents of the drum had been emptied on the ground. Because of the physical properties of the tetrachloroethylene, much of the chemical probably evaporated into the air. However, some of the chemical must have soaked into the soil where it migrated to the groundwater and was subsequently drawn into the nearby WRUD well (Figure 3).

After the discovery of the presence of the tetrachloroethylene in the water system, the utility worked with TDEC-DWS representatives in Chattanooga to come up with a plan to resolve the problem. The utility began using a treatment method utilizing activated carbon powder to remove the tetrachloroethylene from the groundwater. Treatment with powder activated carbon (PAC) began on June 4, 2003 (TDEC-DWS 2005b).

After the initial discovery of the tetrachloroethylene, the concentration levels fluctuated above and below the MCL from February through May 2003. The highest level recorded was 41 ppb in February 2003 and the next highest level was 13 ppb in May 2003. After the initiation of the PAC treatment of the water in June 2003, the tetrachloroethylene levels dropped below the MCL. There was one sample above the MCL (December 14, 2004) after the PAC treatment began. This exceedance (5.2 ppb; 0.2 ppb over the MCL) necessitated that the utility send notification to its customers concerning the matter. The remaining samples to the date of this document have been below the MCL.

Table 1 shows all of the sampling results for tetrachloroethylene since February 2003. The analysis of the water samples was performed by the State Laboratory in Knoxville, Tennessee, and by Environmental Science Corporation, a private laboratory in Mt. Juliet, Tennessee. (TDEC-DWS 2005a; WRUD 2005b).

TABLE 1. Walden's Ridge Utility District, summary of analytical results, from February 2003 to June 2005, for tetrachloroethylene (PCE) in the finished water sent to the water distribution system. Results are reported in parts per billion (ppb). The EPA Maximum Contamination Level (MCL) for tetrachloroethylene in public/municipal drinking water is 5 ppb.			
PCE Levels before PAC treatment started		PCE Levels after start of PAC treatment	
Sample Dates	PCE Levels	Sample Dates	PCE Levels
2/6/03	5.6	6/9/03	1.2
2/25/03	41.0	6/11/03	1.3
3/11/03	5.6	6/16/03	1.6
4/1/03	2.0	9/24/03	2.6
4/15/03	4.6	12/8/03	1.1
4/22/03	2.1	1/12/04	1.3
4/29/03	1.7	4/19/04	1.2
5/13/03	5.5	7/27/04	0.5
5/21/03	13.0	12/14/04	5.2
5/28/03	3.1	3/15/05	0.9
6/4/03	<i>Beginning of PAC water treatment process</i>	6/9/05	0.6
Average PCE level before start of PAC water treatment system = 8.4 ppb (approximately 4 months)		Average PCE level after start of PAC water treatment system = 1.6 ppb (approximately 24 months)	

Introduction to Chemical Exposure

To determine whether persons have been, are, or are likely to be exposed to chemicals, Environmental Epidemiology of the Tennessee Department of Health evaluates mechanisms that could lead to human exposure. An exposure pathway contains five parts:

1. a source of contamination,
2. a media such as air or soil through which the contaminant is transported, a point of exposure,
3. a point of exposure where people can contact the contaminant,
4. a route of exposure by which the contaminant enters or contacts the body, and
5. a receptor population.

A pathway is considered complete if all five elements are present and connected. If one of these elements is missing, the pathway is considered incomplete, and human exposure is not possible.

We evaluated the potential for human exposure to PCE in drinking water in a 4-step process. First, we examined the pathway by which people could come in contact with PCE. Second, we compared the maximum levels and the average levels of PCE to EPA's MCL to determine if further evaluation was needed. Third, we estimated the amount (dose) that people could ingest, using the maximum reported value. In the final step, we determined whether a reasonable combination of dose and duration (amount of time a person might be exposed) was sufficient to cause illness or other adverse health problems.

Potentially Exposed Populations

A completed pathway is assumed to have existed since February 2003 because very small amounts of tetrachloroethylene were reported to be present in the WRUD drinking water distribution water system. However, no laboratory analysis were made on tap water from residences or businesses to confirm whether detectable levels of tetrachloroethylene were present in the water entering homes and businesses connected to the distribution system. The utility currently serves approximately 2,660 water service taps (WRUD 2005a).

Tetrachloroethylene Exposure

To understand if harmful levels were ingested by anyone drinking water before or after the PAC treatment started, we calculated exposure doses (see Table 2) and compared those doses to the EPA Reference Dose (RfD). A RfD is defined as an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups such as children) that is likely to be without an appreciable risk of adverse effects during a lifetime. Essentially, no harmful effects are expected for anyone ingesting doses at levels below the RfD.

A dose is the amount of a substance to which a person is exposed over some period of time. Dose is a measurement of exposure. Dose is typically expressed in milligrams (amount; mg) per kilogram (a measure of body weight; kg) per day (a measure of time) when people ingest a substance by eating or drinking contaminated food or water. In general, the greater the dose, the greater the likelihood of an effect.

The RfD for tetrachloroethylene is 0.01 mg/kg/day (i.e. micrograms per kilogram of body weight per day). Thus, according to the definition of RfD, a human ingesting an amount up to 0.01 mg/kg/day of tetrachloroethylene over the course of a lifetime is not likely to develop any adverse non-carcinogenic health effects (USEPA 2004).

As displayed in Table 2, we estimated the exposure dose for people using water from WRUD in four different exposure concentrations. The doses are calculated for a 70 kg adult (i.e. an adult weighing 154 pounds) drinking 2 liters of tap water per day; and a 10 kg child (i.e. a child weighing 22 pounds) drinking 1 liter of tap water per day.

TABLE 2. Human dose calculations for four scenarios. Calculations utilize the tetrachloroethylene (PCE) concentrations in the finished water sent through the Walden's Ridge Utility District water distribution system (from TABLE 1), from February 2003 to June 2005. Dose results are reported in milligrams per kilogram per day (mg/kg/day). The RfD for tetrachloroethylene is 0.01 mg/kg/day.

Dose Calculation Scenario	Adult Dose	Child Dose
Ingestion of drinking water containing the highest reported tetrachloroethylene concentration of 41.0 ppb.	0.00100	0.00400
Ingestion of drinking water containing an average of the five samples exceeding the tetrachloroethylene MCL of 5.0 ppb. The average concentration of those five samples is 14.1 ppb.	0.00040	0.00140
Ingestion of drinking water containing an average of all eleven samples analyzed after the beginning the PAC water treatment. This includes the 12/14/04 sample that exceeded the MCL. The average concentration of those eleven samples is 1.6 ppb.	0.00005	0.00016
Ingestion of drinking water containing an average of all sample results shown in TABLE 1. Thus, this would represent the total dose received from 2/6/03 through 6/9/05. The average concentration of all samples is 4.8 ppb.	0.00014	0.00048

The dose calculations indicate that the highest potential dose that may have been received by any person ingesting tap water provided by the WRUD is below the EPA RfD for tetrachloroethylene in drinking water. Therefore, no illness or other adverse health effects are anticipated for anyone ingesting the water provided by WRUD.

Children's Health Considerations

In communities faced with water contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than adults from certain kinds of exposure to hazardous substances (ATSDR 1997, 1998). Children have lower body weights than adults. Yet, children drink a larger volume of water per mass of body weight than adults. Therefore, a child's lower body weight and higher intake rate results in a greater dose of tetrachloroethylene per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children may sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus, adults need as much information as possible to make informed decisions regarding their children's health.

For children, ATSDR has calculated an intermediate-duration reference dose media evaluation guide (RMEG) for tetrachloroethylene in drinking water at 100 ppb (four times smaller than the adult level). This value is 20 times higher than the MCL and over twice the value as the highest concentration of tetrachloroethylene (41 ppb) detected in the WRUD water in February 2003.

Based upon reviews of the scientific literature, chemical comparison values, EPA RfDs, and the history of the site, no other health risks unique to children were identified. Prudent public health practice dictates that tetrachloroethylene exposure should be eliminated for all WRUD customers.

Future Water Source for Walden's Ridge Utility District

Over three years ago (spring 2002), prior to the discovery of tetrachloroethylene in the water supply, the WRUD began working on plans to secure a new source of water for its customers. Studies conducted by the utility indicated that the groundwater resources currently used would not be able to supply the projected water needs, due to population growth and development, in the coming years (WRUD 2005a). Thus, to ensure that all future needs could be met, the utility district decided to purchase water from the Tennessee American Water Company (TAWC). Based in Chattanooga, Tennessee, the TAWC also provides water to the Cities of Chattanooga, East Ridge, Red Bank, Ridgeside, and Signal Mountain.

In May 2004, the TDEC-DWS approved engineering plans for WRUD to build a pipeline to establish the connection to the TAWC water distribution system (TDEC-DWS 2005b). Construction began shortly after the plan approval and is still currently underway (Figure 4). The pipeline is scheduled to be completed in February 2006. The transition to the new water source will begin once the utility has met all TDEC-DWS regulatory requirements. WRUD will discontinue use of the current groundwater sources once the transition is completed. This change should eliminate the exposure of tetrachloroethylene to the WRUD customers.

Bacterial Contamination

Coliform is a family of bacteria common in soils, plants, and animals. The coliform family is made up of several groups, one of which is the fecal coliform group, which is found in the intestinal tracts of warm-blooded animals including humans. The presence of some fecal material in lakes, ponds and rivers is to be expected as part of the environment in which we live. Coliform or other bacteria in water used for drinking or bathing will not necessarily cause adverse health effects. However, if these organisms are present, other disease-causing organisms may also be present. Therefore, in drinking water, the presence of any coliform bacteria is a sign that action should be taken.

In November 2004, during routine bacteriological testing, there was a positive test result for coliform bacteria. After the positive test was found, several other samples were also taken to determine where the bacteria may be coming from. Four repeat samples were taken. Two of the repeated samples were positive and the other two were negative. After the positive test event in November 2004, all subsequent bacteriological tests have been negative (TDEC-DWS 2005b).

The positive samples were investigated by both TDEC-DWS and the utility to determine the cause of the bacteria (TDEC-DWS 2005b). The water sample that tested positive was taken from a private residence in the Edwards Point area. The Edwards Point area is near the end of a water line service area, or *low use area*. Utilities commonly collect water samples from low use areas to determine whether the treatment measures are sufficiently maintaining the quality of the water. Immediately after the discovery of the positive samples, utility workers flushed that portion of the water service area.

The cause of the positive bacteriological test results was not determined. No physical problems with the distribution system (for example, a break in a water line) were found to be present in the Edwards Point vicinity. Since the positive test was preceded by over twenty months of negative bacteriological test results and the positive results did not extend into the months following, it was speculated by TDEC-DWS and WRUD that the sampling was performed in a manner that introduced contamination into the water sample containers.

TDEC and WRUD concluded that the positive bacteria test in this part of the water distribution system was an isolated occurrence. The water distribution system, as a whole, was not contaminated with bacteria (TDEC-DWS 2005b).

The positive test necessitated that the utility send notification to its customers concerning the matter. The notification explained the findings and circumstances of the positive bacteriological sample and what the WRUD did to resolve the issue.

Sewage in Middle Creek

A complaint from a Timesville community resident was made on June 28, 2005 concerning sewage in Middle Creek. The complaint was investigated by personnel from TDEC-WPC on June 29, 2005. They did not encounter any sewage odors or see any indicators that sewage may be present in the creek during their field investigation (TDEC-WPC 2005).

Middle Creek, like many streams that flow across portions of Walden Ridge, is impacted by Acid Mine Drainage (AMD). Past coal mining activities in the upper portions of the Middle Creek watershed are the source of the AMD problems seen in the lower reaches of the creek, including the portion flowing through the Timesville community. AMD formation occurs during and after surface mining activities, where the overlying rocks are broken and removed to get the coal.

AMD results when the mineral pyrite (made up of iron and sulfur) is exposed to air and water, resulting in the formation of sulfuric acid and iron hydroxide. Pyrite is commonly present in coal seams and in the rock layers overlying coal seams. The products of AMD formation, acidity and iron, lowers the pH (or acidity) of the water and causes the coating of stream bottoms with iron hydroxide (the orange colored material called *yellow boy*, Figure 5). The smell of sulfur can also be associated with AMD. This is the likely cause of the odors encountered by the complainant.

In order to thoroughly assess whether Middle Creek was contaminated with sewage, the WPC personnel returned on July 14, 2005 to deploy an optical brightener test kit in the creek (TDEC-WPC 2005). Optical brighteners are man-made additives found in clothes washing detergents used to make clothes look clean and bright. The fluorescing glow of white clothing when viewed under a black light is caused by the presence of optical brighteners. Optical brighteners are not found in nature, thus their presence in stream water is an indicator of the presence of sewage.

On July 18, 2005, WPC personnel returned to collect the optical brightener test kit from Middle Creek. The analysis of the kit was negative for the presence of optical brighteners. Again, on that date, no sewage odors were detected nor was any visual evidence of sewage noted in the creek (TDEC-WPC 2005). Additionally, no sewage odors were detected by TDH-EEP personnel, on August 31, 2005, during the site visit to observe Middle Creek.

Water Line Break on Timesville Road at Lewis Mine Road

Community residents indicated to TDH-EEP personnel that there was a water line break on Timesville Road at the intersection with Lewis Mine Road. It was felt by some community members that the apparent break in the water line could be the cause of the perceived contamination entering the drinking water supply in the Timesville area. TDH-EEP contacted the WRUD regarding this situation. The WRUD representative explained that they made a thorough investigation and that there are no broken water line pipes on Timesville Road (WRUD 2005a).

TDH-EEP investigated the water seeping out of the road and the immediate vicinity around the intersection (Figure 6). It was noted that water was seeping into the ditches along both roads in several different places. Flowing water was also observed entering the ditch along Timesville Road over 100 feet uphill from the intersection. One local resident explained that there is water present in all of the road ditches at the intersection year-round. All of these observations indicate that the water seen in the ditches and seeping out of the roadway is groundwater.

Local geologic conditions and topography, in conjunction with the prevalence of shallow soils in the Timesville community (soil depth to sandstone bedrock is \leq 40 inches; NRCS 1982), have combined to create an area where groundwater is flowing to the ground surface. Shallow groundwater can accumulate at the contact between the sandy soil and the hard sandstone bedrock. Sandstone bedrock was seen in several places along the roadside ditches where groundwater was observed to be flowing. At any point where this contact is exposed, the groundwater can easily flow to the ground surface.

Additionally, where a road bed intersects the soil/rock contact point, shallow groundwater will accumulate under a roadway (i.e. in the gravel layer under the asphalt) and seep to the surface through cracks in the paving surface. This type of groundwater problem is found in many roads on the Cumberland Plateau region within Hamilton county (HCHD 2005).

Conclusions

1. No apparent health hazard exists from tetrachloroethylene in the Walden's Ridge Utility District (WRUD) drinking water because during the months before and after treatment began, the levels did not increase to a dose level expected to cause illness or other adverse health effects.
2. No apparent health hazard exists from coliform bacteria in the WRUD drinking water because the one time exceedance of the coliform bacteria standard appears to have resulted from a sampling error since the result was not repeated after November 2004 and no other cause could be discovered.
3. The investigation of the water quality of Middle Creek by the Tennessee Department of Environment and Conservation, Division of Water Pollution Control (TDEC-WPC) did not reveal the presence of sewage contamination.
4. The WRUD determined that the water line along the length of Timesville Road is intact and there are no breaks or leaks in the pipe. The water seen emerging from the asphalt at the intersection of Timesville Road and Lewis Mine Road is groundwater.
5. According to the Tennessee Department of Environment and Conservation, Division of Water Supply (TDEC-DWS) records, the WRUD is in compliance with all current regulatory standards.

Recommendations

1. WRUD should continue to utilize the Powder Activated Carbon (PAC) treatment process to reduce and maintain the concentrations of tetrachloroethylene below the U.S. Environmental Protection Agency (EPA) Maximum Contaminant Level (MCL) as long as the current groundwater source is utilized.
2. For a 3 month period, the WRUD should conduct once a month tetrachloroethylene sampling and analysis of the nearest public water tap (such as drinking water fountain at a school or other public building) to confirm the effectiveness of the treatment system and levels users may be ingesting. Such sampling may demonstrate that ingested levels are even lower than those measured at the treatment plant.
3. Citizens concerned about the quality of drinking water provided by any water utility, or from any other source (e.g. private well, spring, etc.) should contact the TDEC-DWS (1-888-891-8332) for information and assistance.

Public Health Action Plan

1. Tennessee Department of Health, Environmental Epidemiology (TDH-EEP) will provide copies of this public health consultation to any concerned local residents, any concerned customers of the WRUD, management of the WRUD, the Chattanooga-Hamilton County Health Department (CHCHD), and the TDEC-DWS.
2. TDH-EEP will continue to provide health education to environmental regulatory agencies and community members concerned about the site.
3. TDH-EEP will continue to work with the CHCHD, and TDEC-DWS as needed.
4. TDH-EEP is available to review additional data.

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APPENDIX A

Tetrachloroethylene (PCE) $\text{Cl}_2\text{C}=\text{CCl}_2$

Tetrachloroethylene is a commonly used drycleaner solvent/fluid and metal degreaser (also known as perchloroethylene; also referred to as “perc” or “PCE”). Introduced in the 1930s, tetrachloroethylene is the solvent or cleaning agent, most often used by professional drycleaners. It can removes stains and dirt from all common types of fabric, and does not usually cause clothes to shrink or dyes to bleed.

Tetrachloroethylene is a clear, colorless liquid said to produce a sharp, sweet smell. It evaporates readily at room temperature, and unlike many other common solvents, it is not flammable. Tetrachloroethylene is a synthetic chemical and is often used as a starting point for the manufacture of other chemicals (ATSDR 1997). If it is released to surface soil, it will mostly evaporate into the air and disperse. It is in a class of chemicals called DNAPLs (Dense Non-Aqueous Phase Liquids). Due to the physical properties of DNAPLs, they readily travel through soil and enter into groundwater. Once in the groundwater, DNAPLs do not easily dissolve in to the water, and can remain there for many months or years with very little chemical breakdown or change.

People can detect the smell of tetrachloroethylene in the air at 1 part per million (ppm) or more. Background concentration of tetrachloroethylene in the environment is usually less than 1 ppb. It is used in certain consumer products including water repellents, silicone lubricants, fabric finishers, spot removers, adhesives, and wood cleaners. Tetrachloroethylene has been widely used in the drycleaning industry for decades. Clothes brought home from a drycleaners may release small amounts of tetrachloroethylene into the air. Scientific studies have shown that the levels of tetrachloroethylene in a closet, where newly dry-cleaned garments were placed, ranged from 74 – 428 ppb after one day. It was found that levels of up to 74 ppb could persist in the closet for several days. The significance of exposure to small amounts of tetrachloroethylene is unknown, but to date, they appear to be relatively harmless (ATSDR 1997).

Most tetrachloroethylene leaves the body through the lungs while breathing. A small amount is changed by the liver into other chemicals and is removed from the body in urine. Most of the altered chemical leaves the body in a few days. However, tetrachloroethylene can be found in blood and other tissues, especially body fat, and may remain stored in the body for several days to weeks (ATSDR 1997). Tetrachloroethylene has been used safely as a general anesthetic. At high concentrations it is known to produce loss of consciousness. When air concentrations are high, particularly in closed, poorly ventilated areas, single exposures can cause dizziness, headache, sleepiness, confusion, nausea, difficulty in speaking and walking, unconsciousness, and death. Irritation may result from repeated or extended dermal (skin) contact. Results in animal studies, conducted with amounts of tetrachloroethylene much higher than most people are normally exposed to, show that it can cause liver and kidney damage and also liver and kidney cancers. Although studies have not shown tetrachloroethylene to cause cancer in humans, the International Agency for Research on Cancer (IARC) has determined that tetrachloroethylene also is probably carcinogenic to humans. Exposure to very high levels of tetrachloroethylene in animals has shown to produce neurological deficits and developmental problems (ATSDR 1997).

APPENDIX B

Water Utilities in the State of Tennessee

All water utilities in the state are regulated by the Tennessee Department of Environment and Conservation, Division of Water Supply (TDEC-DWS). These utilities must, under state law, follow the Rules of the TDEC-DWS, Chapter 1200-5-1, concerning Public Water Systems (the Rules). These rules were developed and adopted by the state after the passage, by the legislature, of the Tennessee Safe Drinking Act of 1977. These rules are posted on the TDEC-DWS website at <http://www.tennessee.gov/environment/> or paper copies can be obtained from the Chattanooga Field Office of TDEC-DWS.

The Rules are contained in a 226 page document. Within the Rules, every aspect of supplying drinking water to the public is addressed. Topics covered under the Rules include:

- how water is to be treated,
- quality standards that must be met,
- the types of chemical testing that must be conducted,
- intervals at which water samples are to be taken,
- when and how quickly public notifications must be given,
- the education, training, and qualifications required of persons that operate water treatment plants and water distribution systems.

All regulatory matters concerning a water utility are administered through the TDEC-DWS. There are representatives of the DWS available at every TDEC field office across the state to assist citizens with any type of concern they may have about their drinking water. A DWS representative can be reached, toll-free, at 1-888-891-8332. The caller to the toll-free number will be automatically directed to the TDEC field office that serves the county from which they are calling.

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FIGURE 1 - Map showing the Signal Mountain, Walden and Timesville community vicinity.
(Map credit: TOPO! National Geographic)

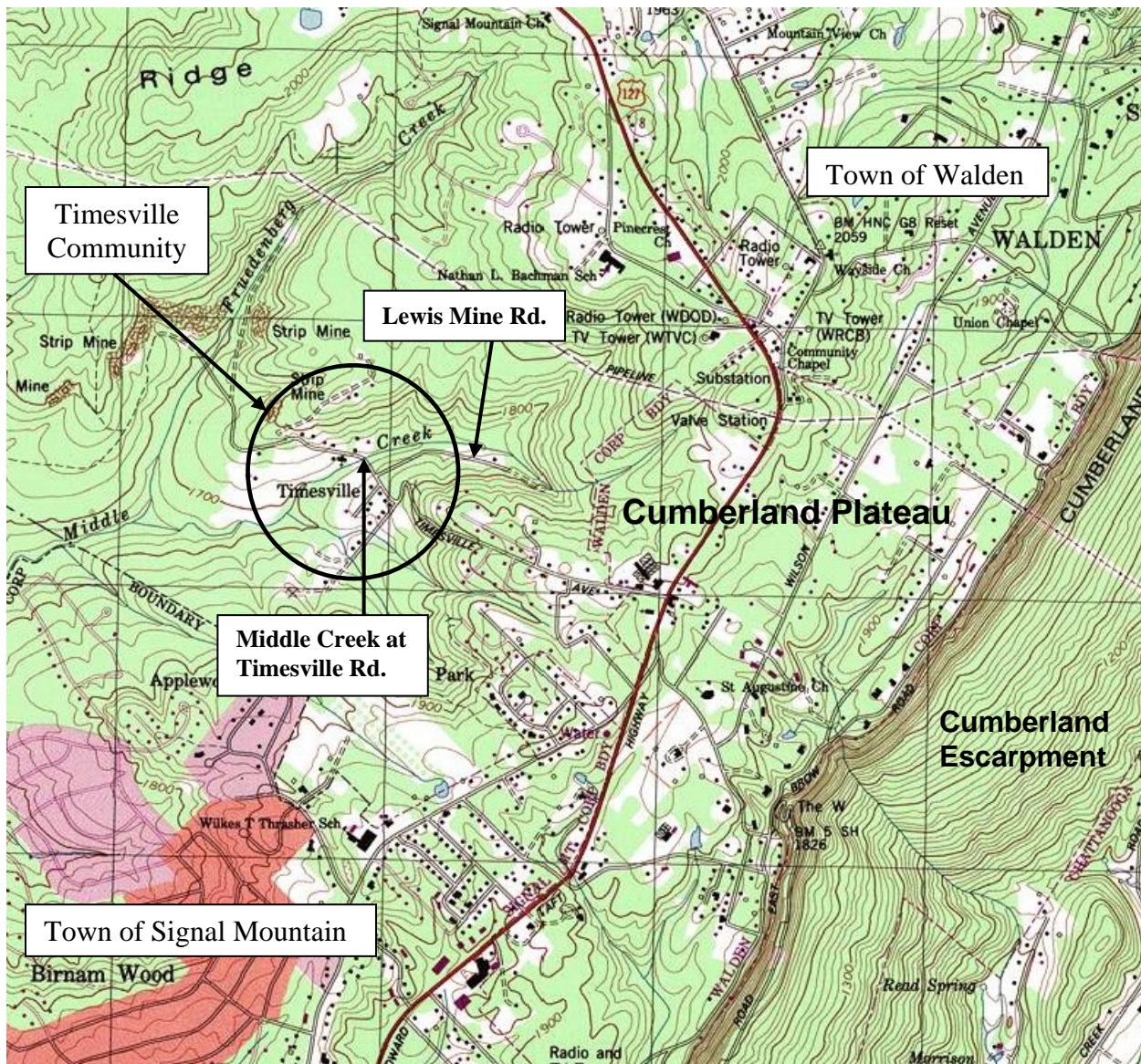


FIGURE 2 - Photo of the WRUD Water Treatment Facility. Hamilton County, Tennessee.
(Photo credit: Ron Clendening, TDH, 8/31/05)



FIGURE 3 - Photo of the well building at the WRUD water treatment facility. The tetrachloroethylene spill occurred on the property beyond fence; approximately 100 yards from the well building. Hamilton County, Tennessee. (Photo credit: Ron Clendening, TDH, 8/31/05)



FIGURE 4 - Photo of the new water line construction. This view is looking to the east from the top of the Cumberland Escarpment (on East Brow Road). Walden, Hamilton County, Tennessee. (Photo credit: Ron Clendening, TDH, 8/31/05)



FIGURE 5 - Photo of Middle Creek in the Timesville community. The orange colored material in creek (called *Yellow Boy*) is caused by Acid Mine Drainage (AMD).
(Photo credit: Ron Clendening, TDH, 8/31/05)



FIGURE 6 - Photo of water seeping from Timesville Road, at the intersection with Lewis Mine Road, in the Timesville community. (Photo credit: Ron Clendening, TDH, 8/31/05)



Certification

This Public Health Consultation (*Walden's Ridge Utility District, Signal Mountain, Hamilton County, Tennessee*) was prepared by the Tennessee Department of Health Environmental Epidemiology under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It was prepared in accordance with the approved methodology and procedures that existed at the time the health consultation was begun. The editorial review was completed by the cooperative agreement partner.

Technical Project Officer, CAT, SPAB, DHAC, ATSDR

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

Team Leader, CAT, SPAB, DHAC, ATSDR