ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

SMALLEY-PIPER
COLLIERVILLE, SHELBY COUNTY, TENNESSEE
EPA FACILITY ID: TNN000407378
MAY 8, 2006

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR 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 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 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 which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

SMALLEY-PIPER

COLLIERVILLE, SHELBY COUNTY, TENNESSEE

EPA FACILITY ID: TNN000407378

Prepared by:

Tennessee Department of Health
Communicable and Environmental Disease Services
Environmental Epidemiology
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
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 (CERCLA), also known as the *Superfund* law. This law set up a fund to identify and cleanup our country's waste sites. The Environmental Protection Agency (EPA) and the individual states regulate the investigation and cleanup of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment for each site 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. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR and the Tennessee Department of Health (TDH) also conduct public health assessments when petitioned by concerned individuals. This public health assessment was carried out by environmental health scientists from the State of Tennessee Department of Health with which ATSDR has a Cooperative Agreement. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example: a public health assessment could be one document or it could be a compilation of several health consultations; the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As first step in the evaluation, ATSDR and TDH 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 and TDH do not collect their own environmental sampling data but review 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, are, or could come into contact with hazardous substances, then ATSDR and TDH scientists evaluate whether or not these contacts may result in harmful effects. ATSDR and TDH recognize 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 and TDH consider 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 and TDH use existing scientific information, which can include the results of medical, toxicological, and epidemiological studies and data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and there are occasions when scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health hazards, if any, posed by a site. When health hazards have been determined for high risk groups, such as children, elderly, chronically ill, and people engaging in high risk practices, they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in public health action plan.

ATSDR and TDH are primarily advisory agencies, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR and TDH. However, if there is an urgent health hazard, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR and TDH solicit and evaluate information from numerous city, state and federal agencies, the companies potentially responsible for cleaning up the site, and the community. Then, they share their conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's and TDH's upcoming conclusions and recommendations, often times other agencies will begin to react to them before the final release of the report.

Community: ATSDR and TDH also need 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 and TDH actively gather 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 comments received from the public are responded to in the final version of the report.

Glossary: A list of commonly used environmental health terms, abbreviations, acronyms, and units of measure, along with their definitions, is available at the end of this document.

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Summary

A release of chromium more than 20 years ago has led to contaminated groundwater in Collierville, Shelby County, Tennessee. The chromium is likely from past battery casing manufacturing at the Smalley-Piper site. Chromium is now present in groundwater under and beyond the site. In 2002, chromium was detected in the raw groundwater drawn by the Town of Collierville's Water Plant #2. Traditional water treatment was unable to remove all of the chromium contamination from the raw water; therefore, the finished product public drinking water contained low levels of chromium. The Town of Collierville closed Water Plant #2 to ensure that chromium would not increase to harmful levels.

Cautious actions performed by the Town of Collierville maintained all regulatory drinking water standards. The federal maximum contaminant level (MCL) of 100 parts per billion (ppb) of total chromium in public drinking water was never exceeded. A finished product water sample was analyzed at Water Plant #2 on January 27, 2003, and was found to contain 46 ppb hexavalent chromium(VI). This was the maximum concentration detected at the treatment plant prior to the closure of Water Plant #2 on December 3, 2003. Therefore, people using water from the distribution system immediately before closure are assumed to have ingested chromium at concentrations less than 46 ppb. Dilution effects within the distribution system may have lowered the concentrations substantially. No sampling of tap water was performed to confirm the level of chromium residents might have been exposed to via the municipal drinking water.

In November 2003, the Tennessee Department of Health, in partnership with the Agency for Toxic Substances and Disease Registry (ATSDR), issued a health consultation noting that reported chromium levels at the treatment plant were unlikely to cause illness. The health consultation also noted that, if not mitigated, chromium levels could increase and lead to future public health problems.

In September 2004, EPA proposed to add the Smalley-Piper site to the National Priorities List (NPL). Following a public comment period, the site was finalized on the NPL in April 2005.

TDH and ATSDR conclude that no apparent public health hazard existed from drinking water that may have been contaminated with chromium. Under current conditions, which include the closure of Water Plant #2 and the absence of private drinking wells in the contaminated groundwater area, no public health hazard exists. However, chromium contamination in the groundwater does pose a future public health hazard if untreated and unmonitored groundwater is used as a future drinking water supply.

This document was released for public comment on October 25, 2005. A public meeting was held at the Collierville Town Hall to present the Public Health Assessment, provide clarification, and answer questions. During the subsequent comment period no comments were received from the general public. A few comments were received from governmental agencies and an environmental firm. All pertinent comments were incorporated into this document, which is now presented as a final release.

Purpose

This public health assessment of the Smalley-Piper site has been issued to update the public health findings and recommendations since the issuance of a health consultation report in November 2003. This report also recognizes written comments provided during a public comment period in late 2005.

This report evaluates the public health significance of sources of chemical contamination from the Smalley-Piper site to local drinking water. Environmental permits, enforcement actions, environmental emissions, and spills have been used to examine the environmental data for the Collierville community. Health outcome data, including cancer incidences, hospital visits, and causes of death, have also been considered.

Because of the limitations of data and science, this report is not intended to inform someone why they are experiencing any particular symptom or illness. Such information on personal medical conditions should come from a board-certified physician following appropriate medical examination and testing.

Background

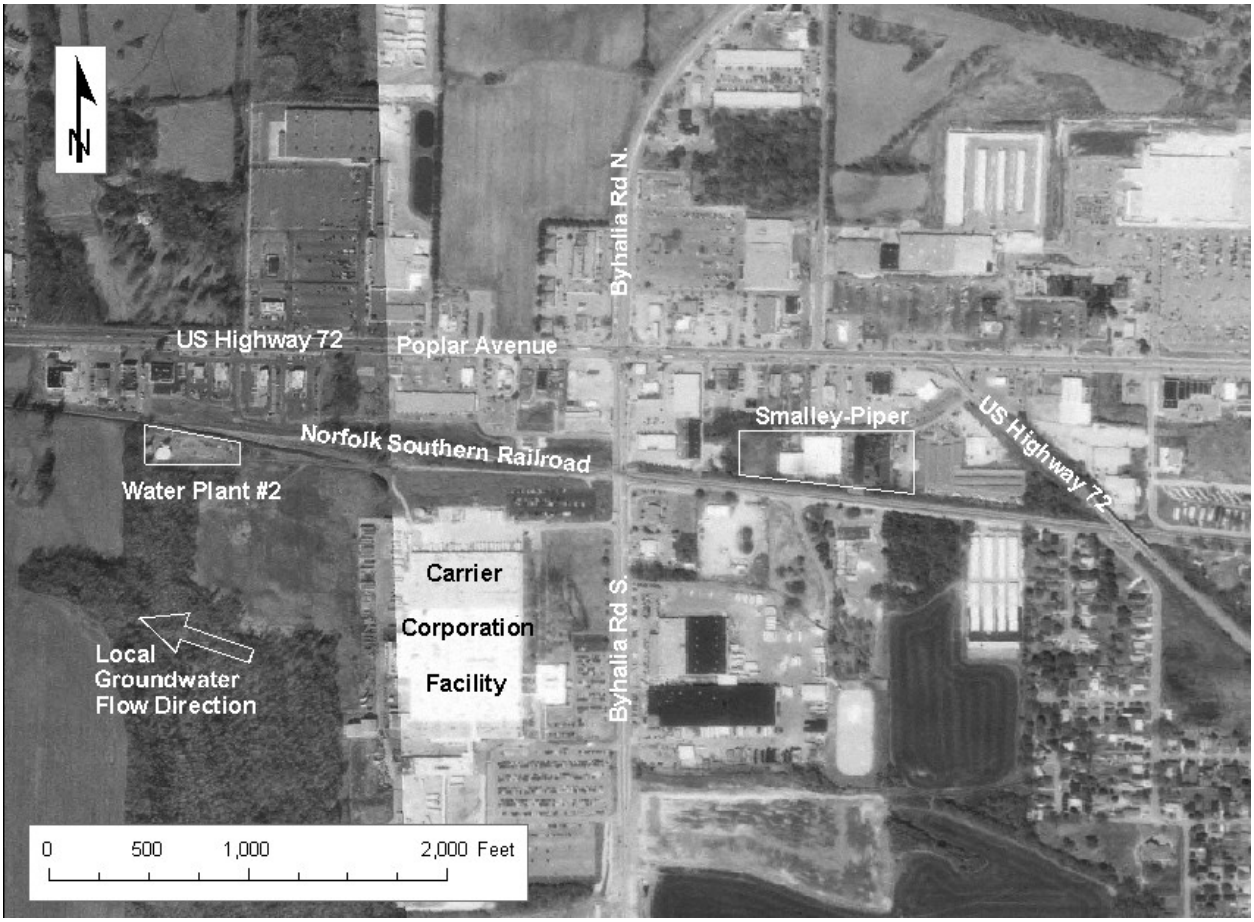
In July 2003, Tennessee Department of Health (TDH) Environmental Epidemiology (EEP) was asked by the U.S. Environmental Protection Agency (EPA) to provide a written public health consultation for the Smalley-Piper site. Although some chromium pollution in groundwater was getting into the drinking water supply, the chromium concentration never exceeded the federal safe drinking water MCL for public water systems. The *Health Consultation: Smalley-Piper, Collierville, Shelby County, Tennessee*, published on November 6, 2003, reported no apparent public health hazard. Use of the groundwater in question was stopped, eliminating the exposure pathway. However, because potential future exposure to the chromium could not be ruled out, the Smalley-Piper site was given priority for federal cleanup evaluation.

EEP formally began this health assessment on January 12, 2005, with a stakeholders' meeting held in Collierville. Mr. David Borowski, Environmental Health Program Manager and principal author of both the health consultation and health assessment, presented the public health assessment process, next steps, and a schedule for completion. This meeting was effective in helping to discover stakeholders who may or may not have had personal correspondence during the initial health consultation process.

Several stakeholder groups were interested in the potential environmental public health impacts from Smalley-Piper, foremost was the Town of Collierville. Collierville officials wanted to protect their constituents. The Department of Public Services desired to maintain their drinking water operations at top quality. The Memphis and Shelby County Health Department Water Quality Program and the Tennessee Department of Environment and Conservation (TDEC) Division of Water Supply (DWS) both regulate water quality. The TDEC Division of Remediation (DoR) (formerly Superfund) is responsible for conducting the oversight of

Superfund cleanup activities in Tennessee. The EPA operates the Superfund NPL program on the federal level. The owner(s) and trustee(s) of Smalley-Piper property have concern for the public well-being. The Carrier Corporation is an impacted third party responsible for a different chemical contaminant in the same groundwater. Others including citizens, environmental contractors, and elected officials have also expressed interest.

FIGURE 1. Aerial photograph of Smalley-Piper, Carrier, and Water Plant #2. Groundwater flow is west northwest. Groundwater drawn by Water Plant #2 has been impacted. It appears that chromium is migrating from Smalley-Piper and that trichloroethylene is migrating from Carrier. Collierville, Shelby County, TN (source: USGS & NRCS)



This public health assessement was spurred by the possibility that Water Treatment Plant #2 will resume operation in the future and that there would be potential for anyone on the Collierville drinking water system to be exposed if the chromium could not be removed. There are 14,000 water connections in this area, therefore the potential exposure is significant. Even though the potential exposure can be eliminated with conservative measures by Town of Collierville officials, the source of the chromium pollution remains. Therefore, the government continues to investigate the Smalley-Piper site in an effort to cleanup lingering chromium contamination.

History of Smalley-Piper

The Smalley-Piper site is located at 695 US Highway 72 W (719 Piper Street) in a business area of Collierville, Tennessee, zip code 38017. The site was previously operated by Piper Industrial Coatings, Inc., which was engaged in the business of hardfacing and recycling farm equipment. Hardfacing uses a metal slurry to strengthen tools in areas that are susceptible to wear-and-tear (WSI 2002). The site began making farm tools in the 1960s. Both ownership and manufacturing processes changed several times over the decades. In the early 1970s, site operations included the manufacturing of magnesium battery casings (EPA 2002).

During the manufacturing process, the magnesium battery casings went through a treatment train consisting of ten vats each equipped with leakage (prevention) baskets. The ten-step process consisted of: 1) caustic soda, 2) rinse water, 3) rinse water, 4) acetic acid, 5) rinse water, 6) rinse water, 7) chromic acid, 8) rinse water, 9) rinse water, and 10) boiling rinse water.

The entire treatment train was surrounded by a concrete berm to contain spills. The rinse water used in the treatment process came from an on-site production well. The production well still exists, but it is no longer used. The process wastes were discharged on-site into an equalization pond. The volume of rinse water, combined with caustic soda, acetic acid, and sodium nitrate, was estimated to be 28,000 gallons per day. The chromic acid was changed after approximately 4,000 battery casings were processed; 200–300 casings were processed at a time.

In theory, mixing the caustic soda and acetic acid could yield a neutralization reaction. After being discharged into the equalization pond, the spent chromic acid was treated by injecting liquid sulfur dioxide (SO_2) from a pressure bullet tank directly into the pond. The pond was reported to be tested twice weekly by the plant chemist. SO_2 and pH adjustments were made as necessary. The goal was to remove hexavalent chromium(VI) present in the chromic acid as a sulfide precipitate containing trivalent chromium(III). The chemical reaction is:

$$2CrO_3 \text{ [chromium(VI)]} + 3SO_2 \rightarrow Cr_2S_3 \text{ [chromium(III)]} + 6O_2$$

In 1981–82, the magnesium casing operations, including equipment and monitoring reports, were moved to another site in New Albany, Mississippi. When the manufacturing stopped, the equalization pond was closed. Pond sediment was removed and spread on plastic sheets. The pond sediment was turned over, mixed with an indigenous material, and allowed to dry. When the State was satisfied with the analytical results from its testing activities, the contents were put back into the equalization pond area, covered with soil, and seeded (WSI 2002). Statements about TDEC oversight have been made in site reports. TDEC officials report that there are no records of oversight during the time of closure has been located.

The past industrial use of chromium containing materials at the Smalley-Piper site has led to former operators of the site and the current owners of the site becoming potentially responsible parties for recent environmental investigations concerning chromium contamination of groundwater in Collierville.

The site is currently operated as Lund Coating Technologies. In the current hardfacing process, iron-carbide powder is mixed with water to form a thick slurry in which parts are submersed and coated. The parts are then sent through a curing oven and hardened. The current process does not generate a hazardous waste stream.

Environmental Story

In March 2001, water flowing into an off-site surface water drainage ditch near a potential development northeast of the site was discovered to contain 153 parts of total chromium per billion parts of water (ppb). The developer believed the water could be traced back to Smalley-Piper. In April 2001, the on-site production well and the surface water drainage ditch were sampled. Concentrations of total chromium of 141 ppb and 139 ppb, respectively, were measured. Until this discovery, the Smalley-Piper site was believed to have been successfully remediated. This discovery also prompted the testing of the groundwater withdrawn from the Collierville's municipal source water wells. All 12 wells that supply the Town of Collierville's Department of Public Services public drinking water plants (EPA 2002) were tested in July 2001.

From the July 2001 testing, 2 groundwater wells, located west of Smalley-Piper (WSI 2002), were reported to have detectable total chromium levels. These wells named, East Well #201 and West Well #202, provide the source water for the Town of Collierville's Water Plant #2. During the same time period, the Smalley-Piper on-site production well and the surface water drainage ditch were both sampled again. Total chromium concentrations reported were 93 ppb and 89 ppb, respectively. After the contamination was discovered, frequent environmental monitoring of the source groundwater and finished drinking water product was performed.

After the July 2001 testing, chromium was again detected in the source water wells at Water Plant #2. Total chromium levels ranged from non-detect to 74 ppb in these wells. Water from East Well #201 was mixed with water from West Well #202 prior to public distribution. This action diluted the chromium concentration in the water supply. Total chromium concentrations in drinking water distributed to the public ranged from non-detect to 43 ppb between July 20, 2001 and December 1, 2003. (It should be noted that this is a theoretical maximum value for hexavalent chromium in publicly consumed drinking water as mixing within the water system prior to distribution should result in dilution.) On December 3, 2003, operation of both wells supplying Water Plant #2 ceased. No tap water samples were collected to verify the actual amount of chromium present in water coming out of a residential faucet.

While in operation, Water Plant #2 processed 1.0 million gallons of groundwater per day (MGD), which was 15% to 20% of the Town of Collierville's total demand. Water Plant #2 accounts for about 6% of their capacity. Department of Public Services workers mentioned some loss in water pressure due to the loss of these two source water wells on their system.

The Potential for Health Issues

The Town of Collierville's Department of Public Services provides drinking water for the rapidly growing suburban area. The town operates 5 drinking water plants that pump water from

12 different wells. Groundwater is drawn into the drinking water plants where it is treated for human use and consumption. The finished product drinking water from the treatment plants is then blended into the water distribution system which has a capacity of about 23 MGD. The Town of Collierville provides an average of 5.5 million gallons of water on a daily basis to its approximately 14,000 connections.

Water samples analyzed, both source groundwater and finished drinking water, never exceeded the EPA regulated maximum contaminant level (MCL) of 100 parts per billion (ppb) of total chromium for drinking water. Yet, there was concern that the amount of chromium contained in the groundwater could increase over time. If this happened, there could be a health concern. As a protective measure, the Town of Collierville's Department of Public Services set a voluntary action level of 50 ppb for chromium in the drinking water. This was a conservative measure, but one they felt prudent and justified. The November 2003 Health Consultation suggested that children could be at greater risk from chronic hexavalent chromium exposure via drinking water. Subsequently, the Town of Collierville decided not to use groundwater at Water Plant #2 for public use if chromium was detected in it. Their drinking water analysis most often employed an analytical detection minimum of 10 ppb total chromium.

Drinking Water Quality Reports

The Tennessee Department of Environment and Conservation Division of Water Supply is charged to maintain safe drinking water. There are federal drinking water standards that must be upheld. Other state or local standards may also be applicable. The Division of Water Supply must be provided with periodic reports detailing water samples that have been analyzed from municipal drinking water plants. As previously stated, at no time were chromium standards exceeded. As a precaution, other aspects of drinking water purification and reporting were investigated from 1999 to 2005. Between 1999 and 2003, only one infraction was held against the Collierville Public Services Water Department. For the month of March 2000, there was a bacteriological violation (TDEC DWS 2005a). It was a one-time infraction. Overall, the Collierville public drinking water has been of excellent quality.

Geology and Hydrogeology

Collierville is located in the physiographic region known as the Gulf Coastal Plain. The Gulf Coastal Plain is characterized by gently rolling to steep topography formed as the result of the erosion of geologic formations of Tertiary and Quaternary age. The characteristic topography is broken at many places by the relatively flat alluvial plains of the streams that cross the area. Two major streams that pass to the north and south of Collierville are the Wolf River and Nonconnah Creek, respectively.

The Gulf Coastal Plain in western Tennessee lies within a geologic feature known as the Mississippi embayment. The embayment is essentially a broad trough, over 150 miles wide along the 35^{o}N line of latitude and over 3,000 feet deep along its axis. The trough trends southwest to northeast and the axis roughly follows the course of the Mississippi River. In Tennessee, the sediments that fill the trough tilt gently westward into the embayment and southward down its axis. The sequences of sediments that fill the trough are subdivided into 8

stratigraphic layers. Of the 8 layers present, 4 act as freshwater aquifers. An aquifer is defined as a subsurface geologic horizon that contains sufficient water-saturated, permeable material that will conduct and yield significant quantities of groundwater to wells and springs. In the Memphis area, only 2 of these layers, the Memphis Sand aquifer and the deeper Ft. Pillow Sand aquifer, are used as potable water sources by the municipal water utilities. The shallow fluvial aquifers are not used as potable water sources.

The Town of Collierville Water Plant #2 obtains its water from two wells placed in one of the main aquifers in the Mississippi embayment known as the Memphis Sand. The two wells are installed at different depths. The flow of the groundwater in the Memphis sand is westward toward the Mississippi River following the dip of stratified sediments that form the aquifers of the region (USGS 2001). In much of Shelby County, the Memphis sand aquifer is protected from surface pollutants by relatively impermeable overlying geologic layer. However, this protective layer is not likely present in the southeast portion of Shelby County (USGS 1985, 1990). Boring logs (TDEC DoR 2005a) for monitoring well installation suggest the confining layer pinches out west of Smalley-Piper and is thus absent in the area around the site.

The areas that lack a confining layer to aquifer layers exposed to the ground surface are called recharge areas. Contaminants released upon any aquifer recharge area can introduce those contaminants into the groundwater conducted by the aquifer. The Smalley-Piper site is situated in the recharge area of the Memphis sand. Water Plant #2 is west or hydrologically down-gradient of Smalley-Piper. East Well #201 is 287 feet deep and West Well #202 is 324 feet deep. Chromium contamination has not been measured in a monitoring well located to the east of Smalley-Piper, which is hydrologically up-gradient of the site.

Land Use and Demographics of site area

The land use of the area surrounding the Smalley-Piper site has changed over the years and has become developed into suburban commercial. A strip mall, retail stores, gas stations, and restaurants are along the nearby highway. Closest to the site are a gas station and self-storage business. As seen in an aerial photo (Figure 1), many land use types, including residential, are now present in proximity to the Smalley-Piper site. A collection of photographs taken at Smalley-Piper is located in Appendix A.

According to the Chamber of Commerce, the population of Collierville was 42,323 in 2002. Collierville is an area with a quickly growing population of approximately 11,000 families (Collierville 2005a). Of these, 54% are married with children and 34% married without children. The others are single. Over 93% of people 25+ years of age in Collierville have at least graduated high school. About 75% of people have some college education with 42% having graduated college. About 30% of the Collierville population consists of children 0 to 17 years old. Nearly 21% of the population is 35 to 44 years old.

Discussion

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. contaminant transport through an environmental medium,
3. a point of exposure,
4. a route of human exposure, and
5. a receptor population.

An exposure pathway is considered complete if there is evidence that all five of these elements have been, are, or will be present at the site. The pathway is considered either a potential or an incomplete exposure pathway if there is no evidence that at least one of the five elements listed has been, is, or will be present at the site, or if there is a lower probability of exposure.

When a chemical is released from an area such as an industrial plant or from a container such as a drum, it enters the environment. A chemical release does not, however, always lead to human exposure. Persons can be exposed to a chemical when contact is made by breathing, eating, drinking, or otherwise touching the chemical.

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

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

Defining the Potentially Exposed Population

Investigating the need to cleanup pollution from past industrial activities at the Smalley-Piper site is a complex procedure. Historical documents show that chromic acid, a source of chromium, was used in the past. A chromium contaminant plume has been identified in groundwater. People typically do not come into physical contact with groundwater; however, chromium can be spread after the Town of Collierville pumps, or has the ability to distribute, chromium-contaminated water onto the public drinking water system. When this condition was identified, the Town of Collierville took a cautious approach and stopped using the two water wells that were affected by the contaminated groundwater. Therefore, no exposure pathway

exists, because no contamination can now reach the general public. In order to further develop this public health assessment, a potentially exposed population must be defined.

Likely, only people living in close proximity to Water Plant #2 would have had the risk of an increased chromium level in their drinking water, when the groundwater was being used. Since we cannot know what homes would have received chromium-contaminated water from the drinking water system, we chose to be cautious and define the potentially exposed population as the entire Collierville community. This includes the entirety of zip codes 38017 and 38027. The Town of Piperton receives water from Collierville, is part of the 38017 zip code, and is included in the potentially exposed population. Residents of Fayette County may be included.

Environmental Sampling

Chromium contamination discovered in March 2001 in a surface water drainage ditch near the Smalley-Piper site led to sampling groundwater in the on-site production well and the drainage ditch in April and July 2001. Table 1 provides the results of the sampling. No sediment samples were collected. As chromium may remain, sediment sampling in areas where children are likely to play in the surface water drainage ditch should be conducted to rule out dermal contact as a possible exposure pathway.

TABLE 1. Chromium (IV) and total chromium concentrations (ppb) detected in an on-site production well and a surface water drainage ditch in April and July 2001.

	on-site production well		**surface water drainage ditch**	
	April 2001	July 2001	April 2001	July 2001
chromium(VI)	not measured	76	not measured	75
total chromium	141	93	139	89

An EPA site investigation (SI) was conducted at Smalley-Piper the week of July 8, 2002. Three groundwater monitoring wells were installed during the SI. The on-site production well was also sampled in duplicate. The wells were sampled for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), pesticides/PCBs, metals, and cyanide. Various compounds were identified and measured in small quantities (EPA 2002). Table 2 shows that one of the groundwater monitoring wells contained an elevated concentration of total chromium. The 250 ppb total chromium measured in well SP02GW is greater than the 100 ppb MCL. Additionally, a Smalley-Piper on-site production well, that was shutdown by order of TDEC during the summer of 2002, was sampled as SP04GW. A potable water sample (i.e., a blank) was collected to facilitate further evaluation incase contamination was introduced by the use of the municipally supplied water as drilling fluid (EPA 2002).

TABLE 2. Total chromium (ppb) measurements from three groundwater monitoring wells and the on-site production well during the July 2002 EPA Site Investigation at the Smalley-Piper site.

SP01GW	SP02GW	SP03GW	SP04GW on-site well	SP04GW duplicate	SP05PW potable blank
13	250	14	20	16	not detected

As a precaution, the Town of Collierville's Department of Public Services was required to perform periodic monitoring of the chromium concentration in its municipal water sources and finished drinking water supply. Results of Water Plant #2 samples collected from the East Well #201 and West Well #202 and the finished drinking water are presented in Table 3 (TOC 2003).

Chromium exists in different forms in the environment. The three main forms, elemental chromium(0), trivalent chromium(III), and hexavalent chromium(VI), are discussed later in Toxicology. An important difference to note is that hexavalent chromium(VI) is considered the most likely to cause adverse health effects (ATSDR 2000; EHP 2000). Chromium(VI) is the form that is most soluble in water (TCF 2002a). Typically, the chromium found in water is mostly hexavalent chromium(VI) with small amounts of the other forms. Total chromium concentration or only hexavalent chromium(VI) concentration can be measured in water samples. It is common to simply measure total chromium, as the laboratory analysis is much less expensive, and assume the number represents all hexavalent chromium(VI). This explains why hexavalent chromium is rarely reported after June 26, 2003, as listed in Table 3. Using the total chromium value and assuming 100% hexavalent chromium(VI) can be acceptable in risk analysis.

In several instances, the hexavalent chromium(VI) analysis resulted in a concentration greater than the total chromium measurement. This is not possible. The analytical error in some testing methods can make data display impossible values. For example, on January 30, 2003, when water measured 21 ppb total chromium, 46 ppb hexavalent chromium was reported. For this sample, assuming the 21 ppb total chromium measurement is 100% hexavalent chromium is appropriate.

Although the chromium concentrations measured in the groundwater wells and the finished drinking water were below the EPA MCL of 100 ppb, both total chromium and hexavalent chromium(VI) concentrations have increased since 2001. Moreover, the West Well #202 had higher levels of chromium than the East Well #201 (Table 3). Before shutdown, operational controls were used to ensure that both wells were drawn from at the same time in order to mix the source waters and thus dilute the total chromium concentration. If for any reason either well pump failed to function properly, then the entire water plant would shut down to prevent the west well from operating alone. The Town of Collierville Water Plant #2 used 1.0 million gallons of groundwater per day, with a pump rate of 1,000 gallons per minute (WSI 2002). Of the five water plants in the Town of Collierville system, Water Plant #2 was the smallest volume plant.

TABLE 3. Total chromium and hexavalent chromium(VI) concentrations (ppb) measured in the Town of Collierville's Department of Public Services Water Plant #2 source water wells and finished drinking water, July 20, 2001, to December 1, 2003, Collierville, Shelby County, Tennessee (TOC 2003; TDEC DWS 2005a).

	East Well #201		West Well #202		Plant #2 – finished drinking water	
Date	**Total Cr**	**Cr(VI)**	**total Cr**	**Cr(VI)**	**total Cr**	**Cr(VI)**
7/20/01	15	15			<9	<10
8/02/01	19	21	8	10	15	12
10/22/01		20		20		
1/16/02		20		26		
4/10/02		14		26		
7/16/02		<10		42		
8/07/02			41	41	26	28
8/26/02		<10		46		30
10/29/02		10		50		20
1/27/03	<9	15	10	73	21	46
1/30/03	<9	<10	65	56	27	23
2/06/03	7	<10	66	63	18	13
3/04/03	6	<10	70	60	26	30
4/28/03	<10	<10	<10	<10	<10	<10
5/05/03	8	<50	9	<50	8	<50
5/19/03	10		58		34	
5/27/03	11	<10	60	43	38	32
5/27/03		<9		53		31
6/26/03	13		73		42	
7/31/03	16		74		43	
8/29/03	12		74		40	
9/17/03	13		70		40	
10/07/03	12		73		40	
10/28/03	13		67		17	
11/24/03	11		74		40	
12/1/03	10	16	64	71	41	17

"<" indicates a value below the analytical detection limit listed

ATSDR has not established a health guideline for ingestion of chromium, because the available data are insufficient or too contradictory to establish minimum levels of effect (e.g., LOAELs). Because chromium(III) is an essential nutrient in the body, the National Research Council has established a range of "estimated safe and adequate daily dietary intakes" (ESADDIs) for chromium. The range is 50 to 200 micrograms (µg) per day. The upper end of this range, 200 µg/day, has been adopted by ATSDR as a provisional guideline for oral exposure to chromium(VI) and chromium(III) compounds (ATSDR 2000).

This provisional guideline is equivalent to an oral exposure dose of 0.003 mg/kg/day for a 70-kilogram adult and 0.02 mg/kg/day for a 10-kilogram child. Using 43 ppb as the maximum concentration of total chromium ingested, the calculated dose for a 70-kilogram adult would be 0.0012 mg/kg/day, and the dose for a 10-kilogram child would be 0.0043 mg/kg/day. Both doses are well below the interim guidelines. EPA has a similar health guideline for chronic ingestion of chromium (VI). EPA's reference dose (RfD) for chronic oral exposure, based on animal studies, is 0.003 mg/kg/day for adults (EPA IRIS). Therefore, in the unlikely event that anyone ingested the assumed maximum concentration of chromium from Water Plant #2, no illness or other adverse health effect would be anticipated.

The ATSDR *Toxicological Profile for Chromium* (2000) is a peer-reviewed document that reviews the scientific literature available on the effects of chromium. Additional information on oral exposure to chromium is presented in Appendix B.

A Remedial Investigation / Feasibility Study (RI/FS) is being conducted to characterize the Smalley-Piper site. Table 4 lists the total chromium and hexavalent chromium(VI) concentrations from 6 monitoring wells. Hess Environmental Services, Inc. performed these measurements April 25 to June 13, 2005. Chromium is still present in the groundwater under the site. Geographically, the monitoring well data suggest that the chromium contaminant plume extends west northwest and not in all directions. This is evidence for a potential future health issue if groundwater were to be used for drinking water without prior treatment or removal.

TABLE 4. Results of Smalley-Piper on-site monitoring well samples for total chromium and hexavalent chromium(VI) collected on April 25, May 9, or June 13, 2005 (HES 2005).

monitoring well number	sample depth (feet)	total chromium (ppb)	hexavalent chromium(VI) (ppb)
MW-1	85	ND	ND
MW-2	85	6,000	5,700
MW-4	130	119	170
MW-4	170	114	84
MW-7	85	NA	304,000
MW-8	85	23,600	18,300
MW-9	85	12,600	12,400

NA = not available *ND = not detected*

Children's Health Considerations

For communities faced with chemical 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. 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 a chemical per unit of body weight. If chemical exposure levels are high enough during critical growth stages, the developing body systems of children can 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.

ATSDR (2005) hexavalent chromium(VI) ingestion screening levels for intermediate exposure (15 to 364 days) for increased non-cancer adverse health effects are different for adults and for children. The reference dose media evaluation guide (RMEG) for adults exposed for an intermediate duration to hexavalent chromium(VI) in drinking water is 100 ppb. This value is to the same as the EPA MCL for total chromium.

For children, ATSDR has projected an intermediate RMEG for chromium(VI) in drinking water at 30 ppb. The finished product drinking water data in Table 3 shows that this guidance level for hexavalent chromium(VI) was slightly exceeded between May and December 2003 (assuming hexavalent chromium at 100% of total chromium). Exceedance of any health guidance value does not mean that any adverse health effect will occur. ATSDR's RMEG is based on EPA's reference dose (RfD) for adults exposed to chromium(VI) of 0.003 mg/kg-day. This RfD has a combination of uncertainty and modifying factors totaling 900. EPA's overall confidence in the RfD is low. Given the low confidence in EPA's RfD and the large safety factor of 900 used in establishing the RfD, the health guidance values are likely over-protective.

The calculated maximum dose for a small child was presented earlier and shown to be within ATSDR provisional guidance. Given these calculations and the safety factors inherent in the ATSDR RMEG no adverse health effects unique to children would have been expected during the intermediate exposure period assuming no dilution of chromium within the water system.

When the finished product drinking water from Water Plant #2 enters the distribution system, it will be mixed with water already in the system. Assuming that the rest of the water supply is from chromium-free sources, a dilution will occur. This means that in people's homes, if chromium was present in drinking water, it should have been less than what was reported at Water Plant #2. In an effort to be as conservative and protective of public health as possible, the Town of Collierville officials decided that the new goal would be to achieve no detectable amount of chromium in the drinking water. A typical detection limit for total chromium analysis is 10 ppb. This action level is highly conservative and is not a required health or legal standard.

Private Drinking Water Wells

As of January 2005, 140 wells were recorded within 1 mile of the Smalley-Piper site. Only 1 of these wells is a private water supply. This well is located northeast and up-gradient of the site. The other 139 wells consisted of 113 geo-probe borings; 3 vapor extraction points; 16 monitoring wells for Carrier and Texaco #1; 3 monitoring wells and 1 soil boring at the Smalley-Piper site; plus 3 wells that have been grouted and closed.

The area of Collierville was reported to have had municipal drinking water available for 10–15 years. Homeowners were given 1 year to connect to municipal water once available. Therefore, no other residents within 1 mile of the site are thought to be drinking water from a private well. If residents are found to be obtaining drinking water from private wells near the Smalley-Piper site, they should be advised to have their water tested and to contact the Tennessee Department of Health for more information.

Federal NPL Superfund cleanup sites

Around Collierville, there are two Superfund sites. Smalley-Piper (EPA ID TNN000407378) was a new, proposed site when this document was begun. Smalley-Piper was listed on the NPL on April 27, 2005. The United Technologies Carrier (UTC) Air Conditioning Company site (EPA ID TND04406222) was proposed in 1984 and finalized in 1990.

The Carrier Air Conditioning Company site is located on a 135-acre parcel of land in Collierville. Since the late 1960's, the company has manufactured residential heating and air conditioning units. In 1979 and again in 1985, trichloroethylene (TCE) was released near the main manufacturing building. TCE was also reported to be in a wastewater lagoon from 1972 to 1979 (EPA 2005a). TCE is a volatile organic compound (VOC) commonly used as a cleaner and degreaser. TCE contaminated the soil and eventually passed into groundwater. In 1986, low levels of TCE were discovered in the groundwater drawn by Water Plant #2.

In 1989, Carrier installed a soil vapor extraction system to remove trichloroethylene contamination from soil in the former wastewater lagoon. In 1990, packed aeration towers were installed at Water Plant #2 by UTC. These air strippers remove TCE and its degradation products from the groundwater immediately after it is pumped from the wells and prior to its entry into the drinking water chlorination system. In accordance with an EPA Unilateral Administrative Order, design, construction, and operation of this system was performed by Carrier and permitted by the State of Tennessee. More information on the agreement between Carrier, EPA, and the Town of Collierville is available in the Record of Decision for the Carrier Site (EPA 1992) and the Five-Year Review (EPA 2000). Neither this system nor traditional water treatment can significantly reduce the chromium concentration. A benefit of the system is that it reduces movement of the contaminant plumes in the Memphis Sand aquifer. The system will continue to remove TCE from the groundwater at Water Plant #2 until cleanup goals are achieved. The treated water volume is in accordance with Collierville's public water demands and not necessarily reflective of what would be treated if remediation were the only goal (EPA 2005a). These remediation efforts are under state oversight from the TDEC DoR and federal oversight from the EPA Region 4.

Exposure to Water and Sediment in Drainage Ditch

A surface water drainage ditch received chromium-polluted water. The ditch is located approximately 0.25 mile north of the site. It does run through commercial and residential properties. There was a potential past exposure pathway for persons playing in or working in the ditch. Scientific literature describes allergic reactions when skin comes into contact with industrial concentrations of chromium compounds (ATSDR 2000; HSDB 2005a). To date, no sampling of the sediments has occurred. The potential exposure to ditch sediments would be of short duration, infrequent, and to less than industrial concentrations. Whether or not contact with the sediments is truly a health concern is unknown without quantitative analysis.

The initial testing of the ditch was performed in 2001 by a land developer who traced the water back to Smalley-Piper. At that time, operations from Smalley-Piper discharged water into this surface water system. A sample was collected where water from Smalley-Piper entered the drainage ditch near Piper Drive. The chromium concentration reported was 153 ppb. Lower concentrations were later reported as shown in Table 1. The ditch, part of the Lateral J, is a surface water collection channel that carries water to the Wolf River. After the chromium was detected, Smalley-Piper was instructed to get a permit for water discharge. Although a permit was initially obtained, it was later discontinued due to repeated exceedances of hexavalent chromium(VI) in their effluent. Smalley-Piper was then required to discharge the water from their on-site process well to the city sewer system (TDEC DOR 2005a).

No recent surface water release of chromium should have occurred. It is possible that as time passed much of hexavalent chromium(VI) may have been reduced to trivalent chromium(III) in the natural environment. Whether or not sediments have accumulated, chromium is an issue that TDEC Division of Remediation plans to address through their continuing Superfund site investigation process.

Other Environmental Considerations

Part of this public health assessment process involved looking into all media capable of carrying an environmental pollutant into a community. At Smalley-Piper the media in question is groundwater, or more specifically the ingestion of contaminated groundwater. Other media that are not specific to the Smalley-Piper site that were also considered in this evaluation of the environmental public health of the Collierville community included local air quality, drinking water quality, industrial emissions, industrial enforcement actions, and recreational water quality. In addition, edible wildlife including wild game and fishes were considered. Additional sources of environmental information are collated in Appendix C.

Future Considerations

After Collierville officials decided to shut down operations at Water Plant #2, there were some side-effects. For a rapidly growing suburban area, lack of public water is a problem. Without the volume of water produced by Water Plant #2, water pressure in the water system was

reduced. The loss of water pressure impaired firefighting capabilities. Also, the Carrier Corporation NPL Superfund site was unable to continue its normal remediation plan.

Carrier's cleanup system was functioning properly to remediate its past TCE spills. When Collierville officials decided to stop pumping groundwater at Water Plant #2, Carrier's treatment system could not operate. This forced Carrier into considering other water discharge options. Working with Collierville Public Services, UTC was allowed to draw groundwater via Water Plant #2, remove the TCE, and then transport the water into the sanitary sewer system that routes wastewater to the Northwest Treatment Lagoon from November 2004 through October 2005. This action allowed Carrier to maintain their agreement with EPA. The volatile nature of TCE readily enables its removal from water; however, the metallic nature of chromium makes it more difficult to remove from water.

A chromium treatment pilot study was performed by UTC as a voluntary effort to provide information that could facilitate and expedite the selection of a chromium treatment remedy once responsible parties had been identified. The chromium treatment pilot study was a component of interim operations while evaluating the chromium plume. The pilot study only treated 3 gallons per minute (less than 1%) of the total flow. The remaining discharge was allowed to be put into the sewer during spring and summer months. Based on the chromium treatment system data provided (EnSafe 2005), the process appeared to remove all detectable amounts of chromium. This is evidence that an engineered treatment system could be a remedy to the source water contamination problem. A treatment system could enable Water Plant #2 to be put back into production. As of the publication date of this document, no final decision to use or not use this type of option had been made. Water Plant #2 has remained non-operational, for its intended purpose of supplying Collierville public drinking water, since the shut down in December 2003.

Community Concerns / Public Meeting

Following an informative media release, a public meeting was held on Tuesday evening, October 25, 2005, to present the Public Comment Release of this Public Health Assessment (PHA). The meeting was held at the Town of Collierville Town Hall. A plain language fact sheet was produced to highlight the technical PHA report. The public meeting consisted of three parts. First, the primary author of this report provided a narrative presentation detailing the entire environmental public health investigation and the PHA process. Then, a question-and-answer session followed with representatives from the TDEC Memphis Field Office, Memphis and Shelby County Health Department, and Town of Collierville forming an expert panel. Then, the process of submitting comments on the Public Comment Release PHA were provided. A 30-day comment period followed.

Attendees to the meeting included some citizens, the EPA Project Manager, Town of Collierville Council members, environmental consultants, and other interested professionals. Reporters from the *Independent* newspaper attended the public meeting and ran subsequent stories to detail the PHA and other environmental work being conducted for the Smalley-Piper site in Collierville. An evaluation was available for attendees. Respondents found the meeting helpful and information easy to understand. Respondents valued both the presentation and fact sheet.

Comments received during the comment period were limited. Comments submitted in writing were incorporated into this Final Release PHA. No comments received were from public entities. Comments were received from an environmental consultant and from several governmental agencies. Beyond grammatical comments, suggestions were provided to help make the report clearer to the reader and to ensure that the statements would have lasting value. These comments led to a small rearrangement of some paragraphs, a double-check of Water Plant #2's water pumping statistics, changing a recommendation to an action plan item, and clarifying the importance of 100 ppb total chromium MCL. Overall, general public concerns have been limited, perhaps because there is no on-going exposure. This report is the final step in the PHA process. The November 2003 Public Health Consultation will be printed and made available to interested readers. Other copies will be placed in local depositories and state files to make a permanent record of this environmental public health investigation dialogue.

Health Outcome Data Review

Although the concentration of total chromium was never at or above levels expected to result in any adverse health effect, TDH opted to review available health outcome data. Data from death certificates, hospital in-patient admissions, hospital out-patient discharges, and the Tennessee Cancer Registry (TCR) were examined. Our goal was to determine how the health outcome data for Collierville area residents compared to the entirety of Shelby County and to statewide total of all 95 Tennessee counties.

In general, the occurrence of the health outcomes analyzed among Collierville area residents in comparison to Shelby County and Tennessee was similar or lower. Eight of the ten leading causes of death among Collierville residents were included in the top ten causes of death in Tennessee and Shelby County. Most causes of death were actually statistically less likely to occur in Collierville than in the Shelby County or Tennessee. The top ten most frequent health outcomes by rate of occurrence for each data set analyzed were rank ordered in associated tables presented in Appendix D. Additional information including assumptions made for the data, a formal definition of cancer, and detailed discussions of the four health outcome datasets analyzed are presented later in Appendix D. The ICD-9/ICD9-CM and ICD-10 codes and definitions are also available at the end of Appendix D.

Conclusions

No apparent public health hazard existed in the past for people who consumed drinking water that may have contained chromium. There was never a time period when drinking water standards for chromium were exceeded in finished product drinking water.

No present public health hazard exists for exposure to chromium. The chromium contamination is limited to Smalley-Piper soils and within the groundwater. The Smalley-Piper site itself is undergoing environmental investigation. The chromium in the groundwater is only an issue if it is consumed. Collierville's decision to stop using Water Plant #2 eliminated the potential ingestion exposure pathway of chromium in the drinking water.

An indeterminate health hazard exists from dermal exposure to uncharacterized sediments in the surface water drainage ditch that received water from Smalley-Piper.

Chromium contamination in the groundwater poses a future public health hazard if untreated and unmonitored groundwater is used as a future drinking water supply. If appropriate actions are taken, the potential for a future public health hazard due to chromium in drinking water is negligible. The stakeholders involved, especially Collierville officials, have been made aware of the environmental issues and can now be proactive in preventing any future public health problem.

Recommendations

As part of prudent public health practice, continued cleanup actions are encouraged to remove chromium from soil and groundwater.

If Water Plant #2 is restarted and draws from East Well #201 or West Well #202 to produce public drinking water, then it is recommended that regular water testing be performed to ensure chromium levels are below the MCL.

Public Health Action Plan

Environmental Epidemiology will communicate our environmental public health message to a wide stakeholder audience such that future environmental public health issues are prevented.

EPA and TDEC DoR will continue to provide oversight to the on-going Superfund environmental investigation of the Smalley-Piper site. As part of the on-going RI/FS Investigation, sediment samples will be collected from the drainage ditch in areas where children are likely to play and analyzed for chromium concentration.

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APPENDIX A

Photo 1: Smalley-Piper parking lot and main building entrance
Collierville, Shelby County, TN (photo credit: dmb 01/12/05)

Photo 2: Northern edge of Smalley-Piper looking westward; note the nearby businesses
Collierville, Shelby County, TN (photo credit: dmb 01/12/05)

Photo 3: Area between the two main on-site buildings, note the old well on left
Collierville, Shelby County, TN (photo credit: dmb 01/12/05)

Photo 4: Looking southwest over the field west of the site
Collierville, Shelby County, TN (photo credit: dmb 01/12/05)

APPENDIX B

Toxicology of Chromium

A naturally occurring element, chromium is found in rocks, animals, plants, soil, and volcanic dust and gases. Chromium can be found in different forms in the environment. The three most common forms of chromium are elemental chromium(0), trivalent chromium(III), and hexavalent chromium(VI). The metal chromium(0) does not occur naturally and, thus, is uncommon. Chromium(III) is an essential nutrient that helps the human body use sugar, protein, and fat. Hexavalent chromium(VI) is produced by industrial processes (ATSDR 2000). Chromium(II) and chromium(V) forms have been witnessed in some compounds.

Chromium compounds have no known odor or taste. Elemental chromium(0) is a grey solid metal with a high melting point. It is used in making steel and other metal alloys. The naturally occurring mineral chromite in the chromium(III) form is used as lining in high-temperature industrial furnaces, in other chemical compounds, and in metal alloys. Chromium(III) and chromium(VI) are used to make chrome metal plating. In addition, chromium(III) and chromium(VI) are used in the manufacture of dyes and pigments, in the tanning of leather, and in wood preserving products (ATSDR 2000).

Drinking chromium-contaminated water was the pathway into the human body that created the need for this health assessment. Chromium(0) is not currently believed to cause a serious health risk to humans. Medical and laboratory studies suggest that the hexavalent form of chromium has the greatest potential to cause adverse health effects in people and laboratory animals. Ingestion of hexavalent chromium(VI), at levels much greater than those reported in Collierville, has been shown to damage the kidneys in several studies. For example, a 1965 study in the People's Republic of China where villagers drank water with 20,000 ppb chromium(VI), compared to a 43 ppb maximum in Collierville, resulted in oral ulcers, diarrhea, abdominal pain, indigestion, and vomiting (ATSDR 2000). Many scientists contend that the stomach converts hexavalent chromium(VI) to chromium(III) which is not readily absorbed into the body. Also, red blood cells are reported to have massive reducing and sequestering capacity preventing chromium(VI) from acting as a systemic toxicant (EHP 2000).

According to the International Agency for Research on Cancer (IARC), chromium(0) and chromium(III) are not classifiable as to their carcinogenicity. EPA has insufficient evidence that chromium(VI) in food or water causes cancer. For the oral exposure route, chromium(VI) is classified as Group D, not classifiable as to human carcinogenicity (ATSDR 2000). No reliable information exists that suggests chromium in any form has harmful effects on reproduction or causes birth defects in humans. However, birth defects have been observed in laboratory animals exposed to chromium(VI) (ATSDR 2000).

APPENDIX C

Additional Environmental Information

Trying to determine exactly where chemicals found in our environment come from is a difficult task. Some chemicals may come directly out of a smoke stack. Some come from the tailpipes of cars and trucks. Others may come from agriculture, business, or household use. Some chemicals are blown in with the wind from other counties or even other states. In addition to direct sources, some chemicals may be a breakdown product of another chemical. Even though it is difficult to pinpoint the source of contamination, some tools are available to aid our attempt.

EPA EnviroMapper and Envirofacts

Citizens may be interested in other environmental aspects of their community. The EPA Internet site EnviroMapper can provide additional environmental information. EnviroMapper can be found at *http://www.epa.gov/enviro/html/em/index.html*. EPA also has a community search site for chemical based information called Envirofacts that can be accessed via *http://www.epa.gov/enviro*. For citizens without Internet access, either the (EPA), Tennessee Department of Health (TDH) or the Tennessee Department of Environment and Conservation (TDEC) will perform community searches and mail the results.

EPA Toxics Release Inventory (TRI)

The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990. The goal of TRI is to empower citizens, through information, to hold companies and local governments accountable in terms of how toxic chemicals are managed (EPA 2005tri).

TRI provides the American public with vital information on chemical releases including disposal for their communities, and is an important instrument for industries to gauge their progress in reducing pollution. Over 23,000 facilities reported on approximately 650 chemicals for calendar year 2003. TRI reporting includes toxics managed in landfills and underground injection wells as well as those released into water and the air.

EPA compiles the TRI data each year and makes it available through several data access tools, including the TRI Explorer and Envirofacts. TRI Explorer is available on the Internet at *http://www.epa.gov/triexplorer*. There are other organizations which also make the data available to the public through their own data access tools, including Unison Institute which puts out a tool called "RTKNet" and Environmental Defense which has developed a tool called "Scorecard" which is available from their Website at *http://www.scorecard.org*.

Permitted Industries

The Collierville community will experience some environmental pollution due to normal industrial activities. For example, companies are permitted to release chemicals into the air or water. The Tennessee Department of Environment and Conservation (TDEC) is the state agency responsible for maintaining these permits and environmental regulatory actions.

Enforcement Actions

TDEC reported no significant enforcement actions to businesses within the 38017 zip code for January 2000 to March 2005. Some minor reporting or paperwork violations did occur, but no major chemical releases.

Edible Wildlife

TDEC and the Tennessee Wildlife Resources Agency (TWRA) work together to establish safe consumption guidelines for edible wildlife such as fishes and big game. There are two major streams that flow nearby Collierville. They are the Wolf River to the north and Nonconnah Creek to the south. There are also several unnamed tributaries that flow to these streams in the vicinity. These streams are considered to be fisheries by the TDEC Division of Water Pollution Control (2004). There are fish advisories for both of these streams (TWRA 2005a); however, they affect portions of the streams several miles downstream from the Collierville vicinity.

APPENDIX D

Analysis of Health Outcome Data

In order to interpret disease trends in a meaningful way, health outcomes among Collierville area residents, zip code 38017, were compared to those of Shelby County and the State of Tennessee. While injuries and suicide are the fifth and ninth causes of death in Tennessee respectively, injuries and suicide were excluded from this assessment to better identify disease trends among Collierville area residents in relationship to potential environmental hazards.

The top ten reasons, excluding injuries and suicide, for inpatient hospital visits, outpatient hospital visits, types of cancer incidence as recorded by the Tennessee Cancer Registry, and causes of mortality among Collierville residents were identified for years in which data are available. Available data for this Health Assessment consisted of:

1. Death certificate data from 1990 through 2003;
2. In-patient hospital discharge data from 1997 through 2003;
3. Out-patient hospital discharge data from 1998 through 2001; and
4. Tennessee Cancer Registry (TCR) incidence case data from 1991 through 2000.

The leading health outcomes identified in each data source were presented in Table 5.

Mortality records for 1990 through 2003 are complete and reliable. TCR incidence data is about 80% complete. Some types of cancer are reported accurately, while other types of cancer may be under-reported. Although available, outpatient hospital discharge data from 1997 was excluded because not all hospitals provided data for that year. It is also important to note that prior to 2000, hospitals reported emergency room visits and out-patient ambulatory surgeries, but only reported 23-hour observations at their discretion. In-patient hospital data is much more reliable for the years 1997 through 2003; reporting from area hospitals is good. One limitation of both the hospital inpatient and outpatient discharge data is that it does not include information about disease incidence observed by private physicians in clinics not associated with hospitals. As a result, considering hospital data alone tends to underestimate morbidity experiences; it is, however, the only morbidity information available. In summary, none of the four data sources is perfect; each has its strengths and weaknesses. For these reasons, analysis of the data can be used as indicators of statistically significant rate differences, but not as definitive conclusions.

For evaluation purposes, the underlying cause of death for each death record was determined. Likewise, the primary cancer site among cancer incidence cases provided by the TCR was identified. Since it is possible for a hospital patient to be seen multiple times in one year and to be diagnosed with the same condition more than once, the filtering of hospital records prior to analysis was necessary so that duplicated patients and diagnoses were properly identified and counted only once. Duplicate patients, across all years in which data are available, were identified by isolating records with identical demographic information. The patient's hospital record number, scrambled social security number, date of birth, race, sex, and county of residence were taken into account for this purpose. Given the differences in availability and accuracy of reporting, inpatient and outpatient data was analyzed separately. Thus, it is possible for a patient to be both an inpatient and an outpatient. It is also possible for a patient to have up to nine diagnoses for each hospital visit. All nine diagnostic fields were reviewed to identify the number of diagnoses for leading health outcomes. For example, if a patient was seen one or

more times for heart disease and one or more times for kidney cancer during the years for which data are available, the patient was counted as one case of heart disease and one case of kidney caner. Groups of multiple diagnoses were not considered in this analysis.

After determining the number of patients seen at least once for each of the leading health outcomes, disease rates for Collierville residents were calculated using U.S. Census Bureau estimates. Since the 1990 census, however, Collierville's population has grown by 121%, making precise population estimates difficult to determine. In spite of these limitations, the U.S. Census Bureau population estimates are the most accurate population data available for Collierville. Rates of health outcomes for Shelby County and the state of Tennessee were calculated using population estimates provided by the Tennessee Division of Health Statistics that are routinely used for other analyses. This approach allows comparison of these analyses to other reports produced the Division of Health Statistics. Rates were not age-adjusted because of small numbers for most diseases when they were stratified by age groupings. Instead age median and age range were calculated to identify differences in age distribution of cases. In order to make all calculations comparable, non-age-adjusted rates for all diseases were calculated.

Statistical differences in overall disease rates for females, males, and total were determined by performing rate-ratio comparisons utilizing the relative risk for disease occurrences greater than one. Disease frequencies, rates, median age, age range, and relative risks with 95% confidence intervals were prepared for the Collierville community.

Explanation of Cancer

Cancer is a group of more than 200 different, but related, diseases that can be described as an uncontrolled growth and spread of abnormal cells in the body. Each type of cancer has a different rate of occurrence, cause, and chances for survival. Cancer is the second leading cause of death in the United States. According to the American Cancer Society, one of every three Americans will develop cancer in their lifetime. The risk for developing cancer increases with age, therefore cancer is more likely to occur as people get older and live longer. This increased longevity may create the impression that cancer is becoming much more common. When, in fact, this increase in the number of cases of cancer is partly related to the aging of our population.

Different types of cancer may have different causes and are likely to depend on many factors. The causes of most cancers are not well understood. Several factors, both inside and outside the body, contribute to the development of cancer. Some of these factors include the environment, heredity, and lifestyle behaviors or behaviors related to how we live. Specific lifestyle behaviors that increase cancer risk include: tobacco use**,** alcohol use, drug use, nutrition, physical inactivity**,** and excessive exposure to sunlight. Other factors that can increase a person’s cancer risk are a family history of cancer, certain infectious diseases, and hormonal factors. Finally, work exposure to some chemicals increases the risk for certain cancers.

Although many people believe that environmental contaminants in the home, community, or workplace are major cause of cancers, researchers have found only a few cancers that are related to environmental contaminants. It is estimated that less than 10% of all cancers are related to environmental contamination.

Interpretation of Health Outcome Data

To further investigate the environmental public health of the Collierville community, health outcome data was analyzed. Data from death certificates, hospital in-patient admissions, hospital out-patient discharges, and the Tennessee Cancer Registry (TCR) were examined. Our goal was to determine how the health outcome data for Collierville area residents compared to the entirety of Shelby County and to statewide total of all 95 Tennessee counties. The Collierville area was defined as the extent of zip codes 38017 and 38027 plus the frequent Collierville typo 38107. The datasets included Piperton residents whose water is supplied by Collierville Public Utilities.

Before any statistics are presented, some strengths and limitations of the datasets need to be understood. First, each dataset has a limited number of years for which the statistics are available. Table 5 includes the four different datasets reviewed and the time period for which data are available. Three of the datasets, death certificates, hospital out-patients, and hospital in-patients, include data as recent as 2003. Statistics derived from these datasets will be skewed toward years before which chromium was an issue for Water Plant #2. It is important to remember that concentrations of total chromium or hexavalent chromium(VI) were never at or above levels expected to result in any adverse health effect.

TABLE 5. The four different health outcome datasets reviewed for this health assessment.

Health Outcome[N]	Death Certificates	Hospital Out-patients	Hospital In-patients	TN Cancer Registry Incidence
Time Period data was available	1990-2003	1998-2003[P]	1997-2003	1991-2000

N = specific disease reporting codes are listed in Appendix D
P = 2003 hospital out-patient data used was provisional and not final

In order to interpret disease trends in a meaningful way, health outcomes among Collierville area residents (the extent of zip codes 38017 and 38027 plus the frequent typo 38107), were compared to those of Shelby County and the State of Tennessee. While injuries and suicide are the fifth and ninth causes of death in Tennessee respectively, injuries and suicide were excluded from this assessment to better identify disease trends among Collierville area residents in relationship to potential environmental hazards.

The target organ of concern for hexavalent chromium exposure through ingestion is the kidney. For this reason, we also evaluated differences in the occurrence of kidney nephritis even though nephritis was not among the most common diseases in any of the data sources investigated.

No differences in out-patient services, in-patient hospitalization, or deaths due to kidney nephritis were observed between males, females, or both sexes combined. The relative risk (RR) of kidney nephritis was actually statistically significantly lower in Collierville given a 95% confidence interval. This means more cases of kidney nephritis were reported in Shelby County

and in Tennessee than in Collierville during the time periods reviewed. Similarly, the occurrence of other digestive system pathologies was not observed among Collierville area residents.

Even though the scientific literature does not present chromium ingestion as cause of cancer (ATSDR 2000), kidney cancer rates were investigated. No statistical differences in out-patient services, in-patient hospitalization, deaths, or cancer incidence due to kidney malignancies were observed when Collierville was compared to Shelby County and Tennessee. This includes the data for only males, only females, and when both sexes were combined.

With respect to non-target organ systems, there were a few statistically significant differences in the populations analyzed. In general, the occurrence of the health outcomes analyzed among Collierville area residents in comparison to Shelby County and Tennessee is similar or lower. Eight of the ten leading causes of death among Collierville residents are included in the top ten causes of death in Tennessee and Shelby County.

The top ten most frequent health outcomes by rate of occurrence for each data set analyzed are rank ordered in associated tables. Table 6 shows the top ten causes of death as listed on death certificates between 1990-2003. Heart disease and all cancers combined are most often reported on death certificates. Alzheimer's Disease was statistically more frequent in Collierville than in Shelby County but not Tennessee as a whole. Most causes of death were actually statistically less in Collierville than in the Shelby County or Tennessee.

Table 7 shows hospital out-patient data for 1998-2003. The 2003 data is provisional, or in other words, not certified as complete. Because it is from the possible exposure period, it was deemed to be worth including. Primary hypertension was the most common reason for hospital out-patient service. Table 8 lists hospital in-patient visits for 1997-2003. Heart disease and primary hypertension were most frequent illnesses. Table 9 illustrates that breast, lung, and prostate cancer were often diagnosed between 1991 and 2000 according to the Tennessee Cancer Registry. These are also the three most commonly reported cancers in the United States. Melanomas were diagnosed more frequently in Collierville than Shelby County or Tennessee.

Table 10 was included to compare the four datasets. The datasets do record different health outcomes, but the magnitude of illnesses such as heart disease, chronic lower respiratory disease, and diabetes mellitus can be better seen. Additional information, including assumptions made for the data, more detailed discussions of the four health outcome datasets analyzed, and a formal definition of cancer, is presented in Appendix D. The ICD-9/ICD9-CM and ICD-10 code list is available at the end of Appendix D.

TABLE 6. Top 10 most frequently reported causes of death as recorded on Death Certificates 1990-2003 for residents of the Collierville area, Shelby County, and Tennessee statewide.

Death Certificates	rank	rate per 100,000		
	Collierville	Collierville	Shelby County	Tennessee statewide
Heart Disease	1	146.03	*271.61*	*294.19*
All Cancers	2	108.80	*195.51*	*215.06*
Cerebrovascular Disease	3	32.61	*70.41*	*72.99*
Bronchus and Lung Malignancies	4	29.44	*56.24*	*68.91*
Chronic Lower Respiratory Diseases	5	20.78	*32.42*	*45.26*
Alzheimer's Disease	6	14.72	***10.64***	12.98
Pneumonia	7	12.70	*30.51*	*32.99*
Colon Malignancies	8	11.83	*19.85*	*18.43*
Breast Malignancies	9	10.39	16.54	16.19
Diabetes Mellitus	10	9.52	*21.12*	*24.44*

italics = this cause of death was reported statistically (RR=95%) less often in Collierville
***bold italics** = this cause of death was reported statistically (RR=95%) more often in Collierville*

TABLE 7. Top 10 most frequently reported reasons for Hospital Out-patient visits 1998-2003 for residents of the Collierville area, Shelby County, and Tennessee statewide.

Hospital Out-patients[P]	rank	rate per 100,000		
	Collierville	Collierville	Shelby County	Tennessee statewide
Primary Hypertension	1	907.16	*1213.85*	*1675.14*
Other Urinary Diseases	2	793.63	*842.60*	*1245.32*
Chronic Lower Respiratory Diseases	3	714.48	*940.32*	*1416.92*
Acute Upper Respiratory Infections	4	712.92	*1211.13*	*1982.34*
Heart Disease	5	707.19	667.51	*1352.28*
Chronic Rhinitis and Sinusitis	6	527.53	524.00	*814.06*
Ulcers and Gastritis	7	456.70	*498.24*	*1014.56*
Other Intestinal and Peritoneum Diseases	8	341.62	*395.90*	*875.17*
Noninfectious Colitis and Enteritis	9	314.54	*380.72*	*665.41*
Diabetes Mellitus	10	311.41	*495.87*	*653.31*

P = 2003 Hospital Out-patient data is provisional and not final
italics = this cause of death was reported statistically (RR=95%) less often in Collierville

TABLE 8. Top 10 most frequently reported illnesses as recorded from Hospital In-patient records 1997-2003 for area Collierville residents, Shelby County, and Tennessee statewide.

Hospital In-patients	rank	rate per 100,000		
	Collierville	Collierville	Shelby County	Tennessee statewide
Heart Disease	1	1581.78	*1999.33*	*2384.84*
Primary Hypertension	2	1027.28	*1390.97*	*1590.28*
Other Urinary Diseases	3	499.10	*684.60*	*757.89*
All Cancers	4	454.77	*503.52*	*546.74*
Chronic Lower Respiratory Diseases	5	443.69	*668.99*	*927.72*
Ulcers and Gastritis	6	428.00	*570.02*	*702.47*
Diabetes Mellitus	7	403.99	*623.66*	*697.95*
Other Intestinal and Peritoneum Diseases	8	372.13	*453.66*	*551.04*
Pneumonia	9	345.81	*508.39*	*675.15*
Cerebrovascular Disease	10	316.73	*458.26*	*476.98*

italics = this reason for inpatient service was reported statistically (RR=95%) less often in Collierville

TABLE 9. Top 10 most frequently reported cancer indecencies as recorded by the Tennessee Cancer Registry 1991-2000 for Collierville area residents, Shelby County, and Tennessee statewide.

Tennessee Cancer Registry	rank	rate per 100,000		
	Collierville	Collierville	Shelby County	Tennessee statewide
Breast Malignancies	1	48.94	59.30	61.70
Bronchus and Lung Malignancies	2	41.73	*59.55*	*72.04*
Prostate Malignancies (males only)	3	69.22	84.37	*99.35*
Colon Malignancies	4	20.11	32.54	35.18
Melanoma	5	12.52	***5.88***	***8.09***
Bladder Malignancies	6	11.76	13.08	15.80
Non-Hodgkin's Lymphomas	7	9.86	9.47	14.37
Kidney Malignancies	8	9.11	9.07	9.99
Pancreatic Malignancies	9	8.35	8.63	8.13
Rectum Malignancies	10	6.83	*11.08*	*12.47*

italics = this cancer incidence was reported statistically (RR=95%) less often in Collierville
***bold italics** = this cancer incidence was reported statistically (RR=95%) more often in Collierville*

TABLE 10. Comparative ranking for the Top 10 most frequently reported illnesses for Collierville area residents reported from four unique health outcome datasets. Numbers listed represent rank order based on rates during the time periods shown.

Health Outcome[N]	Death Certificates	Hospital Out-patients	Hospital In-patients	TCR Cancer Incidence
	1990-2003	1998-2003[P]	1997-2003	1991-2000
Heart Disease	1	5	1	
All Cancers	2		4	
Cerebrovascular Disease	3		10	
Bronchus and Lung Malignancies	4			2
Chronic Lower Respiratory Diseases	5	3	5	
Alzheimer's Disease	6			
Pneumonia	7		9	
Colon Malignancies	8			4
Breast Malignancies	9			1
Diabetes Mellitus	10	10	7	
Primary Hypertension		1	2	
Other Urinary Diseases		2	3	
Acute Upper Respiratory Infections		4		
Chronic Rhinitis and Sinusitis		6		
Ulcers and Gastritis		7	6	
Noninfectious Colitis and Enteritis		9		
Other Intestinal and Peritoneum Diseases		8	8	
Prostate Malignancies				3
Melanoma				5
Bladder Malignancies				6
Non-Hodgkin’s Lymphomas				7
Kidney Malignancies				8
Pancreatic Malignancies				9
Rectum Malignancies				10

N = specific disease reporting codes are listed in Appendix E
P = 2003 hospital out-patient data used was provisional and not final

ICD-9/ICD9-CM and ICD-10 Disease Codes used in health outcome data analysis		
140-208	C00-C97	All Cancers
153	C18	Colon Malignant Neoplasm
154	C19-C20	Rectum Malignant Neoplasm
157	C25	Pancreatic Malignant Neoplasm
162, except 162.0	C34	Bronchus/Lung Malignant Neoplasm
172	C43	Melanoma
174-175	C50	Breast Malignant Neoplasm
185	C61	Prostate Malignant Neoplasm
188	C67	Bladder Malignant Neoplasm
189	C64-C65	Kidney Malignant Neoplasm
200, 202	C82, C83, C85.7, C85.9	Non-Hodgkin's Lymphomas
250	E10-E14	Diabetes Mellitus
331	G30-G31	Alzheimer's Diseases & Cognitive Degenerations
390-398, 402, 404, 410-429	I00-I09, I11, I13, I20-I51	Heart Diseases
401, 403	I10, I12	Primary Hypertension
430-438	I60-I69	Cerebrovascular Diseases
460-466	J01-J06, J20-J22	Acute Upper Respiratory Infections
470-478	J30-J39	Chronic Rhinitis and Sinusitis
480-486	J12-J18	Pneumonias
490-496	J40-J47	Chronic Lower Respiratory Diseases
530-535	K25-29	Ulcers and Gastritis
555-558	K50-K55	Noninfectious Colitis / Enteritis
560-569	K56-K66	Other Intestine / Peritoneum DDS
590-599	N11-N15, N20-N24, N28-N39	Other Urinary Diseases

Glossary

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

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

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

Carcinogen
A substance that causes cancer.

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. This law was later amended by the Superfund Amendments and Reauthorization Act (SARA).

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Dermal contact
Contact with (touching) the skin [see route of exposure]. For example, dermal absorption means passing through the skin.

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

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

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

Hazardous wastes
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed to help a community learn about health risks and how to reduce these risks.

Health statistics review
The analysis of existing health outcome information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

mg/kg
Milligram per kilogram.

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Monitoring
Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

National Priorities List for Uncontrolled Hazardous Waste Sites (NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

ppb
Parts per billion.

ppm
Parts per million.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action plan
A list of steps to protect public health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. There are five public health hazard categories:

Urgent public health hazard
A category used for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Public health hazard
A category used for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No public health hazard
A category used in ATSDR's public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases

Risk
The probability that something will cause injury or harm.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)

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

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

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

Certification

This Public Health Assessment: Smalley-Piper, Collierville, Shelby County, Tennessee, was prepared by the Tennessee Department of Health, Communicable and Environmental Disease Services, 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. Editorial review was provided 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 consultation and concurs with the findings.

Team Lead, CAT, SPAB, DHAC, ATSDR