Public Health Assessment for

GRIGGS & WALNUT GROUND WATER PLUME
(a/k/a GRIGGS & WALNUT GROUNDWATER SITE)
LAS CRUCES, DONA ANA COUNTY, NEW MEXICO
EPA FACILITY ID: NM0002271286
FEBRUARY 25, 2005

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

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EPA FACILITY ID: NM0002271286

Prepared by:

The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Superfund and Program Assessment Branch
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List of Acronyms

ATSDR	Agency for Toxic Substances and Disease Registry
CREG	cancer risk evaluation guide
CSF	cancer slope factor
CVs	comparison values
EMEG	environmental media evaluation guide
EPA	United States Environmental Protection Agency
IARC	International Agency for Research on Cancer
IRIS	integrated risk information system
MCL	maximum contaminant level
mg/kg/day	milligrams per kilogram per day
mg/L	milligrams per liter
mg/m^3	micrograms per cubic meter
MRL	minimal risk level
NMED	New Mexico Environment Department
NOAEL	no-observed-adverse-effect level
NPL	National Priority List
PHA	public health assessment
PCE	tetrachloroethylene
RBC	risk-based concentration
RfD	reference dose
RMEG	reference dose media evaluation guide
SDWA	Safe Drinking Water Act
µg/L	micrograms per liter
VOC	volatile organic compound

Summary

The Agency for Toxic Substances and Disease Registry (ATSDR) has previously evaluated the public health significance of groundwater contamination underlying a central portion of the city of Las Cruces, New Mexico. Subsequent to that evaluation the U.S. Environmental Protection Agency (EPA) added this area to its National Priorities List for Uncontrolled Hazardous Waste Sites (NPL) as the Griggs and Walnut Groundwater Site. Because ATSDR is mandated by Congress to conduct public health assessment (PHA) activities for all sites on the NPL, ATSDR has prepared this public health assessment for the Griggs and Walnut Groundwater site.

The Safe Drinking Water Act requires monitoring of municipal drinking water wells. As a result of this monitoring, between 1993 and 1995 tetrachloroethylene (PCE) was detected in four of the City of Las Cruces' municipal wells. These wells are all within the vicinity of Griggs and Walnut Streets. In 2000, an additional municipal supply well was found to be contaminated with PCE. The affected municipal supply wells have become the subject of ongoing investigations initiated by the New Mexico Environment Department (NMED) and by EPA.

The City of Las Cruces has kept the concentrations of PCE in the drinking water below the 5 micrograms-per-liter maximum contaminant level (MCL) by either (1) removing contaminated wells from the distribution system, or (2) a blending plan approved by the NMED Drinking Water Bureau. The blending plan mixes affected water with unaffected water before it reaches the distribution system.

The result of the city's efforts is that although residents of Las Cruces who receive their drinking water from the municipal water system have been exposed — through ingestion, inhalation, and skin contact — to PCE, that exposure has been at levels below the MCL. The exact timeframe in which people have been exposed to PCE in drinking water is, however, unknown.

ATSDR reviewed the available data and information for the Griggs and Walnut site and identified two completed exposure pathways. These pathways are (1) exposure to PCE from the municipal drinking water supply by ingestion, inhalation, or skin contact, and (2) exposure to PCE via evaporative coolers (also known as swamp coolers). ATSDR reviewed the available data and information on exposure to PCE from both of these pathways. ATSDR concluded that limited exposure to the low levels of PCE found in the municipal drinking water supply is unlikely to result in harmful health effects (i.e., both noncancer and cancer health effects) for either adults or for children. In addition, ATSDR considered possible exposure to PCE via soil gas, plant uptake, and private wells. Exposure to PCE via soil gas and plant uptake are unlikely to result in harmful effects. Although private wells could not be evaluated due to limited data, if requested ATSDR will in the future evaluate private well data as it becomes available.

Because the concentrations of PCE to which people might have been exposed from these pathways are below levels expected to cause adverse health effects, ATSDR has concluded that the Griggs and Walnut Site presents no apparent public health hazard for past or current PCE exposure resulting from the municipal water supply.

But ATSDR recommends continued monitoring of the affected municipal supply wells as required under the Safe Drinking Water Act. This will help to ensure that PCE levels in the Las Cruces municipal drinking water supply do not exceed the maximum PCE contaminant levels.

If in the future, however, PCE levels in the municipal drinking water supply do exceed the MCL, ATSDR recommends additional exposure evaluation.

Purpose and Health Issues

On June 14, 2001, the U.S. Environmental Protection Agency listed the Griggs and Walnut Groundwater Site on its National Priorities List for Uncontrolled Hazardous Waste Sites (NPL). As mandated by Congress, the Agency for Toxic Substances and Disease Registry (ATSDR) has prepared this public health assessment for the Griggs and Walnut Groundwater Site. The data available for the site have been reviewed and summarized in this document. The purpose of this public health assessment (PHA) is to evaluate and present information on whether exposures to site-related contaminants are occurring, and whether health effects could result from these exposures. This document has been drafted in accordance with the ATSDR Public Health Assessment Guidance Manual [1].

Background

Site Description and History

The Griggs and Walnut Groundwater Site is a contaminated groundwater plume centered near the intersection of Griggs Avenue and Walnut Street in Las Cruces, Doña Ana County, New Mexico. PCE(*) contamination was first identified in four of the city's municipal drinking water supply wells (Well #s 18, 19, 21, and 27) between 1993 and 1995 as a result of the Safe Drinking Water Act(†) (SDWA). In 2000, one additional municipal water supply well (Well # 24) was found to be contaminated with PCE. The source of this groundwater contamination is at this time unknown.

The affected municipal supply wells in this area range in depth from 576 feet to 730 feet below ground surface. The actual extent of the groundwater contaminant plume has yet to be defined, but the area of contamination is approximately 2,500 feet by 8,000 feet. Only one of the municipal wells (Well #18) containing PCE was found to have concentrations above EPA's maximum contaminant level (MCL) of 5 micrograms per liter (µg/L).

The city of Las Cruces residential water system comprises 28 wells. In accordance with the SDWA, these wells are monitored periodically. The city's water supply wells are completely within the Santa Fe Group Aquifer, which is the sole-source aquifer for the region. This aquifer produces most of the groundwater used in metropolitan and industrial centers in the area, and supplies a significant proportion of the groundwater used to supplement surface irrigation supplies [2, 3]. Available data indicate that no water containing PCE concentrations higher than the MCL of 5µg/L has entered the residential distribution system. Residential tap water samples collected from April 2000 to April 2002 indicated the presence of low-level concentrations of PCE (up to 3.5 µg/L) in the water supply used for domestic purposes [4].

Demographics

According to U.S. Census 2000 data, approximately 25,000 people reside in the vicinity of the Griggs and Walnut Groundwater Site. More than half of this population is Hispanic or Latino, and 516 individuals are American Indian or Alaska Native. In the vicinity of the site reside 2,570 children aged 6 and younger, and 3,503 adults aged 65 and older. More detailed demographic information is presented in Appendix A.

(*) PCE is a manufactured chemical commonly used for dry cleaning and metal degreasing.

(†) The Safe Drinking Water Act is the main federal law that ensures the quality of public drinking water, under which the U.S. Environmental Protection Agency has set standards for drinking water quality.

Land Use

The groundwater contamination associated with the Griggs and Walnut Groundwater Site is overlain by a developed area on the eastern side of the city of Las Cruces. A large portion of the land area above the groundwater contamination is used for recreational facilities and for light industry related to city and county maintenance facilities. Formerly, the area was used by the New Mexico National Guard to store military equipment. In addition, the Crawford Municipal Airport was in this area. Commercial property and residential neighborhoods are also present in the site investigation area [5].

Environmental Contamination

The groundwater, which is about 100 feet to 200 feet below ground surface (depending on surface topography), is contaminated with PCE [5]. The full nature and extent of the contamination is still being characterized. The contaminated groundwater plume lies within the central city district in the eastern municipal supply well field. The exact extent of the plume has not yet been defined, but it is estimated to be at least 8,000 feet long and 2,500 feet wide. The depth of the plume varies; the plume extends vertically from the water table to the depth of the city water supply wells (approximately 635 feet below ground surface). Groundwater flow is currently east from the Rio Grande toward the city municipal wells near Interstate 25. Concentrations of PCE in monitoring wells vary from less than 0.50 µg/L to 53 µg/L. In November 2003, EPA completed a source investigation report that discusses possible sources of the groundwater contamination [2].

Pathways of Human Exposure

One object of an ATSDR public health assessment is to evaluate exposure pathways at a site that might result in human exposure to contaminants of concern. ATSDR considers a human exposure pathway to consist of five principal elements:

1. a source of contamination,
2. a transport through an environmental medium,
3. a point of exposure,
4. a route of human exposure, and
5. a receptor population.

If all five elements of an exposure pathway exist currently or did exist in the past, the pathway is complete. If one element or more is missing or if exposure is possible but is not likely to occur, the pathway is considered a potential pathway of exposure. The completed and potential exposure pathways at the Griggs and Walnut Groundwater Site are discussed in the following paragraphs, and a summary of the information is provided in Appendix B, Tables 1 and 2.

A review of the environmental data and site conditions indicates two completed exposure pathways by which people could be or could have been exposed to contaminants from the site. These pathways are the drinking water exposure pathway and the evaporative cooler exposure pathway. The public health implications of exposure by these pathways is discussed in the following section. See Appendix C for a detailed description of the public health assessment evaluation process.

Completed Exposure Pathways

Drinking Water Exposure Pathway (Ingestion, Inhalation, Dermal Contact)

The concentrations of PCE in the city municipal supply wells range from nondetectable to slightly above the EPA's MCL of 5 µg/L. The city has kept concentrations of PCE in the drinking water system below the MCL by (1) removing contaminated wells from the distribution system and (2) using a blending program approved by the New Mexico Environment Department (NMED) Drinking Water Bureau. The blending plan mixes affected water with unaffected water before it reaches the distribution system [5].

Through ingestion, inhalation, and direct skin contact, residents of Las Cruces who receive their water from the municipal water supply are likely to have been exposed to PCE at levels below the MCL. Although the PCE contamination was discovered between 1993 and 1995, the exact time frame in which people might have been exposed to PCE in their drinking water is not known.

Evaporative (or Swamp) Cooler Exposure Pathway

At the request of NMED, in July 2003 ATSDR prepared a health consultation to evaluate exposure to Las Cruces residents who used water containing detected levels of PCE in evaporative coolers.

Many homeowners who live in hot, dry climates such as Las Cruces use evaporative coolers (also referred to as swamp coolers) to cool their indoor air. Although individual evaporative coolers can have different features, they all operate in a similar manner. The coolers draw warm outside air into the unit and then through wet filter (paper or fiber) pads. Water from the home's water supply system is used to wet the filter pads. Water collects in a basin at the base of the unit and is then pumped to the top of the filter where it trickles down the filter pad. As the hot air moves through the wet filter pad, the air is cooled and humidified. The cooled air enters the heating, ventilation, and air conditioning system, and from there it is vented throughout the home. Cooler air enters the home through vents and exits the home through open windows and doors [6].

In January 2003, NMED asked whether harmful health effects could result from PCE exposure in homes with swamp coolers using water from the Las Cruces public water supply containing detected levels of PCE [4]. ATSDR used available environmental data and information provided by NMED to address this health concern. The results of the swamp cooler evaluation were documented in a health consultation dated July 2003 [7]. The conclusions of the health consultation are presented in the Public Health Implications Section of this PHA.

Potential Exposure Pathways

Soil Gas Exposure Pathway

To help identify areas in which PCE might have been released into the environment, EPA collected soil gas (or vapor) samples in the groundwater contamination area. Due to PCE's high volatility (i.e., the ability to become airborne), PCE concentrations in soil are suspected indicators that PCE has been released into the air at land surface. More than 600 samples were collected from varying depths, ranging from 5 feet to 115 feet below ground surface. The investigation indicated that the highest concentrations of PCE in soil gas were in areas in which the highest concentrations of PCE were detected in groundwater samples [5].

Due to its chemical and physical properties, PCE in soil and water can easily enter the gaseous state and become airborne. Thus PCE in soil gas can migrate from soil and groundwater into occupied spaces, such as houses or businesses located above the contaminated area. When this happens, individuals who live or work in the buildings could be exposed to PCE by inhalation. As part of this public health assessment, ATSDR evaluated the available soil gas data to determine whether PCE was likely to migrate into enclosed spaces and result in potentially harmful exposures. In this evaluation ATSDR used available data, and used information from EPA's draft guidance on evaluating vapor (or soil gas) intrusion into indoor air [8].

Additional Exposure Pathways Considered and Excluded

ATSDR considered several exposure pathways, then excluded them from further evaluation. Examination of the available information for these pathways indicated that they do not pose a public health threat, or that insufficient information was available on which to base a conclusion. A brief rationale for the exclusion of these pathways is provided below.

Plant Uptake

PCE has not been found to accumulate in plants [9].

Private Wells

Limited data was available to ATSDR for existing private wells in the plume vicinity (one private well had a data point of 1.1 µg/L PCE early in the investigation, but in recent sampling was below detection limits). Therefore, this pathway could not be adequately evaluated. If in the future private well data becomes available, ATSDR would be willing to evaluate that data separately.

Discussion

Public Health Implications

Drinking Water Exposure Pathway

ATSDR reviewed site history and environmental data provided by EPA, NMED, and the city of Las Cruces to determine whether people in Las Cruces using the municipal drinking water supply might experience adverse health effects associated with exposure to PCE through ingestion, through inhalation, and through skin contact (Appendix B, Tables 3 and 4).

Between April 2000 and April 2002, tap water samples were collected from 11 homes and from the upper Griggs storage tank. The maximum detected level of PCE found was 3.5 µg/L (Appendix B, Table 4).

PCE is a common chemical, widely used for dry cleaning and as an industrial solvent. It is also found in some consumer products such as silicone lubricants, spot removers, and adhesives. Air containing PCE has been described as having a sweet smell, and water containing PCE has been described as having a sweet taste. Short-term exposure to high levels of PCE in the air has been associated with eye and nasal irritation. In humans, PCE has also been shown to cause central nervous system depression (e.g., dizziness, headache, confusion, and poor physical coordination). In animal studies, PCE has been shown to damage the liver and kidneys when inhaled or ingested. When mice breathed PCE in air at relatively high concentrations for 30 days, a large percentage of them experienced liver damage [9].

ATSDR calculated adult and child exposure doses of 0.00035 mg/kg/day and 0.00058 mg/kg/day, respectively, for the maximum concentration of PCE in drinking water for

ingestion, inhalation, and dermal contact. The calculated exposure doses are below health-based guidelines or comparison values. The health guideline of 0.010 mg/kg/day is both EPA's oral reference dose(‡) (RfD) and ATSDR's oral minimal risk level(§) (MRL). This exposure dose was also thousands of times lower than the chronic lowest-observed-adverse-effect level (LOAEL) of 386 mg/kg/day and therefore *would not be expected to cause adverse health effects* in the exposed population.

The EPA is currently reviewing information on the cancer-causing potential of PCE. While some data support either side of the question, the EPA has yet to decide whether PCE should be designated as a *possible human carcinogen* or *a probable human carcinogen*. The U.S. Department of Health and Human Services, on the basis of studies reporting liver tumors in male rats, has determined that PCE could reasonably be anticipated to be a carcinogen [9]. Very limited data is available on whether direct PCE exposure might result in cancer. One animal study reported no skin tumor production following the application of high concentrations of PCE on the skin of mice for a period of approximately 20 months [9]. As with studies available for noncancer health effects, cancer studies found that harmful health effects occurred only at doses higher than 100 mg/kg/day. This dose is thousands of times higher than the doses (0.00010 mg/kg/day) calculated for those Las Cruces adults who — through ingestion, inhalation, and dermal contact — could have been exposed to PCE associated with the groundwater plume.

On the basis of this evaluation, it is unlikely that Las Cruces residents would experience harmful health effects (i.e., either cancer or noncancer health effects) from exposure related to water from the municipal drinking water supply. Therefore, past or current exposure poses no apparent public health hazard.

Evaporative (or Swamp) Cooler Exposure Pathway

To estimate potential exposure to public water users in the city of Las Cruces, ATSDR utilized a method that the Arizona Department of Health Services used to evaluate evaporative cooler use in Tucson, Arizona [6]. This method estimates the concentrations of contaminants present in air resulting from the use of water with detectable concentrations of contaminants in evaporative coolers. Appendix D presents a description of this method and a discussion of the assumptions used in the evaluation.

Using this method, ATSDR calculated a PCE air concentration of 0.0067 micrograms per cubic meter ($\mu g/m^3$) and compared it with ATSDR's chronic inhalation MRL of 275 $\mu g/m^3$ [9]. ATSDR's inhalation MRL is a conservative measure which assumes a continuous inhalation exposure for a 7-day per week, 24-hour exposure period. The chronic inhalation MRL for PCE is based on neurological effects observed among humans exposed to concentrations many thousands of times higher than the concentrations calculated for PCE in indoor air for the Griggs and Walnut Groundwater Site [9]. *Therefore, noncancer health effects are not expected among individuals exposed to PCE in indoor air from evaporative coolers using water containing low-level PCE concentrations.*

The excess lifetime cancer risk associated with inhalation exposure to PCE from evaporative cooler use is 1.6×10^{-8}, which indicates a very low excess cancer risk. It should be noted that EPA's inhalation cancer slope factor of 2.0×10^{-2} mg/kg/day^{-1} is currently under review. The available scientific literature indicates cancerous effects (i.e., leukemia and liver) among animals

(‡) See Appendix F for definition.
(§) See Appendix F for definition.

exposed to concentrations of PCE via inhalation that were many thousands of times greater than the concentrations of PCE expected to be present in indoor air from evaporative cooler use [9]. *Therefore, cancer is not expected among individuals exposed to PCE in indoor air from evaporative coolers using water containing low-level PCE concentrations.*

Appendix D contains additional information on the swamp cooler evaluation and conclusions.

Soil Gas Exposure Pathway

Soil gas concentrations were compared with the primary (Tier I) screening values(**) as defined in EPA's draft guidance [8]. Tier I values are generic screening values intended to identify conservatively the potential for subsurface vapor intrusion. Concentrations above screening values indicate that more site-specific evaluation of this pathway might be necessary. Separate screening values are available for shallow soil gas samples (collected in areas less than 5 feet below ground surface) and deep soil gas samples (collected in areas that are greater than 5 feet below ground surface). The maximum detected concentration of PCE in shallow soil gas of 3.03 parts per billion volume (ppbv) did not exceed the Tier I shallow screening value of 12 ppbv. The maximum detected concentration of PCE in deep soil gas (25.3 ppbv) did not exceed the Tier I deep screening value of 120 ppbv [8]. *This evaluation indicates that PCE associated with the Griggs and Walnut Groundwater Site is not expected to migrate through the subsurface and pose adverse health effects for persons in homes or businesses located above the groundwater plume.*

Children's Health Considerations

ATSDR recognizes that the unique vulnerabilities of infants and children demand special emphasis in communities faced with contamination of their water, soil, air, or food. Because of their immature and developing organs, infants and children are usually more susceptible to toxic substances than are adults. Children are generally smaller than are adults, which results in higher doses when compared with adults. Most importantly, children depend completely on adults for risk identification and management decisions, housing decisions, and access to medical care. ATSDR's evaluation in this document considered children as a susceptible subpopulation.

For the maximum concentration of PCE in drinking water for ingestion, inhalation, and dermal contact, ATSDR calculated an exposure dose for children of 0.00058 mg/kg/day. The calculated exposure dose was below the health guideline. The health guideline of 0.010 mg/kg/day is both EPA's oral RfD and ATSDR's oral MRL. This exposure dose was also thousands of times lower than the exposure to PCE that has been associated with health effects. *Therefore, adverse health impacts are not likely to occur among children exposed to low levels of PCE in drinking water via ingestion, inhalation, and direct skin contact.*

ATSDR considered exposure to children as part of the evaluation of inhalation of PCE in indoor air resulting from evaporative cooler use. The concentrations at which harmful effects have been observed among individuals exposed to PCE is many thousands of times greater than those associated with evaporative cooler use in the vicinity of the Griggs and Walnut Groundwater Site [9]. *On the basis of the available information and the scientific literature, health impacts are not expected among children exposed to low-level concentrations of PCE in indoor air.*

(**) Generic Tier 1 screening values, set at a cancer risk level of 1×10^{-5}, were used in this evaluation.

Health Outcome Data

Health outcome data can help determine whether incidence rates of certain adverse health effects are higher than expected in an area potentially affected by hazardous substances migrating from a site. ATSDR conducts a review of health outcome data when the toxicological evaluation of a completed exposure pathway indicates the likelihood of adverse health outcomes. The evaluation of health outcome data can also provide a general picture of the health of a community, or it can confirm the presence of elevated levels of disease or illness in a community. That said, however, elevated rates of a particular disease might not necessarily be caused by hazardous substances in the environment. Other factors, such as personal habits (e.g., diet, smoking, and exercise), socioeconomic status, and occupation can also influence the development of disease.

In a public health assessment, the Superfund law requires consideration of health outcome data. These data can include information on morbidity (illness) and mortality (death). The main requirements for evaluating health outcome data are the presence of a completed exposure pathway, sufficiently high contaminant levels to result in measurable health effects, and a sufficient number of individuals in the completed exposure pathway population. Another important factor for health outcome data evaluation is a database in which disease rates for the population of concern can be identified.

Although completed exposure pathways exist at the Griggs and Walnut Groundwater Site, the contaminant levels do not indicate the likelihood of site-related health effects. Therefore, an evaluation of health outcome data was not conducted in this public health assessment. In response, however, to a community concern regarding cancer, in this PHA's Community Health Concerns section ATSDR reviewed statistics on cancer incidence in New Mexico [13].

Community Health Concerns

The ATSDR site team held a public availability session at the Hermosa Heights Elementary School in Las Cruces, New Mexico, on Tuesday, January 14, 2003, from 5:00 PM to 8:00 PM[(††)] . The meeting was held to explain ATSDR's public health assessment process and to gather health concerns from the community. The session was advertised in the local newspaper, and several members of the press attended the meeting. Approximately 10 community members came to the meeting to get an update on site activities and to express their health concerns to ATSDR representatives. The health concerns gathered from community members are summarized here.

Is exposure to PCE associated with asthma?

Exposure to PCE at very high concentrations via inhalation in occupational settings has been associated with respiratory distress. The levels of PCE found in the Las Cruces municipal drinking water supply, however, are well below the levels associated with these effects. ATSDR found no indication in its review of the scientific literature that would indicate an asthma association with the low levels of PCE found near the Griggs and Walnut Groundwater Site.

Is drinking water from the city of Las Cruces public water supply harmful to my unborn child?

Because of the low levels of PCE found in the Las Cruces municipal drinking water supply, no health effects for unborn children are expected. But it is important to note that some studies have associated health effects in unborn children to higher levels of PCE exposure. ATSDR is

[(††)] ATSDR representatives included Robert Knowles, Annmarie DePasquale, Maria Terán-MacIver, Kris Larson, and Patrick Young.

continuing to research information that will assist environmental health scientists and toxicologists in determining how and whether PCE at hazardous waste sites might impact public health.

ATSDR has reviewed several studies of human exposure to PCE and TCE in drinking water. One study conducted at U.S. Marine Corps Base, Camp LeJeune, North Carolina, examined adverse pregnancy outcomes associated with exposure to volatile organic compounds (VOCs), including PCE and TCE in the drinking water supply. Although the actual concentrations women were exposed to and the duration of their exposure are unknown, concentrations of PCE and TCE in the water supply might have been as high as 215 µg/L and 1,400 µg/L, respectively. Estimates indicate that exposure could have occurred over a period of 25 years. The study concluded that women over 35 years of age who were exposed to PCE and TCE were four times more likely to have infants who were small for gestation age. Only a slightly increased incidence was observed among the entire study group of women. ATSDR is currently conducting a more extensive study of this population [10].

In another study, residents of Woburn, Massachusetts, were exposed to drinking water contaminated with VOCs — including PCE — at concentrations of 21 µg/L, and TCE at concentrations of 250 µg/L or higher. One study of this community found indications that developmental anomalies related to the central nervous system, chromosomes, and oral cleft were associated with exposure [11]. Still, the scientific community has noted limitations with this study regarding the biologic relevance of grouping these anomalies for the purpose of statistical analysis. As a result, the findings of this study are difficult to interpret and difficult to apply to other exposed individuals [11,12].

The levels of PCE found in the city of Las Cruces municipal drinking water supply are much lower than the levels in these studies; the Las Cruces levels are unlikely to cause adverse health effects to an unborn child.

Has a cancer cluster been identified in Las Cruces?

On the basis of ATSDR's review of information received from the New Mexico Department of Health, there is no evidence of any unusual cancer-incidence patterns for people living in the area of the groundwater contamination from the Griggs and Walnut Groundwater Site. The numbers and types of cancer identified are what ATSDR would expect, given the age and sex distribution of the area population. We have not observed any "clustering" of specific types of cancer (especially any cancer types theorized to be associated with PCE) that would suggest a potential association with the Griggs and Walnut Groundwater Site.

ATSDR reviewed cancer statistics developed in accordance with commonly accepted statistical methods by the New Mexico Tumor Registry, the New Mexico Vital Records and Health Statistics Public Health Division, and the Office of Epidemiology, Public Health Division, New Mexico Department of Health [13]. According to these statistics from 1979 to 1996 the average annual age-adjusted cancer incidence and mortality rates for Doña Ana County were below the overall state average. ATSDR also reviewed the rates for bladder cancer, kidney cancer, liver cancer, and leukemia (i.e., cancer types theorized to be associated with PCE) and found that — with the exception of liver cancer — both the incidence and mortality for these types of cancer in Doña Ana County were also below the overall state averages for the same time period. The mortality rate for liver cancer in Doña Ana County was slightly above the average rate for the state of New Mexico. Many liver cancer risk factors might account for the slightly above-average rate, such as chronic liver disease attributed to the hepatitis virus, cirrhosis or extensive

scarring of the liver from various causes, some viral forms of autoimmune liver disease, a mold in food known as aflatoxin, and possibly, alcohol use and certain inherited metabolic diseases.

Is exposure to PCE associated with kidney effects?

The levels of PCE found in the Las Cruces municipal drinking water supply are well below the levels associated with kidney effects. Nevertheless, a review of available studies indicates that among subjects exposed to very high concentrations, PCE and TCE have been associated with liver, kidney, neurologic, and developmental effects, as well as leukemia, especially via inhalation.

Is it safe to use water from the city of Las Cruces public water supply in my swamp cooler?

ATSDR determined that harmful noncancer and cancer health effects are not likely among residents exposed to PCE in indoor air from water in evaporative (or swamp) coolers containing low-level PCE concentrations. Additional information on ATSDR's evaluation of evaporative coolers is provided in Appendix D.

If plant foods are irrigated with contaminated waters, will I become ill from eating the plants?

The main contaminant of concern at the Griggs and Walnut site is PCE. Available data indicates that PCE is not substantively absorbed and accumulated by vegetation [9]. Therefore, ATSDR concludes that eating plants irrigated with contaminated water is not likely to be associated with adverse health effects.

Conclusions

ATSDR identified two completed exposure pathways for the Griggs and Walnut site: (1) current or past exposure to PCE from the municipal drinking water supply by ingestion, inhalation, or dermal contact, and (2) current or past exposure to PCE through evaporative coolers that use water from the municipal water supply. After reviewing the available data and information on exposure to PCE via these pathways, ATSDR believes that adverse noncancer and cancer health effects are unlikely for adults or children from exposure to the low levels of PCE found in municipal drinking water. In addition, ATSDR considered possible exposure to PCE via soil gas, plant uptake, and private wells. Exposure to PCE via soil gas and plant uptake are unlikely to result in harmful effects. Private wells could not be evaluated due to a lack of data; however, if this data becomes available ATSDR will evaluate it, if requested.

The PCE levels associated with the Griggs and Walnut Groundwater Site are below levels expected to cause adverse health effects. ATSDR concludes that the exposures evaluated in this public health assessment present no apparent public health hazard for past or current exposure.

Recommendations

- To prevent future exposures above the MCL, ATSDR recommends that the City of Las Cruces, NMED, and the EPA continue monitoring the affected municipal supply wells to ensure that PCE levels in drinking water do not exceed EPA's MCL of 5 µg/L.
- If in the future PCE levels in the municipal drinking water supply wells exceed the MCL, ATSDR recommends additional exposure evaluation.

Public Health Action Plan

A public health action plan describes the actions designed to mitigate or prevent adverse human health effects that might result from exposure to hazardous substances associated with site

contamination. The following paragraphs summarize the public health actions that have been taken at the Griggs and Walnut Groundwater Site and the actions that are to be taken.

Action Taken

- On January 14, 2003, ATSDR conducted a public availability session at the Hermosa Heights Elementary School in Las Cruces, New Mexico to gather community concerns regarding the Griggs and Walnut Groundwater Site and to discuss ATSDR's public health assessment process.
- ATSDR staff (Maria Teran-Maciver and Kristina Larson) conducted health education activities in Las Cruces on the following dates:
    a. June 17, 2002: Professional Education – Public Health Nurses, District III
    b. June 19, 2002: Professional Education – Nurses & Health Educators
    c. January 14, 2003: Professional Education – Nurses & Health Educators
    d. January 16, 2003: Professional Education – Promotores de Salud
- On August 31, 2004, ATSDR conducted an availability session at the Sierra Middle School in Las Cruces, New Mexico, to discuss with community members the findings of the Public Comment version of this PHA.
- ATSDR provided a 30-day public comment period after the Public Comment Release of this PHA; the public comment period ended October 7, 2004. Although ATSDR received no public comments, some additional agency comments were received and addressed in this final version.

Actions to Be Completed

- ATSDR will continue to work with the appropriate local, state, and federal, agencies, and, if requested, will review any new environmental data associated with the Griggs and Walnut Groundwater Site.

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Appendix A: Figures

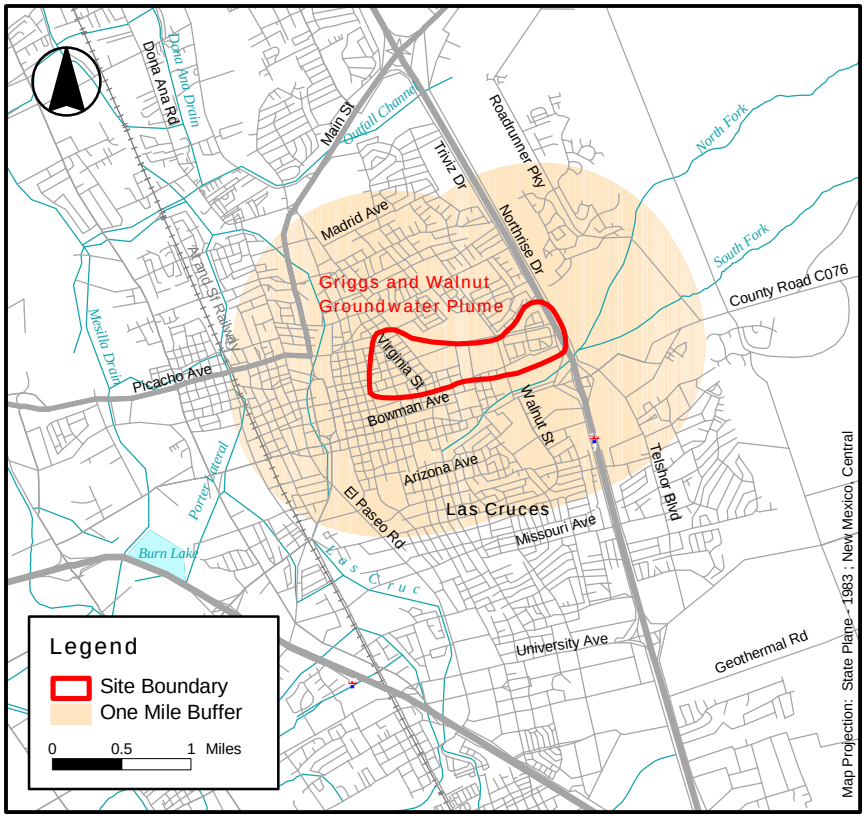
Figure 1: Demographic Map

Griggs and Walnut Groundwater Plume

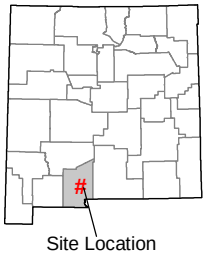
INTRO MAP

Las Cruces, New Mexico

EPA Facility ID NM0002271286



Base Map Source: 1995 TIGER/Line Files

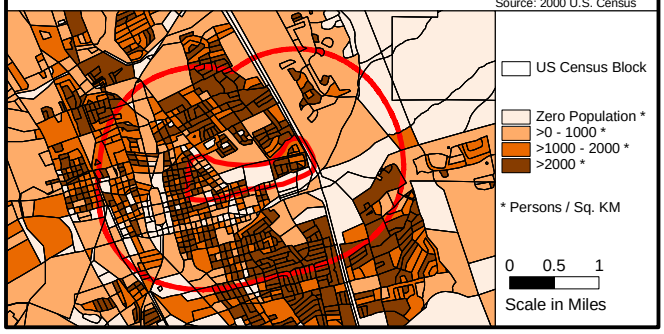


Dona Ana County, New Mexico

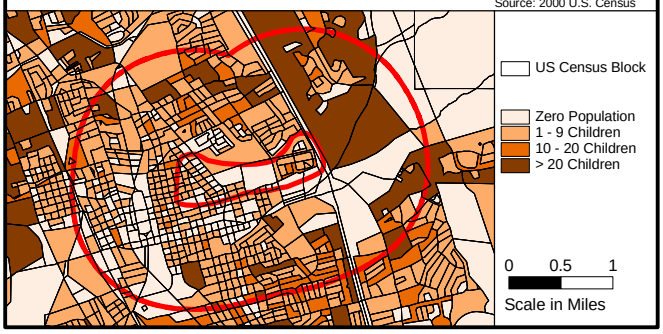
Demographic Statistics Within Area of Concern*	
Total Population	24965
White alone	15929
Black alone	646
Am. Indian and Alaska Native alone	516
Asian alone	184
Native Hawaiian and Other Pacific Islander alone	20
Some other race alone	6554
Two or More races	1117
Hispanic or Latino	15465
Children Aged 6 and Younger	2570
Adults Aged 65 and Older	3503
Females Aged 15 - 44	5879
Total Housing Units	10900

Demographics Statistics Source: 2000 US Census
*Calculated using an area-proportion spatial analysis technique

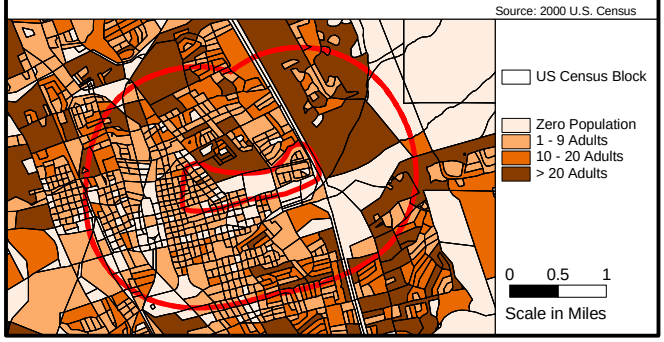
Population Density



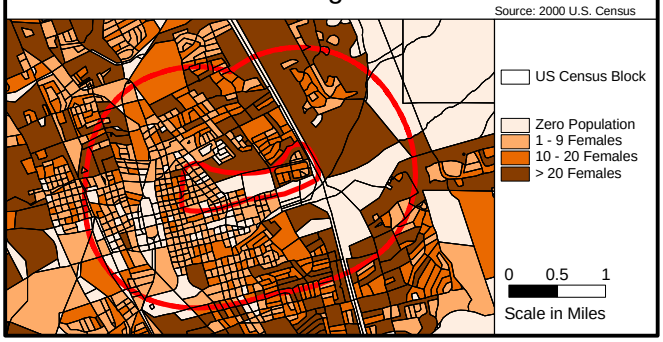
Children 6 Years and Younger



Adults 65 Years and Older



Females Aged 15 - 44



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Appendix B: Tables

Table 1. Completed Exposure Pathways for the Griggs and Walnut Groundwater Site

Pathway Name	*Environmental Media and Transport Mechanisms*	*Point of Exposure*	*Route of Exposure*	*Exposure Population*	*Estimated Number Exposed*	*Time of Exposure*	*Chemical*
Drinking Water (Public Water Supply)	Movement of contaminant from source to groundwater	Municipal Drinking Water Supply	Ingestion, Inhalation, Direct Skin Contact	Residents	25,000	Past, present, future	Tetrachloroethylene (PCE)
Evaporative (or Swamp) Coolers	Movement of contaminant from source to groundwater	Municipal Drinking Water Supply	Inhalation	Residents	Unknown	Past, present, future	Tetrachloroethylene (PCE)

Table 2. Potential Exposure Pathways for the Griggs and Walnut Groundwater Site

Pathway Name	Environmental Media and Transport Mechanisms	Point of Exposure	Route of Exposure	Exposure Population	Estimated Number Exposed	Time of Exposure	Chemical
Soil Gas	Movement of contaminants through soil	Indoor air in buildings overlying the plume	Inhalation	Residents	25,000	Past, present, future	Tetrachloroethylene (PCE)

Table 3. Tetrachloroethylene (PCE) Levels in Las Cruces Municipal Water Supply Wells

Location of Sample	Date of Sample (Maximum)	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Number of Samples	Average Concentration (µg/L)
Well # 18	1/1995	0	32.0	34	6.39
Well # 19	12/2002	<0.1	3.44	39	1.07
Well # 21	12/2002	0.7	5.1	43	2.81
Well # 24	10/2001	<0.5	1.6	21	1.27
Well # 27	8/2001	0	4.9	40	2.86

Table 4. Tetrachloroethylene (PCE) Levels in Las Cruces Municipal Water Supply System

Location of Sample	Date of Sample [Maximum]	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Number of Samples	Average Concentration (µg/L)
Home A	4/2000	-	<0.5	1	-
Home B	6/2001	1.3	1.6	3	1.43
Home C	6/2001	3.1	3.5	3	3.33
Home D	6/2001	3.2	3.4	3	3.27
Home E	6/2001	3.2	3.5	3	3.33
Home F	6/2001	3.2	3.5	2	3.35
Home G	6/2001	3.1	3.5	2	3.30
Home H	6/2001	1.4	4.0	3	2.67
Home I	10/2001	-	1.2	1	1.2
Home J	4/2002	-	2.7	1	2.7
Home K	4/2002	-	2.9	1	2.9
Home L	4/2002	-	0.7	1	0.7
Home M	4/2202	-	0.5	1	0.5
Upper Griggs Storage Tank	7/2002	<0.5	3.5	5	2.24

µg/L: micrograms per liter

< indicates less than actual value – generally occurs because value is below limit of detection

Note: Any data values with a < designator were excluded from the calculations for the average concentration

Appendix C: ATSDR's Evaluation Process

Step 1 – Comparison Values and the Screening Process

To evaluate the available data, ATSDR used comparison values (CVs) to determine which chemicals to examine more closely. CVs are the contaminant concentrations found in a specific media (e.g., air, soil, or water) and are used to select contaminants for further evaluation. CVs incorporate assumptions of daily exposure to the chemical, as well as a standard amount of air, water, and soil that someone would inhale or ingest each day. CVs are generated to be conservative and non-site specific. These values are used only to screen out chemicals that do not need further evaluation. CVs are not intended as environmental clean-up levels, or to indicate that at concentrations exceeding these values, health effects will occur.

CVs can be based on either carcinogenic (cancer-causing) or non-carcinogenic effects. Cancer-based comparison values are calculated from the U.S. Environmental Protection Agency's (EPA) oral cancer slope factor (CSF) or inhalation risk unit. CVs based on cancerous effects account for a lifetime exposure (70 years) with an unacceptable theoretical excess lifetime cancer risk of 1 new case per 1 million exposed people. Noncancer values are calculated from ATSDR's Minimal Risk Levels (MRLs), EPA's Reference Doses (RfDs), or EPA's Reference Concentrations (RfCs). When a cancer and noncancer CV exists for the same chemical, the lower of these values is used in the comparison for conservatism. The chemical and media-specific CVs utilized during the preparation of this PHA are listed below:

A **Reference Dose Media Evaluation Guide (RMEG)** is a comparison concentration that is based on EPA's estimate of the daily exposure to a contaminant that is unlikely to cause adverse health effects.

A **Cancer Risk Evaluation Guide (CREG)** is a comparison concentration that is based on an excess cancer rate of one in a million persons and is calculated using EPA's cancer slope factor (CSF).

A **Maximum Contaminant Level (MCL)** is a contaminant concentration that EPA deems protective of public health, and may consider the availability and economics of water treatment technology.

A **Life Time Health Advisory (LTHA)** is developed by EPA and is considered a lifetime exposure level for contaminants specifically in drinking water (assuming 20% of an individual's exposure comes from drinking water) at which adverse, non-carcinogenic health effects would not be expected to occur.

Preliminary Remediation Goal (PRG) is a screening tool, generated by EPA Region IX, which is used at the early stages of human exposure evaluation and clean-up considerations at contaminated sites. PRGs are risk-based concentrations derived from standardized equations, combining exposure assumptions and EPA toxicity data. These values are generic and do not take into account available site-specific information.

Step 2 – Evaluation of Public Health Implications

The next step in the evaluation process is to separate those contaminants that are above their respective CVs and further identify which chemicals and exposure situations are likely to be a health hazard. Specific child and adult exposure doses (i.e., the amount of a contaminant that gets into a person's body) are calculated for site-specific exposure scenarios, using assumptions regarding an individual's likelihood of accessing the site and contacting contamination. A brief explanation of the calculation of estimated exposure doses for the site is presented below.

Calculated doses are reported in units of milligrams per kilograms per day (mg/kg/day). Separate calculations have been performed to account for noncancer and cancer health effects for each chemical, based on the health impacts reported for that chemical. The same dose equations have been used for noncancer and cancer calculations with the indicated modifications. Some chemicals are associated with noncancer effects, notwithstanding that the scientific literature might indicate that same exposure is not expected to result in cancer-related health impacts.

Exposure Dose Estimation

When chemical concentrations at the site exceed the established CVs, it is necessary to conduct a more thorough evaluation of the chemical. To evaluate the potential for human exposure to contaminants present at the site and the potential health effects from site-specific activities, ATSDR calculates exposure doses. These estimate human exposure to the site contaminant from various environmental media. A brief discussion of the calculations and assumptions is presented below. Unless otherwise specified the equations and the assumptions are based on the EPA Risk Assessment Guidance for Superfund, Part A, and the EPA Exposure Factors Handbook. A discussion of the cancer and noncancer evaluation of exposure is presented following the equations for each pathway.

Ingestion of PCE Present in Drinking Water

The exposure dose for ingestion of drinking water is

$$\text{Dose}\,(\text{mg}/\text{kg}/\text{day}) = \frac{\text{C} \times \text{IR} \times \text{EF} \times \text{ED}}{\text{BW} \times \text{AT}}$$

Where

C = chemical concentration (mg/L)

IR = ingestion rate (L/day)

EF = exposure frequency (days/years)

ED = exposure duration (years)

BW = body weight (kg)

AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in milligrams per liter (mg/L). An ingestion rate (IR) of 2 liters per day (L/day) for adults and 1 L/day for children. An exposure frequency (EF) of 350 days per year was assumed (1 year minus 2 weeks of vacation or other time spent away from the home). It was assumed that the exposure duration (ED) was 30 and 6 years for adults and children, respectively. A body weight (BW) of 70 kilograms (kg) for adults and 10 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating noncancer and cancerous health effects. The averaging time (AT) for noncancer-causing chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Inhalation of PCE Present in Drinking Water

Concentrations of PCE in drinking water can become airborne during a bath, or particularly during a shower. Exposure to PCE via showering has been evaluated in this PHA by assuming

that the inhalation route is equal to half the ingestion route, or ingestion of an additional 1 L/day of drinking water.

Direct Skin Contact of PCE Present in Drinking Water

The exposure dose for direct skin contact with drinking water is

$$\text{Dose}\,(\text{mg}/\text{kg}/\text{day}) = \frac{\text{C} \times \text{SA} \times \text{PC} \times \text{ET} \times \text{EF} \times \text{ED} \times \text{CF}}{\text{BW} \times \text{AT}}$$

Where
C = chemical concentration (mg/L)
SA = surface area (cm^2)
PC = permeability constant (cm/hour)
ET = exposure time (hours/day)
EF = exposure frequency (days/years)
ED = exposure duration (years)
CF = conversion factor (mg/µg)
BW = body weight (kg)
AT = averaging time (days)

Exposure doses were calculated using the maximum detected concentration of a contaminant (C) from the environmental data in milligrams per liter (mg/L). A surface area (SA) of 18,150 square centimeters (cm^2) for adults and 7,195 cm^2 for children. The permeability constant of 0.37 centimeters per hour (cm/hour) is based on EPA's 1992 Dermal Exposure Guidance. An exposure frequency (EF) of 350 days per year was assumed (year minus two weeks of vacation or other time spent away from the home). It was assumed that the exposure duration (ED) was 30 and 6 years for adults and children, respectively. A body weight (BW) of 70 kilograms (kg) for adults and 10 kg for children was also assumed. It should be noted that different averaging times (AT) are used for evaluating noncancer and cancerous health effects. The averaging time (AT) for noncancer causing chemicals is equal to the ED multiplied by the EF, which is 10,500 days for adults and 2,100 days for children. For chemicals associated with cancerous effects, AT of 25,550 days was used to account for lifetime exposure to a particular chemical (365 days per year multiplied by 70 years).

Noncancer Health Effects

The doses calculated for exposure to each individual chemical are then compared to an established health guideline, such as a Minimal Risk Level (MRL) or a Reference Dose (RfD) to assess whether adverse noncancer health impacts from exposure are expected. These health guidelines, developed by ATSDR and EPA, are chemical-specific values that are based on the available scientific literature and are considered protective of human health. Non-carcinogenic effects — unlike carcinogenic effects — are believed to have a threshold; that is, a dose below which adverse health effects will not occur. As a result, the current practice for deriving health guidelines is to identify, usually from animal toxicology experiments, a No Observed Adverse Effect Level (or NOAEL), which indicates that no effects are observed at a particular exposure level. This is the experimental exposure level in animals (and sometimes humans) at which no adverse toxic effect is observed. The NOAEL is then modified with an uncertainty (or safety) factor, which reflects the degree of uncertainty that exists when experimental animal data are extrapolated to the general human population. The magnitude of the uncertainty factor considers

various factors such as sensitive subpopulations (for example; children, pregnant women, and the elderly), extrapolation from animals to humans, and the completeness of available data. Thus, exposure doses at or below the established health guideline are not expected to result in adverse health effects because these values are much lower (and more human health protective) than doses, which do not cause adverse health effects in laboratory animal studies. For noncancer health effects, the following health guidelines are described below in more detail. It is important to consider that the methodology used to develop these health guidelines does not provide any information on the presence, absence, or level of cancer risk. Therefore, a separate cancer evaluation is necessary for potentially cancer-causing chemicals detected in samples at this site. A more detailed discussion of the evaluation of cancer risk is presented in the Cancer Risks Section of this Appendix.

Noncancer Health Guidelines

Minimal Risk Levels (MRLs) – developed by ATSDR

ATSDR has developed MRLs for contaminants commonly found at hazardous waste sites. The MRL is an estimate of daily exposure to a contaminant below which noncancer, adverse health effects are unlikely to occur. MRLs are developed for different routes of exposure, such as inhalation and ingestion, and for lengths of exposure, such as acute (less than 14 days), intermediate (15-364 days), and chronic (365 days or greater). At this time, ATSDR has not developed MRLs for dermal exposure. A complete list of the available MRLs can be found at http://www.atsdr.cdc.gov/mrls.html.

References Doses (RfDs) – developed by EPA

An estimate of the daily, lifetime exposure of human populations to a possible hazard that is not likely to cause noncancerous health effects. RfDs consider exposures to sensitive sub-populations, such as the elderly, children, and the developing fetus. EPA RfDs have been developed using information from the available scientific literature and have been calculated for oral and inhalation exposures. A complete list of the available RfDs can be found at http://www.epa.gov/iris.

If the estimated exposure dose for a chemical is less than the health guideline value, the exposure is unlikely to result in noncancer health effects.

If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the PHA. The known toxicological values are doses derived from human and animal studies that are presented in the ATSDR Toxicological Profiles and EPA's Integrated Information System (IRIS). A direct comparison of site-specific exposure doses to study-derived exposures and doses found to cause adverse health effects is the basis for deciding whether health effects are likely to occur. This in-depth evaluation is performed by comparing calculated exposure doses with known toxicological values, such as the no-observed adverse-effect-level (NOAEL) and the lowest-observed-adverse-effect-level (LOAEL) from studies used to derive the MRL or RfD for a chemical. As part of this comparison to toxicological values, a margin of exposure (MOE) is calculated by dividing the NOAEL or LOAEL by the site-specific exposure dose. Generally, when the MOE is greater than 1,000, harmful health effects are not expected. When the MOE ranges from approximately 100 to 1,000, further toxicological evaluation is necessary to determine whether harmful effects are likely. This could include a closer look at the studies used to derive the NOAELs and LOAELs. Adverse health effects may occur when the MOE is less than 10.

Cancer Risk

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated excess risk of developing cancer from exposure to contaminants associated with the site was calculated by multiplying the site-specific adult exposure doses, with a slight modification, by EPA's chemical-specific Cancer Slope Factors (CSFs or cancer potency estimates), which are available at http://www.epa.gov/iris.

An increased excess lifetime cancer risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular contaminant. Therefore, the cancer risk calculation incorporates the equations and parameters (including the exposure duration and frequency) used to calculate the dose estimates, but the estimated value is divided by 25,550 days (or the averaging time), which is equal to a lifetime of exposure (70 years) for 365 days/year.

Because of the uncertainties regarding cancer's mechanism, in the scientific community, suggestions vary regarding an acceptable excess lifetime cancer risk. The recommendations of many scientists and EPA have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 are not typically considered a health concern. An important consideration when determining cancer risk estimates is that the risk calculations incorporate several very conservative assumptions that are expected to overestimate actual exposure scenarios. For example, the method used to calculate EPA's CSFs assumes that high-dose animal data can be used to estimate the risk for low dose exposures in humans. As previously stated, the method also assumes that there is no safe level for exposure. Lastly, the method computes the 95% upper bound for the risk, rather than the average risk, suggesting that the cancer risk is actually lower, perhaps by several orders of magnitude.

Because of the uncertainties involved with estimating carcinogenic risk, ATSDR employs scientific/ biomedical judgment in evaluating relevant data. Therefore, the carcinogenic risk is also described in words (qualitatively) rather than giving a numerical risk estimate only. The numerical risk estimate must be considered in the context of the variables and assumptions involved in their derivation and in the broader context of biomedical opinion, host factors, and actual exposure conditions. The actual parameters of environmental exposures have been given careful and thorough consideration in evaluating the assumptions and variables relating to both toxicity and exposure. A complete review of the toxicological data regarding the doses associated with the production of cancer and the site-specific doses for the site is an important element in determining the likelihood of exposed individuals being at a greater risk for cancer.

Appendix D: Swamp Cooler Exposure Pathway Evaluation Process

Inhalation of PCE in Indoor Air Resulting from Swamp Cooler Use

At the request of NMED, ATSDR prepared a Health Consultation in July 2003 to evaluate exposure to Las Cruces residents using water containing detected levels of PCE in swamp coolers. NMED provided the following information for consideration in the evaporative cooler exposure evaluation:

- Given the climate in Las Cruces, evaporative coolers are potentially used during the months of April through October.
- Evaporative coolers might be operated continuously over a 24-hour period during the summer months.
- During the summer months, people spend the majority of their time indoors.
- Though concentrations of PCE up to 3.5 micrograms per liter (µg/L) have been detected in the distribution system, consider PCE concentrations as high as the Environmental Protection Agency's (EPA's) Maximum Contaminant Level (MCL) of 5 µg/L in the evaluation.
- Consider water usages

To estimate potential exposure to public water users in the City of Las Cruces, ATSDR utilized an approach used by the Arizona Department of Health Services to evaluate evaporative cooler use in Tucson, Arizona. The approach estimates the concentrations of contaminants present in air resulting from the use of water with detectable concentrations of contaminants in evaporative coolers.

ATSDR used the following calculation and conservative assumptions (derived from the resources provided by NMED) to calculate the PCE concentration in air:

$$C = \frac{(CW)(WU)}{CFM}$$

Where

C= concentration in air (milligrams per cubic meter [mg/m^3])

CW= concentration in water (µg/L)

WU= water used by the evaporative cooler per minute (liters per minute [L/min])

CFM = cooler air volume per minute (cubic meters per minute [m^3/min])

ATSDR considered the maximum concentrations of PCE in water to be 5 µg/L [(A)]. The estimated water use was assumed to be 0.16 L/min [(B)]. An estimated air volume of 100 m^3/min [(C)] was assumed for a house of approximately 1,500 to 2,000 square feet. Using these assumptions, the calculated PCE air concentration was 0.0067 $\mu g/m^3$.

[(A)] Assumption is based on the EPA MCL (provided by NMED).

[(B)] Assumption is based on a water use estimate of 13,000 gallons per season for a high water consumption cooler (Albuquerque Journal, June 2002) for a 7-month season (provided by NMED).

[(C)] Assumption is based on 2 CFM per square foot air volume; most conservative value provided in reference material (Evaporative Coolers: An Energy-Saving Way to Beat the Heat; 1999).

Noncancer Health Effects

To evaluate the potential for noncancer health effects, the calculated concentration of PCE was compared with the available health guideline; in this case, ATSDR's chronic inhalation Minimal Risk Level (MRL). If the estimated exposure dose for a chemical is less than the health guideline value, the exposure is unlikely to result in noncancer health effects. If the calculated exposure dose is greater than the health guideline, the exposure dose is compared to known toxicological values for the particular chemical and is discussed in more detail in the text of the PHA. A complete discussion of the process for further evaluation is presented in Appendix C.

Cancer Risk

The following equation was used to estimate the cancer risk associated with this potential exposure pathway:

$$\text{Theoretical Cancer Risk} = \frac{(C \times IR \times ED \times EF \times CF) \times CSF}{BW \times AT}$$

Where
C = Concentration of PCE in the air ($\mu g/m^3$)
IR = Inhalation Rate (m^3/day)
ED = Exposure Duration (days/year)
EF = Exposure Frequency (years)
CF = Conversion Factor (mg/µg)
BW = Body Weight (kg)
AT = Averaging Time (days)

Exposure to a cancer-causing compound, even at low concentrations, is assumed to be associated with some increased risk for evaluation purposes. The estimated excess risk of developing cancer from exposure to PCE associated with evaporative cooler use in the vicinity of the Griggs and Walnut Groundwater Site was calculated with consideration of several factors. These included contaminant concentration (estimated by the approach previously discussed), inhalation rate (20 cubic meters per day [m^3/day]), exposure duration (365 days per year), exposure frequency (30 years), and body weight (70 kilograms). The calculation of risk is not a specific estimate of expected cancers. Rather, it is an estimate of the increase in the probability that a person may develop cancer sometime during his or her lifetime following exposure to a particular contaminant. Therefore, exposure is averaged over the lifetime of an individual (365 days/year for 70 years). ATSDR also incorporated the U.S. Environmental Agency (EPA)'s chemical-specific inhalation Cancer Slope Factor (CSFs or cancer potency estimates) to calculate the increased excess lifetime cancer risk from exposure to PCE present in indoor air from evaporative cooler use. EPA's inhalation CSF of 2.0×10^{-2} (milligrams per kilogram per day^{-1}) $mg/kg/day^{-1}$, is currently under review.

As discussed in Appendix C, there are varying suggestions among the scientific community regarding an acceptable excess lifetime cancer risk, due to the uncertainties regarding the mechanism of cancer. The recommendations of many scientists and EPA have been in the risk range of 1 in 1 million to 1 in 10,000 (as referred to as 1×10^{-6} to 1×10^{-4}) excess cancer cases. An increased lifetime cancer risk of one in one million or less is generally considered an insignificant increase in cancer risk. Cancer risk less than 1 in 10,000 are not typically considered a health concern. A more detailed discussion of cancer risk and the uncertainties associated with its evaluation are presented in Appendix C.

Selected Bibliography

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Appendix E: Levels of Public Health Hazard

ATSDR categorizes exposure pathways at hazardous waste sites according to their level of public health hazard to indicate whether people could be harmed by exposure pathways and site conditions. The categories are

Urgent Public Health Hazard:	This category applies to exposure pathways and sites that have certain physical features or evidence of short-term (less than 1 year), site-related chemical exposure that could result in adverse health effects and require quick intervention to stop people from being exposed.
Public Health Hazard:	The category applies to exposure pathways and sites that have certain physical features or evidence of chronic (long-term), site-related chemical exposure that could result in adverse health effects.
Indeterminate Public Health Hazard:	The category applies to exposure pathways and sites where important information is lacking about chemical exposures, and a health determination cannot be made.
No Apparent Public Health Hazard:	The category applies to pathways and sites where exposure to site-related chemicals may have occurred in the past or is still occurring, however, the exposure is not at levels expected to cause adverse health effects.
No Public Health Hazard:	The category applies to pathways and sites where there is evidence of an absence of exposure to site-related chemicals.

Appendix F: ATSDR Glossary of Environmental Health Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency with headquarters in Atlanta, Georgia, and 10 regional offices in the United States. ATSDR's mission is to serve the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases related to toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces environmental laws to protect the environment and human health.

This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. If you have questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption

The process of taking in. For a person or animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute

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

Acute exposure

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

Additive effect

A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with **antagonistic effect** and **synergistic effect]**.

Adverse health effect

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

Aerobic

Requiring oxygen [compare with **anaerobic**].

Ambient

Surrounding (for example, *ambient* air).

Anaerobic

Requiring the absence of oxygen [compare with **aerobic**].

Analyte

A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study

A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect

A biologic response to exposure to multiple substances that is **less** than would be expected if the known effects of the individual substances were added together [compare with **additive effect** and **synergistic effect**].

Background level

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

Biodegradation

Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study

A study that uses (a) **biomedical testing** or (b) the measurement of a substance [an **analyte**], its **metabolite**, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see **exposure investigation**].

Biologic monitoring

Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake

The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing

Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota

Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden

The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP

See **Community Assistance Panel**.

Cancer

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

Cancer risk

A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen

A substance that causes cancer.

Case study

A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study

A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number

A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system

The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see **Comprehensive Environmental Response, Compensation, and Liability Act of 1980**]

Chronic

Occurring over a long time (more than 1 year) [compare with **acute**].

Chronic exposure

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

Cluster investigation

A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)

A group of people, from a community and from health and environmental agencies, who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)

Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see **exposure pathway**].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

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.

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.

Delayed health effect

A disease or injury that happens as a result of exposures that might have occurred in the past.

Dermal

Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact

Contact with (touching) the skin [see **route of exposure**].

Descriptive epidemiology

The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit

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

Disease prevention

Measures used to prevent a disease or reduce its severity.

Disease registry

A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD

United States Department of Defense.

DOE

United States Department of Energy.

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.

Dose (for radioactive chemicals)

The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship

The relationship between the amount of exposure [**dose**] to a substance and the resulting changes in body function or health (response).

Environmental media

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

Environmental media and transport mechanism

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

EPA

United States Environmental Protection Agency.

Epidemiologic surveillance

The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Epidemiology

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

Exposure

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

Exposure assessment

The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction

A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation

The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

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**.

Exposure registry

A system of ongoing follow-up of people who have had documented environmental exposures.

Feasibility study

A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)

A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds

Training sessions for physicians and other health care providers about health topics.

Groundwater

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

Half-life ($t_{½}$)

The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard

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

Hazardous Substance Release and Health Effects Database (HazDat)

The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste

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

Health consultation

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

Health education

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

Health investigation

The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to estimate the possible association between the occurrence and exposure to hazardous substances.

Health promotion

The process of enabling people to increase control over, and to improve, their health.

Health statistics review

The analysis of existing health 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.

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.

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**].

Inhalation

The act of breathing. A hazardous substance can enter the body this way [see **route of exposure**].

Intermediate duration exposure

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

In vitro

In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with **in vivo**].

In vivo

Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with **in vitro**].

Lowest-observed-adverse-effect level (LOAEL)

The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring

A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism

The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite

Any product of **metabolism**.

mg/kg

Milligram per kilogram.

mg/cm^2

Milligram per square centimeter (of a surface).

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.

Migration

Moving from one location to another.

Minimal risk level (MRL)

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

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, condition, or injury) is stated.

Mutagen

A substance that causes **mutations** (genetic damage).

Mutation

A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites

(National Priorities List or **NPL)**

EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

No 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-observed-adverse-effect level (NOAEL)

The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

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.

NPL [see **National Priorities List for Uncontrolled Hazardous Waste Sites]**

Physiologically based pharmacokinetic model (PBPK model)

A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica

A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume

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

Point of exposure

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

Population

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

Potentially responsible party (PRP)

A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb

Parts per billion.

ppm

Parts per million.

Prevalence

The number of existing disease cases in a defined population during a specific time period [contrast with **incidence**].

Prevalence survey

The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention

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

Public comment period

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

Public availability session

An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public health action

A list of steps to protect public health.

Public health advisory

A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human 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

A category used in ATSDR's public health assessments 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.

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. The five public health hazard categories are **no public health hazard**, **no apparent public health hazard**, **indeterminate public health hazard**, **public health hazard**, and **urgent public health hazard**.

Public health statement

The first chapter of an ATSDR **toxicological profile**. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public meeting

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

Radioisotope

An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide

Any radioactive isotope (form) of any element.

RCRA [see **Resource Conservation and Recovery Act (1976, 1984)**]

Receptor population

People who could come into contact with hazardous substances [see **exposure pathway**].

Reference dose (RfD)

An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry

A systematic collection of information on persons exposed to a specific substance or having specific diseases [see **exposure registry** and **disease registry**].

Remedial investigation

The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)

This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA

RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD

See **reference dose**.

Risk

The probability that something will cause injury or harm.

Risk reduction

Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication

The exchange of information to increase understanding of health risks.

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**].

Safety factor [see **uncertainty factor]**

SARA [see **Superfund Amendments and Reauthorization Act**]

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.

Sample size

The number of units chosen from a population or environment.

Solvent

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

Source of contamination

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

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.

Substance

A chemical.

Substance-specific applied research

A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's **toxicological profiles**. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund Amendments and Reauthorization Act (SARA)

In 1986, SARA amended CERCLA and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water

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

Surveillance [see **epidemiologic surveillance**]

Survey

A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see **prevalence survey**].

Synergistic effect

A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see **additive effect** and **antagonistic effect**].

Teratogen

A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent

Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

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.

Tumor

An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

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**].

Urgent public health hazard

A category used in ATSDR's public health assessments 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.

Volatile organic compounds (VOCs)

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

Other Glossaries and Dictionaries

Environmental Protection Agency - http://www.epa.gov/OCEPAterms/
National Center for Environmental Health (CDC) - http://www.cdc.gov/nceh/dls/report/glossary.htm
National Library of Medicine (NIH) - http://www.nlm.nih.gov/medlineplus/dictionaries.html