Public Health Assessment for

ELY COPPER MINE SITE
VERSHIRE, VERMONT

EPA FACILITY ID: VTD988366571

SEPTEMBER 30, 2008

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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Prepared by:

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
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FOREWORD

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

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

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

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

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

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

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

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

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List of Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	contaminants of concern
CV	comparison value
EMEG	environmental media evaluation guide (ATSDR)
EPA	U.S. Environmental Protection Agency
IAS	Initial Assessment Study
MCL	EPA's maximum contaminant level
MRL	ATSDR's minimal risk level
NPL	National Priorities List (EPA)
PHA	public health assessment
ppb	parts per billion
ppm	parts per million
RBC	EPAs Region III risk-based concentrations
RCRA	Resource Conservation and Recovery Act
RDA	Recommended Daily Allowance
RfD	reference dose (EPA)
RMEG	reference media evaluation guide (ATSDR)
ROD	record of decision
SSA	site screening assessment area
VT ANR	Vermont Agency of Natural Resources
VT DOH	Vermont Department of Health

Summary and Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) prepared this public health assessment (PHA) to evaluate potential health hazards associated with exposures to contaminants originating from the Ely Copper Mine Site. The Ely Copper Mine is an abandoned copper mine located in Vershire, Orange County, East Central Vermont. It is located on Beanville Road west of West Fairlee. Copper mining activities took place from 1821 to 1920. In September 2001, the Ely Copper Mine Site was placed on EPA's National Priorities List.

The mine site contains piles of waste rock, smelter waste, and tailings generated from mining processes. Acidic drainage from waste piles (acid mine drainage) affects surface waters by carrying dissolved metals and low pH waters. ATSDR evaluated potential exposures to contaminants from Ely Mine, primarily from off-site surface water and sediment as well as the uptake of metals in fish. Our conclusions regarding potential off-site exposures are that no adverse health effects are likely.

There are on-site physical hazards which should be addressed because of trespassers. The acidity of on-site surface waters could cause skin and eye irritation on contact as well as skin corrosion. On-site surface water and groundwater should not be used for drinking water due to acidity and elevated concentrations of metals. To the best of our knowledge, no one is using on-site surface water or groundwater for drinking water purposes. A warning sign near vertical shafts or other potential hazards is recommended. Additionally, site access and trespassing should be discouraged.

As a prudent public health measure, EPA should consider placing deed restrictions on the property to prevent on-site exposures to metals in mining wastes, surface water, sediment, and groundwater. EPA is conducting a Remedial Investigation of the site and a Record of Decision pertaining to site clean-up is anticipated in 2009.

ATSDR's public health assessment process is designed to identify populations who may have been or are being exposed to hazardous substances and determine the public health implications of the exposure. As part of this process, ATSDR visited the site in October 2001 and May 2002. No comments on this assessment were received from the public during the comment period, March 3 through April 3, 2008. We received a site database in August 2008 and subsequently updated and finalized our evaluation.

Background

Site Description and History

The Ely Copper Mine is an abandoned copper mine located in Vershire, Orange County, East Central Vermont. It is located on Beanville Road; 1.4 miles west of the intersection of Beanville Road with Route 113 in West Fairlee (Figure 1). Currently, it is privately owned by Ely Mine Forest Inc. and Green Crow Corp. (US EPA 2001a). There are no restrictive barriers to pedestrian access on the property. In 1999, the entry gate was damaged permitting vehicular access (EPA 2001b); however, it has been repaired. The mine area became the Ely Copper Mine Superfund Site in 2001 (US EPA 2001b).

The initial discovery of copper-containing ore deposits was made in 1813. Copper mining activities took place from 1821 to 1920 on about 275-350 acres of the 1880 acre property. In 1854, rich vein ore was struck by the Vermont Copper Mining Company, which operated until 1883 (State of Vermont 1986). The mine site was rapidly expanded during the Civil War because there was an increased need for copper. A mining settlement with 50 homes, school, post office, general store, two churches, and multiple businesses was established by the 1870s. Most activity at the mine occurred between the mid-1850s and about 1905. Past mining operations included cobbing (fragmenting), roasting, and smelting the ore. Processing of ore was supported by processing mills, roasting beds, a smelter plant with 24 furnaces, kilns, a stone-lined buried flue, a mill, and a complex water system (State of Vermont 1986). The mine was a major U.S. copper producer between 1866 and 1881. By 1906, the mining site was abandoned. In 1918, a flotation mill was built to extract additional copper from existing waste piles.

The ore at Ely is essentially sulfide, containing mainly of pyrrhotite (an iron sulfide of reddish color which can be magnetic or nonmagnetic) with lesser pyrite (iron sulfide), chalcopyrite (copper-iron sulfide), sphalerite (zinc sulfide), and minor sulfides. The waste material is mainly quartz, mica, and feldspar (State of Vermont 1992). The sulfide ore averaged 3.3 percent copper (US EPA 2001b) and was mined from an ore body estimated to be 100 feet wide, 10 feet thick, and 3,400 feet long (US DOI 1944). The underground mine, located north-centrally on the property, extends below ground approximately 1500 feet, slopes 35 degrees, and extends onto the adjacent property (Figure 2). There are numerous vertical air shafts near the mine. Although these shafts could represent a physical hazard, they are not going to be addressed by EPA as part of Superfund (communication with E. Hathaway, EPA RPM, on 09/10/2007). The historic ranking of the site is driving preservation of the mining site remnants.

In 1949-1950, approximately 60,000 tons of waste rock was shipped to Elizabeth Mine, located in South Stafford, Vermont, for the recovery of residual copper (US EPA 2001a). Sampling of the mine dumps in 1944 indicated coarse material with recovery potential containing on average 1.67% copper, 0.67% zinc, 36.8% iron and 23.4% sulfur. (US DOI 1944).

The site contains piles of waste rock and smelter waste generated from mining processes. The U.S. Bureau of Mines estimated that 100,000 tons of tailings and slag were generated by mining activities on the property (US EPA 2001a). There are three main tailings and waste piles located centrally on the property (Figure 2): a mine tailings pile covering 10.8 acres, a smaller waste rock pile, and a mixed tailings and waste pile. The mine tailings pile consists of fine-grained material which is reddish brown on the surface. A smelter waste pile, covering 4.3 acres, is located in the southern portion of the site on both sides of Beanville Road. The smelter waste pile consists of slag that exhibits a metallic luster. The tailings and slag dump areas are basically devoid of vegetation. Sulfur emissions from the roasting beds and smelting furnaces killed the vegetation within one-half mile of the site (US EPA 2001a). Additionally, contaminated soil located within the mine drainage system is estimated at approximately one-quarter of an acre. Extensive erosion control measures have not been implemented at the site (communication with E. Hathaway, EPA RPM, on 9/10/2007).

Woodlands surround the property. Portions of the property are managed for commercial timberland (US EPA 2001a). There are birch, poplar, and pine trees on the property and numerous logging roads (State of Vermont 1992).

Remedial and Regulatory History

The Ely Copper Mine site has been investigated by State and Federal agencies, and private companies (US EPA 2001b). Samples from the mine tailings, waste rock, slag, surface water, soil, sediment, and water within the waste piles have been collected and analyzed for metals. Results indicate elevated metals with respect to background. Selected results are presented in the Environmental Contamination and Other Hazards section.

A Screening Site Inspection (SSI) was performed in 1991/1992 (State of Vermont 1992). The purpose of the SSI was to evaluate the site as a candidate for the NPL. The site was recommended for the NPL based on the release from the site of elevated levels of copper, lead, and zinc in the surface water and sediment samples. In 1992, the extent of elevated metals contamination was restricted to Ely Brook.

In 1995, the Bureau of Mines conducted an experimental biological treatment system of the mine drainage (US EPA 2001a). They used a passive treatment system of manure, compost, wood chip, and limestone as a bacterial sulfate reduction system (five 32-gallon barrels were placed within the drainage flow) to precipitate metals and sulfates, and increase the pH (buffer it so that pH is near neutral) of the mine drainage. Although it essentially was successful, monitoring and maintenance was irregular.

On September 13, 2001, the Ely Copper Mine site was placed on the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) National Priorities List (NPL) (US EPA 2002). Currently, the US EPA is conducting a Remedial Investigation/ Feasibility Study to assess contaminants resulting from historical mining operations and determine what remediation needs to occur. A Record of Decision (ROD) for this site is anticipated in 2009 (communication with E. Hathaway, EPA RPM, on 09/10/2007).

ATSDR Involvement

ATSDR's public health assessment process is designed to identify populations who may have been or are being exposed to hazardous substances and determine the public health implications of the exposure. As part of this process, ATSDR visited the site in October 2001 and May 2002.

ATSDR conducted an initial site scoping visit in October 2001 (ATSDR 2001). They were accompanied by representatives from the State of Vermont Agency of Natural Resources (VT ANR) and a representative from the Vermont Department of Health (VT DOH). ATSDR observed and photographed the mine site from the mine shafts to the smelter operations south of Beanville Road. Neither the entrance to the property nor to the mine (adit) were marked for "No Trespassing" and both were easily accessible. There were numerous signs of trespassing and use of the property (shells from hunters, hiking trails, snowmobile/ski trails etc.). Drainage from the mine area, which was entering Ely Brook, had a red-orange hue.

ATSDR also visited the area on May 22, 2002. Some selected photos from this site visit are presented in Figure 3. The closest residences were noted being within 0.2 miles of the mine site (it is unclear whether these residences were occupied). The majority of residences are over 0.5 miles southeast of the mine on Beanville Road and closer to West Fairlee (ATSDR 2002a). During this trip, ATSDR joined EPA and the VT ANR at their May 22 Public Information Meeting. At the meeting, ATSDR learned of two community concerns: 1) potential contamination of private wells and 2) whether past smoke from the smelter could have deposited contaminants in area soil (ATSDR 2002b).

No comments on this assessment were received from the public during a March 3 through April 3, 2008 comment period. A database for the site was provided to ATSDR in August 2008 and was used to update information for this final PHA.

Demographics

ATSDR examines demographic information to identify the presence of sensitive populations, such as young children and the elderly, in the vicinity of a site. Demographics also provide details on residential history in a particular area, information that helps ATSDR assess time frames of potential human exposure to contaminants. Demographic information for the site and residential areas surrounding Ely Copper Mine is presented in this section.

In the 1870s, there were approximately 1200 people (Cornish, Irish, and Italian miners) at the mine site and 50 residences (State of Vermont 1992). Since the mine is abandoned, there are no longer residents or workers living or working at the Mine; although there are some loggers, etc. working to harvest the timber. In the 1990s, the total population within a mile radius from the site was between 35-40 people. The area is rural with some residents (the 1990 census estimate was 114 people within 1 mile and the 2000 census estimate is 239 people; these census estimates tend to overestimate the population by including people in a census block that really reside at a greater distance—likewise it appears that the housing units are also overestimated). According to the 2000 U.S. Census, the population within a one-mile radius of the site is 239, mostly white (Figure 1). From the topographic map, there appears to be approximately 30 residences along Schoolhouse Brook prior to the confluence with the Ompompanoosuc River (Figure 2).

Land Use, Topography, and Natural Resources

Ely Copper Mine is located in the Vermont Copper Belt in east central Vermont. The topographic relief ranges from 860 to 1510 feet above sea level (Crouse & Company Map).

Basically, the property is on a mountain –side and the mine spans both directions from the ridge top. Elizabeth Mine, near South Stafford, is south of Ely and Pike Hill Mine is of similar distance but to the north (northwest of Corinth). Both Elizabeth Mine and Union Mine at Pike Hill lie in the same ore body in the Vermont Copper Belt as Ely Copper Mine (communication with E. Hathaway, EPA RPM, on 09/10/2007).

The Indiana bat and Small-footed bat, both of which are listed as federal and state endangered and state-threatened species, have been identified within 1-mile of the Ely Copper Mine (US EPA 2001a) and are believed to use part of the mine shaft. Ely Brook may be part of their habitat in addition to the mine adit or shafts.

Schoolhouse Brook (referred to in US EPA 2001a as Ely Brook) is designated by the State of Vermont as a Class B Water (high quality compatible with swimming and other recreational uses). Portions of Schoolhouse Brook support fish (blacknose dace and some brook trout) and some fishing occurs there. Other portions of Schoolhouse Brook are marginally inhabitable for brook trout because of drainage from the mine site, which has degraded water quality and the aquatic biology (US EPA 2001a).

The property is used for many recreational purposes. There are no restrictive barriers to pedestrian access on the property. Historic mining relics have been left on the siite. In 1999, the entry gate was damaged permitting vehicular access. The access gate to the property was open and non-functional in the past so public entry onto the property was feasible (ATSDR 2001). The access gate has been repaired (communication with E. Hathaway, EPA RPM, on 01/03/2008). The property is used by the public for hunting and snowmobile riding; off-road vehicular access still occurs. A large portion in the southern part of the property is used by deer. A gun club has permission to access the property for hunting (US EPA 2001b).

Hydrogeology

Ely Copper Mine is situated in the Gile Mountain Formation. Ore was mined from massive sulfide deposits containing pyrrhotite, chalcopyrite, and minor sphalerite and pyrite. Remains of the mining process include underground workings, waste rock, tailings, roast beds, and slag.

Acid Mine Drainage

Exposure of iron sulfide minerals (such as chalcopyrite, pyrite, pyrrhotite) at the ground surface to atmospheric oxygen and water results in oxidation and release of acidity to the environment. Oxidation of these minerals in the tailings and waste piles produces sulfuric acid leading to the dissolution and mobilization of metals within the waste piles. This drainage is called the acid mine drainage (low pH or high acidity). In addition to the sulfides, other sulfate minerals (such as jarosite), and efflorescent salts (such as copiapite, melanterite, and rozenite) also contribute to acid mine drainage (USGS 2004). Acid mine drainage from the site discharges to on-site intermittent streams and into Ely Brook (US EPA 2001a) or in the case of the smelter waste pile, directly to Schoolhouse Brook. Acid mine drainage affects on-site and off-site surface waters by elevating metal concentrations and lowering pH.

Surface water:

The mine waste is situated in and drained by the Ely Brook watershed, which is approximately 250 acres (USGS & CRREL 2002). Ely Brook discharges to Schoolhouse Brook which flows into the East Branch of the Ompompanoosuc River at West Fairlee, about 1.5 miles from the mine site (US EPA 2002). The West Branch of the Ompompanoosuc receives drainage from the Elizabeth Mine. The Ompompanoosuc River flows into the Connecticut River roughly 10 miles south of the site. The towns of West Fairlee, and Post Mills, Vermont are located on the Ompompanoosuc River downstream of the Ely mine. However, there are no known drinking water intakes located within 15 downstream miles of the site (which includes downstream portions of the Ompompanoosuc River) (US EPA 2001a). In addition, the off-site brook receiving site drainage, Schoolhouse Brook, is not used for agricultural purposes. ATSDR does not have information on surface water to groundwater interactions (ie. such as the potential of surface water contamination to contribute to groundwater contamination and therefore potentially to private wells).

Surface water in the area north of the mine site (the underground mine extends onto the adjacent property to the north) flows to a tributary to the Ompompanoosuc River, north of West Fairlee, upstream of the confluence of Schoolhouse Brook with the Ompompanoosuc River (Figure 2).

Groundwater:

The area is not served by municipal water so all residents are assumed to be on private groundwater systems. Most people have private groundwater wells. There is a community well 2.5 miles southeast of the site which is served by 2 dug wells and one bedrock well (460 feet deep in a formation of schist, slate and quartz that yields 8 gallons per minute) for 50 residents at the West Fairlee Trailer Park (State of Vermont 1992).

The Ely Copper Mine extends underground onto the adjacent property to the north. Groundwater draining from the deepest parts of the underground mine impacts groundwater off-site and to the north of the mine site as indicated by the mine slope and topography (Figure 2). Although groundwater from the mine site has the potential to contaminate private wells, most private wells, such as those in West Fairlee, are a considerable distance from the site and are unlikely to be impacted.

Quality Assurance and Quality Control

In preparing this PHA, ATSDR reviewed and evaluated information provided in the referenced documents. Documents prepared for the CERCLA program must meet standards for quality assurance and control measures for chain-of-custody, laboratory procedures, and data reporting. The environmental data presented in this PHA come from site characterization, remedial investigation, and monitoring reports prepared for US EPA under CERCLA and/or RCRA. Geochemical characterization of site wastes (bulk rock chemistry and leachate data) were characterized by USGS (USGS 2003a and 2004). ATSDR used leachate data to evaluate potential contamination to surface water and its potential impact downstream of the mining site.

ENVIRONMENTAL CONTAMINATION, HUMAN EXPOSURE PATHWAYS, AND PUBLIC HEALTH IMPLICATIONS

In this section, ATSDR evaluates whether community members have been (past), are (current), or will be (future) exposed to harmful levels of chemicals. Figure 4 describes the exposure evaluation process used by ATSDR. ATSDR screens the concentrations of contaminants in environmental media (e.g., groundwater or soil) against health-based comparison values (CVs). Because CVs are not thresholds of toxicity, environmental levels that exceed CVs would not necessarily produce adverse health effects. If a chemical is found in the environment at levels exceeding its corresponding CV, ATSDR estimates site-specific exposure and evaluates the likelihood of adverse health effects. *ATSDR emphasizes that a public health hazard exists only if exposure to a hazardous substance occurs at sufficient concentration, frequency, and duration for harmful effects to occur.*

What is meant by exposure?

ATSDR's PHAs evaluate the potential for human exposure or contact with environmental contaminants. Chemical contaminants released into the environment have the potential to cause adverse health effects. However, *a release does not always result in human exposure*. People can only be exposed to a contaminant if they come in contact with it—if they breathe, eat, drink, or come into skin contact with a substance containing the contaminant.

How does ATSDR determine which exposure situations to evaluate?

ATSDR scientists evaluate site conditions to determine if people could have been, are, or could be exposed (i.e., exposed in a past scenario, a current scenario, or a future scenario) to site-related contaminants. When evaluating exposure pathways, ATSDR identifies whether exposure to contaminated media (soil, sediment, water, air, or biota) has occurred, is occurring, or will occur through ingestion, dermal (skin) contact, or inhalation.

If exposure was, is, or could be possible, ATSDR scientists consider whether contamination is present at levels that might affect public health. ATSDR scientists select contaminants for further evaluation by comparing them against health-based CVs. These are developed by ATSDR from available scientific literature related to exposure and health effects. CVs are derived for each of the different media and reflect an estimated contaminant concentration that is *not likely* to cause adverse health effects for a given chemical, assuming a standard daily contact rate (e.g., an amount of water or soil consumed or an amount of air breathed) and body weight. Further information on ATSDR's CVs can be found in the summary text box on the next page, in Appendix A (for a list and description of CVs used by ATSDR) or in our Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/phamanual/.

If someone is exposed, will they get sick?

Exposure does not always result in harmful health effects. The type and severity of health effects a person can experience as a result of contact with a contaminant depend on the exposure concentration (how much), the frequency and/or duration of exposure (how long), the route or pathway of exposure (breathing, eating, drinking, or skin contact), and the combined effects of exposure to multiple substances.

Once exposure occurs, characteristics such as age, sex, nutritional status, genetics, lifestyle, and health status of the exposed individual influence how the individual absorbs, distributes, metabolizes, and excretes the contaminant. Together, these factors and characteristics determine the health effects that may occur.

In almost any situation, there is considerable uncertainty about the true level of exposure to environmental contamination. To account for this uncertainty and to be protective of public health, ATSDR scientists typically use worst-case exposure level estimates as the basis for determining whether adverse health effects are possible. These estimated exposure levels usually are much higher than the levels that people are really exposed to. If the exposure levels indicate that adverse health effects are possible, ATSDR performs a more detailed review of exposure, also consulting the toxicologic and epidemiologic literature for scientific information about the health effects from exposure to hazardous substances.

What potential exposure concerns were evaluated for Ely Copper Mine?

Following the strategy outlined above, ATSDR reviewed the environmental data generated from environmental investigations conducted at Ely Copper Mine to identify past, current, or future public health hazards. The term *"exposure concerns"* is used to describe conditions and circumstances by which people could come into contact with contaminants. Appendix A contains further explanation of ATSDR's comparison values. Appendix B describes the methods ATSDR used in its evaluation of potential public health hazards. Appendix C contains a glossary of environmental health terms that are frequently used in ATSDR's PHAs.

About ATSDR's Comparison Values (CVs)

CVs are not thresholds for adverse health effects. ATSDR CVs represent contaminant concentrations many times lower than levels at which no effects were observed in experimental animals or human epidemiologic studies. If contaminant concentrations are above CVs, ATSDR further analyzes exposure variables (for example, duration and frequency of exposure), the toxicology of the contaminant, other epidemiology studies, and the weight of evidence for health effects. Some of the CVs used by ATSDR scientists include:

EMEGs — environmental media evaluation guides
RMEGs — reference dose media evaluation guides,
MCLs — EPA's maximum contaminant levels (MCLs).
LTHAs — EPA's lifetime health advisories

EMEGs and RMEGs are non-enforceable, health-based CVs developed by ATSDR for screening environmental contamination for further evaluation. **EPA's** MCLs are enforceable drinking water regulations developed to protect public health. LTHAs are drinking water screening values.

You can find out more about the ATSDR evaluation process by reading ATSDR's Public Health Assessment Guidance Manual at: http://www.atsdr.cdc.gov/HAC/phamanual/, or contacting ATSDR at 1-888-42ATSDR.

ATSDR identified potential exposure concerns associated with site-related contaminants at Ely Copper Mine requiring further evaluation:

- *Contaminated surface waters (including seeps) or sediments migrating off site, including potential contamination of private well water.*
- *Soil contaminated by former smelter emissions*
- *Consumption of fish downstream of site drainage*

There are several pathways that we did not evaluate further due to the assumed low frequency of exposure. The site is remote and on-site trespassing is occurring intermittently but not on a regular basis to the best of our knowledge. Although deer could graze on the site, there is minimal vegetation for their consumption, particularly in the most contaminated areas. Currently, there is minimal opportunity for people to contact contamination via these potential exposure pathways:

- *Off-gassing of hydrogen sulfide from the tailings*
- *Consumption of site berries by trespassers*
- *Consumption of wildlife (deer, etc.) exposed to site contaminants*

The surface waters of Schoolhouse Brook are not used for irrigation of crops. Although it is feasible that metals could increase in crops irrigated with these surface waters, we currently consider crops as a potential but unlikely pathway based on current use of the brook and future remediation of the site:

- *Food--Crops irrigated with surface water receiving drainage from the site*

Discussion

Characterization of the Issues and Data Analyses

Drainage from the mine tailings, waste piles, and seeps flows into Ely Brook, which runs north-south through the site. At the southern property boundary, it joins Schoolhouse Brook. Metals concentrations in surface water, in general, decrease from mine sites due to a number of physical, chemical, and biological mechanisms such as: increasing distance from the source, formation and dissolution of minerals containing metals, sorption of metals to surfaces of streambed material, uptake of metals by growing aquatic plants, geochemical conditions within the streambed and variations in stream flow (USGS 2003b). Data from many off-site pathways were evaluated because of off-site migration of contaminants.

A database for the site was provided to ATSDR in August 2008 and was used to update information for this final PHA. The database contained surface water, fish tissue, sediment, and macroinvertebrate data. Fish tissue and sediment data were evaluated and surface water analyses were updated. Macroinvertebrate data, which can be used to assess the environmental impact of drainage from the site, were not evaluated due to the lack of direct significance to human health.

Additionally, groundwater data (not in the database) were included from on-site samples taken in 2006 and 2007.

Mine Seeps and Leachate Tests of Mine Wastes

Acid mine drainage from Ely Copper Mine was characterized during spring runoff in 2002 (USGS & CRREL 2002). Results showed waters from the mine are highly acidic and highly contaminated with metals during spring runoff. Low pH surface water containing elevated levels of aluminum, copper, iron, manganese, and zinc and other metals is being discharged from Ely Copper Mine. During Spring 2002 runoff (April 2-3), contaminant loading at the mouth of Ely Brook primarily consisted of iron, aluminum, and copper (USGS & CRREL 2002).

Analysis of seeps on the site and emerging from mine wastes indicate low pH and significant leaching of metals (Table 1). Even with snowmelt and rainwater dilution, the pH of the seeps (samples ES-1 through ES-12) were generally less than 3.5 and occasionally less than 2.0; the pH remained below 5.5 during spring 2002 runoff. Water with pH levels below 4.3 have been shown to irritate skin and eyes and below 3.9 to corrode skin (Worth A. and M. Cronin 2001). Metals in the highest concentrations were aluminum, copper, and iron. Trace metals in the highest concentrations were copper, manganese, and zinc.

Leaching tests (Table 1) on Ely Mine waste samples were conducted with eastern synthetic precipitation (a solution that approximates eastern US precipitation). The results also show that significant concentrations of metals can be released from the wastes. The metals leached in the highest concentrations were aluminum, iron, copper, and zinc or cobalt (Table 1). The major anion (negatively charged ion) in the leachate is sulfate (USGS 2003a).

Table 1*: Leachate testing of mine wastes and analyses from on-site seeps

[Potential of site wastes to contribute selected metals (ppb) and acidity (pH) to surface water]

Metal or pH	Leachate 1 Maximum	Leachate 2 Maximum	On-site Seeps Maximum
Aluminum (Al)	3,800	19,000	>200,000
Cadmium (Cd)	7.8	1,200	42
Cobalt (Co)	700	13,000	1,600
Copper (Cu)	21,000	120,000	76,000
Iron (Fe)	52,000	66,000	170,000
Manganese (Mn)	310	940	5,700
Nickel (Ni)	190	3,000	380
Lead (Pb)	18	5.9	5
Zinc (Zn)	320	91,000	2,800
Sulfate (SO_4)	290,000	790,000	2,000
Hardness ($CaCO_3$)	Not measured	Not measured	559
Lowest pH	3.55	2.83	1.84

* This table was constructed to compare leachate testing of mine wastes to on-site seeps for metals; To the best of our knowledge, no one is drinking water on the mine site, particularly from seeps. Leachate testing was done using a solution that approximates eastern US precipitation.

Reported results are ICP-MS results from filtered samples.

Leachate 1 Source: USGS 2003

Leachate 2 Source: USGS 2004

Seeps Source: USGS & CRREL 2002; 16 analyses from Spring runoff

Surface Water and Sediment

Table 2 presents selected results of surface water sampling at Ely Copper Mine in 2002 during spring runoff. The pH of off-site waters in Schoolhouse Brook are all near neutral and correspondingly, the metals concentrations there are significantly lower as shown in Table 2. However, the on-site concentrations of metals in Ely Brook exceeded comparison values for drinking water (Table 2). The only metal exceeding comparison values downstream of the mine site, in Schoolhouse Brook, was copper at a maximum concentration of 300 ppb; it did not exceed its comparison value in filtered water at a maximum concentration of 66 ppb.

As part of the Remedial Investigation, many other surface water locations were sampled, including additional locations on Schoolhouse Brook. A review of the surface water data in the 2008 Ely Copper Mine database showed that locations at the mine site and in Schoolhouse Brook have elevated metals. Most of the maximum concentrations for metals in surface water are in the

Spring 2002 data. The maximum concentrations in the database for locations SB-2 and SB-3 are shown in Table 2 in parentheses. These data are maximum concentrations from 2002, the only year sampled for these locations. Copper exceeded its comparison value of 100 ppb in Schoolhouse Brook. The highest copper concentration recorded for Schoolhouse Brook (1100 ppb at location SB-3245 in 2006) was on-site, adjacent to the smelter waste pile. The second highest copper concentration, 378 ppb, in Schoolhouse Brook was downstream at SB-2. Copper, at a maximum of 378 ppb in March 2002, was again the only metal which exceeded its comparison value (100 ppb) for drinking water in Schoolhouse Brook, downstream of the mine site. EPA's action level for copper in drinking water is 1,300 ppb (Table 2). Based on these surface water data, no adverse health effects are anticipated if people drink water from Schoolhouse Brook, downstream of the mine site. Additional locations were sampled on Schoolhouse Brook and the Ompompanoosuc River in 2006 and 2007. To date, the Ompompanoosuc River remains minimally impacted by drainage from the mine site.

A review of the sediment data in the 2008 Ely Copper Mine database indicates that metals exceed comparison values (risk-based concentrations for non-cancerous effects) on-site (USGS 2008). Stream sediment records show there are twelve on-site locations (19 samples) where copper exceeded its comparison value of 3,100 ppm and twenty-three locations (54 samples) where iron exceeded its comparison value of 23,000 ppm. There was also one location, north of the mine site, on a tributary to the Ompompanoosuc River where iron exceeded this comparison value. The highest concentration of arsenic in sediment at the site was 12 ppm followed by 5 ppm. Arsenic in soil or sediment at 20 ppm is considered protective of public health. There is minimal risk of exposure by ingestion of these sediments at this remote site. Elevated metals in sediment will be addressed by EPA during their Remedial Investigation/Feasibility Study and Record of Decision for this site.

Table 2*: Unfiltered metals [ppb] in brooks receiving drainage from the Ely Copper Mine site: Ely Brook (EB), Schoolhouse Brook (SB), and the Ompompanoosuc River (OR)						
Metal or pH	Upstream Background	On-site Ely Brook	Downstream of mine site			Comparison Value for drinking water (ppb); source
	SB-1	EB 1-7**	SB-2	SB-3***	OR1	
Aluminum (Al)	730	34,000	1400 (2000)	700 (1200)	390	10,000; EMEG child
Cadmium (Cd)	0.02	17	0.51	0.29	<0.02	5; MCL 2; EMEG child
Cobalt (Co)	0.5	630	11 (13)	6.2	0.24	100; intermediate EMEG child
Copper (Cu)	2	15,000	300 (378)	170 (208)	0.7	100; intermediate EMEG child 1,300; EPA's MCL[1] action level
Iron (Fe)	700	71,000	1700 (2000)	800 (900)	360	None
Manganese (Mn)	59	3600	110 (129)	55 (72)	38	300; EPA's LTHA 500; RMEG child
Nickel (Ni)	0.83	140	3.6 (10)	2 (12)	0.65	100; EPA's LTHA 200; RMEG child
Lead (Pb)	0.82	2.7	1.1	0.65	0.5	15; MCL action level
Zinc (Zn)	20	2300	46 (80)	27 (48)	10	2000; LTHA 3000; EMEG child
Sulfate (SO_4)	9.8	760	30	25 (22)	11	None
Hardness ($CaCO_3$)	121,000	267,000	131,000	121,000 (119,326)	110,000	None
Lowest pH	6.55	2.50	6.20	6.87	6.34	7- neutral

** This table was constructed for screening purposes; To the best of our knowledge, no one is drinking water with these maximum concentrations. Additionally the filtered values for this data set did not exceed our CVs for these metals except in Ely Brook, where the filtered and unfiltered sample maximums were essentially the same.*

**Most maximums in Ely Brook (EB) were reported at EB3 and EB5, which drain the central waste pile
Source: CRREL &USGS 2002; reporting ICP-MS results except for Hardness
*** numbers in parentheses are maximums for 2002 from the 2008 USGS database. Locations SB-2 and SB-3 were sampled in 2002; no later analyses were conducted.
[1] U.S. Environmental Protection Agency's Maximum Contaminant Levels for drinking water

Groundwater

In 2006 and 2007, groundwater data were collected from sixteen monitoring wells and two other locations for EPA's Remedial Investigation. Water samples were collected from depths of a few feet to approximately 46 feet. Most of the samples were taken in or near mine tailings or waste piles and so contained elevated metal concentrations. On-site groundwater is not being used for drinking water. Dissolved metals that exceeded screening values for drinking water were aluminum, cadmium, cobalt, copper, manganese, molybdenum, nickel, and zinc. Manganese and copper were the metals found most often at elevated concentrations. The maximum concentrations of these metals were 4033 ppb manganese and 15, 100 ppb copper. Additionally, groundwater at some locations was acidic; the lowest pH recorded was 2.58. We do not anticipate that untreated groundwater with elevated metals will be used for drinking water at the site and suggest that deed restrictions be placed to prevent it.

Fish downstream of mine

Schoolhouse Brook (referred to in US EPA 2001a as Ely Brook) is designated by the State of Vermont as a Class B Water (high quality compatible with swimming and other recreational uses). Fish population and benthic community surveys of 2001 (fish population surveys were also conducted in 1988, 1997, and 2000) show that Ely/Schoolhouse Brook is impacted by mine drainage/runoff and fails Class B Vermont Water Quality Standards for biological integrity for benthic and fish communities. Water Quality above the mine met this classification. Portions of Schoolhouse Brook support fish (blacknose dace and some brook trout) and some fishing occurs there. Other portions of Schoolhouse Brook are marginally inhabitable for brook trout because of drainage from the mine site, which has degraded water quality and the aquatic biology (US EPA 2001a).

Fish Tissue Analyses

Fish can accumulate metals that are present in their environment. Fish were sampled downstream of the Ely Copper Mine site in September and October of 2001, September 2006, and September 2007. Fish were collected from five locations on Schoolhouse Brook and three locations on the Ompompanoosuc River. Fish tissue analyses for metals were conducted on Brook and Rainbow Trout, Blacknose and Longnose Dace, Longnose and White Sucker, and Slimy Sculpin (USGS 2008).

To evaluate the public health significance of the Ely Copper Mine fish tissue results, we used the maximum wet-weight fish tissue result for each metal shown in Table 3. We evaluated the dose that children might be exposed to if they consume an average amount of fish (conservative assumptions and parameters are listed in Table 3; ATSDR does not have site-specific consumption rates). Doses to adults with similar consumption rates would be less than those calculated for children. As presented in Table 3, no health-based screening levels were exceeded. Our analyses, along with the many benefits from eating fish, suggest that fish downstream of the mine site should not pose a health hazard based on metal content in their tissues.

Table 3: Fish Tissue Analysis and Estimated Exposure Doses for Children

Metal	Maximum Detected in Fish Tissue (mg/kg wet weight)	Estimated Exposure Dose (mg/kg/day) Child	Health-based Screening Level Chronic Oral (mg/kg/day)
Aluminum (Al)	26.5	0.02	1.0
Arsenic (As)	Below detection limit (DL) of 0.3	The dose at DL 0.0001	0.0003
Cadmium (Cd)	0.08	0.00005	0.001
Cobalt (Co)	0.11	0.00007	No Value
Copper (Cu)	7.9	0.005	0.04
Iron (Fe)	60.5	0.04	0.7
Manganese (Mn)	6.43	0.004	0.14
Mercury (Hg)**	0.026	0.00002	0.0003
Nickel (Ni)	0.2	0.0001	0.02
Lead (Pb)***	1.17	0.0008	No value
Selenium	0.7	0.0003	0.005
Zinc (Zn)	42.5	0.03	0.3

- *EPAs reference doses (Rfd) are the basis for the health-based screening levels.
- The highest actual wet weight recorded was used for the maximum concentration in fish tissue. A 31 kg body weight (average for a child five to twelve years of age) was used for a child consuming 20,100 mg/day of fish tissue at 100% bioavailability of the metal. Site-specific intake rates were not available so the nationwide average of the general population of 20,100 mg/day was used.
- ** The average mercury concentration in U.S. fish from pre-1990 measurements was 0.12 mg/kg wet weight (Schmitt and Brumbaugh 1990 in Kadlec and Knight 1996).
- ***The average lead concentration in U.S. fish from pre-1990 measurements was 0.19 mg/kg wet weight (Schmitt and Brumbaugh 1990 in Kadlec and Knight 1996).

Soil contamination from former smelter emissions

Winds tend to blow from the south in the summer and north in the winter (State of Vermont 1992). Particulate matter (consisting primarily of copper and iron oxides) and sulfur dioxide are the principal air contaminants emitted by primary copper smelters such as operated at the Ely Copper Mine site (State of Vermont 1992). However, the sulfuric acid mist may have contained arsenic, antimony, cadmium, lead, mercury, or zinc oxides as well. Although fugitive dusts contaminated with heavy metals could impact off-site soils, there are no inhabitants in the immediate vicinity of the site.

Summary and Evaluation of Potential Public Health Hazards

Trespassers on the site could come in contact with surface water. The low pH of on-site surface waters could cause skin and eye irritation on contact as well as skin corrosion. On-site surface water (Ely Brook and on-site seeps) and groundwater should not be used for drinking water due to low pH and elevated concentrations of metals. To the best of our knowledge, no one is using on-site surface water or groundwater for drinking water purposes.

Fish could accumulate metals from surface water or sediment coming from the mine site. Our fish tissue analyses indicated that eating fish caught in Schoolhouse Brook, downstream of the mine site, should not pose a health hazard based on metal content in their tissues.

ATSDR reviewed sampling data from adjacent streams and evaluated the potential for contaminants to migrate off-site at levels that could be harmful if people came in contact with them. Surface water or sediment in downstream areas does not contain hazardous levels of metals. Surface water is not being used as a drinking water source. Copper is the only metal exceeding ATSDR's comparison values in surface water downstream of the mine site. We evaluated copper further to determine whether adverse health effects might occur if someone were to use Schoolhouse Brook as drinking water. Based on surface water results, we conclude that no adverse health effects would be anticipated. The adjacent text box describes some criteria ATSDR uses for evaluating human exposure.

Evaluating Exposure

In assessing the potential for human exposure it is important to determine the following:

What are the source characteristics (e.g., media, contaminant concentration)?

How is the contamination distributed within the various media (e.g., location and extent of contamination)?

What are the transport pathways (physical and/or biological)?

What is the ultimate fate of the contaminants (i.e., where do the contaminants ultimately end up)?

If a completed exposure pathway is identified, what is the estimated individual exposure dose?

Copper

Copper, a trace mineral found in all body tissues, is essential to human life and good health. It assists in the formation of hemoglobin and red blood cells by facilitating iron absorption, thereby helping in the treatment of anemia. It is involved with protein metabolism and in healing processes. It is necessary for the production of RNA (ribonucleic acid), a carrier for genetic information. The Food and Nutrition Board of the Institute of Medicine has developed recommended dietary allowances (RDAs) for children aged 1-3 years (340 µg/day), 4-8 years (440 µg/day), 9-13 years (700 µg/day), and 14-18 years (890 µg/day). The RDA for adults is 900 µg/day (ATSDR 2004). *Based on a 378 ppb (ug/l) maximum for total copper (drinking water is usually filtered such that the concentration would be lower) in the Schoolhouse Brook, no adverse health effects are expected; The maximum estimated dose is below the lowest RDA of 340 µg/day for children 1-3 years old.*

Copper can be toxic at high concentrations. Copper toxicity rarely, if ever, occurs in human beings because in most people (genetically normal individuals) excretion would occur under conditions of dietary excess. An exception occurs if there is an inherited defect in the process that facilitates excretion such as in Wilson's disease (a rare genetic disorder that results from abnormal copper metabolism, bringing about excess copper retention in the liver, brain, kidney and corneas of the eyes (Selinus, Olle et al. 2005).

There do not appear to be any reports in the literature of teratogenesis (structural defects that affect the development) in human beings induced by excess copper. A very small percentage of infants and children are unusually sensitive to copper. Studies in animals suggest a decrease in fetal growth may occur if high levels of copper are ingested (ATSDR 2004).

If you drink water that contains elevated levels of copper, you may experience nausea, vomiting, stomach cramps, or diarrhea (ATSDR 2004). The EPA action level for copper in drinking water is 1.3 mg per liter of water (mg/l or ppm) (Table 2). Copper water pipes in a home may be a source of copper for the occupants. Copper levels in drinking water vary based on variations in pH, hardness of the water supply, and copper released from the water distribution system. The MRL for copper is 0.01 mg Cu/kg/day and is based on the NOAEL of 0.042 mg Cu/kg/day for gastrointestinal effects in women ingesting copper sulfate in drinking water for 2 months (ATSDR 2004). The gastrointestinal tract is the sensitive target of toxicity in humans. Manganese and zinc are effective in increasing copper excretion from the body. *Based on the maximum of 387 ppb copper for surface water in Schoolhouse Brook, the estimated adult dose (0.009* mg Cu/kg/day) *is about five times lower than this NOAEL.*

Community Health Concerns

There are several ways in which ATSDR may learn about specific concerns within the community. A resident may contact ATSDR directly and discuss specific issues that they are concerned about. Residents may also contact community leaders or state and/or local health agencies and they, in turn, may contact ATSDR and communicate these concerns. Another common way that ATSDR learns about community concerns at some sites is through public availability sessions coordinated by ATSDR or other public meetings that are attended by ATSDR representatives.

Two community concerns were identified by an ATSDR representative at an EPA public meeting on May 22, 2002: the potential for contamination of private wells from streams receiving acid mine drainage and soil contamination by former smelter emissions (ATSDR 2002b). US EPA is gathering data during the Remedial Investigation to address these concerns.

Community members and other interested parties had the opportunity to submit comments, questions, or concerns related to ATSDR's evaluation of Ely Copper Mine during a public comment period, March 3 through April 3, 2008. No comments were received from the public.

Child Health Considerations

ATSDR recognizes that infants and children may be more sensitive to exposures than adults in communities with contamination in water, soil, air, or food. In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. Children play outdoors and sometimes engage in hand-to-mouth behaviors that increase their exposure potential. Children are shorter than are adults; this means they breathe dust, soil, and vapors close to the ground. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health. ATSDR is committed to evaluating their special interests at sites such as Ely Copper Mine as part of the ATSDR Child Health Initiative.

According to the 2000 U.S. Census, there were 5 children aged 6 and younger within half a mile of the site and 18 children within one mile (Figure 1). Due to the remoteness of the site and the lack of completed exposure pathways of public health significance, *ATSDR concludes that site contamination does not pose unique health hazards for children; however, due to potential physical hazards, children should be discouraged from trespassing on the site.*

Conclusions

ATSDR does not consider the Ely Copper Mine Site to pose a public health hazard based on the surface water and sediment pathway downstream of the mine site. We categorize the off-site surface water and sediment pathway as No Apparent Public Health Hazard. Contaminated surface waters of Schoolhouse Brook and the Ompompanoosuc River, downstream of the site, are not used as drinking water sources (no intakes) or for irrigation of crops. To date, the Ompompanoosuc River remains minimally impacted by drainage from the mine site.

There are on-site physical hazards which should be addressed because of trespassers. The acidity of on-site surface waters could cause skin and eye irritation on contact as well as skin corrosion. On-site surface water (Ely Brook and on-site seeps) and groundwater should not be used for drinking water due to acidity and elevated concentrations of metals. To the best of our knowledge, no one is using on-site surface water for drinking water purposes.

Based on surface water data, metals in Schoolhouse Brook are not at levels of concern if this surface water were to be used for drinking water. Metal concentrations are likely to be reduced downstream through dilution, sorption, and precipitation. Therefore any wells with a surface water connection should not have drinking water levels that are harmful to human health. Additionally, metals in sediment of Schoolhouse Brook do not pose a health hazard.

Leachate results of unoxidized flotation mill tailings in the central waste pile indicate this waste material has the greatest potential to contribute metals to surface water. Off-site surface water quality is most degraded immediately downstream of site drainage.

Our analyses, along with the many benefits from eating fish, suggest that fish downstream of the mine site should not pose a health hazard based on metal analyses of fish tissue.

Although groundwater from the mine site has the potential to contaminate private wells, most private wells, such as those in West Fairlee, are a considerable distance from the site and are unlikely to be impacted.

Recommendations

EPA should consider marking the entrance to the property and the mine adit for “No Trespassing”. A warning sign near vertical shafts or other potential hazards is recommended. Additionally, site access and trespassing should be discouraged.

EPA or other agency should consider sampling off-site to determine if soil is contaminated from former smelter emissions.

EPA/USGS/USACE or other agency should sample private wells because they have the potential to be impacted by contaminated groundwater or surface water from the site. Based on surface water results, we recommend sampling any private wells near Schoolhouse Brook downstream of the mine.

As a prudent public health measure, EPA should consider placing deed restrictions on the property to prevent on-site exposures to metals in mining wastes, surface water, and groundwater.

EPA should consider priority remediation of the unoxidized flotation mill tailings in the central waste pile to protect human health and the environment.

If future data become available which indicate the potential for adverse human health effects based on contamination coming from Ely Copper Mine, ATSDR will consider conducting further evaluations.

Public Health Action Plan

The Public Health Action Plan (PHAP) for Ely Copper Mine contains a description of actions taken and to be taken by ATSDR, EPA, and other state or local agencies subsequent to the completion of this PHA. The purpose of the PHAP is to ensure that this PHA not only identifies potential and ongoing public health hazards, but also provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. The public health actions that are completed, ongoing or planned, and recommended are listed below.

Completed Actions

The site has been characterized through chemical analyses of site wastes, seeps, sediment, surface water, and groundwater. Additionally, most of the relevant pathways have also been considered off-site except for groundwater (potential private well contamination) and soil contaminated by former smelter emissions.

The entry gate to the site has been repaired.

Ongoing and Planned Actions

EPA is collecting data for the remedial investigation; a record of decision is anticipated in 2009. Site remediation has not occurred.

EPA plans to conduct a private well survey and evaluate whether or not any private wells have been impacted by surface water or groundwater drainage from the site.

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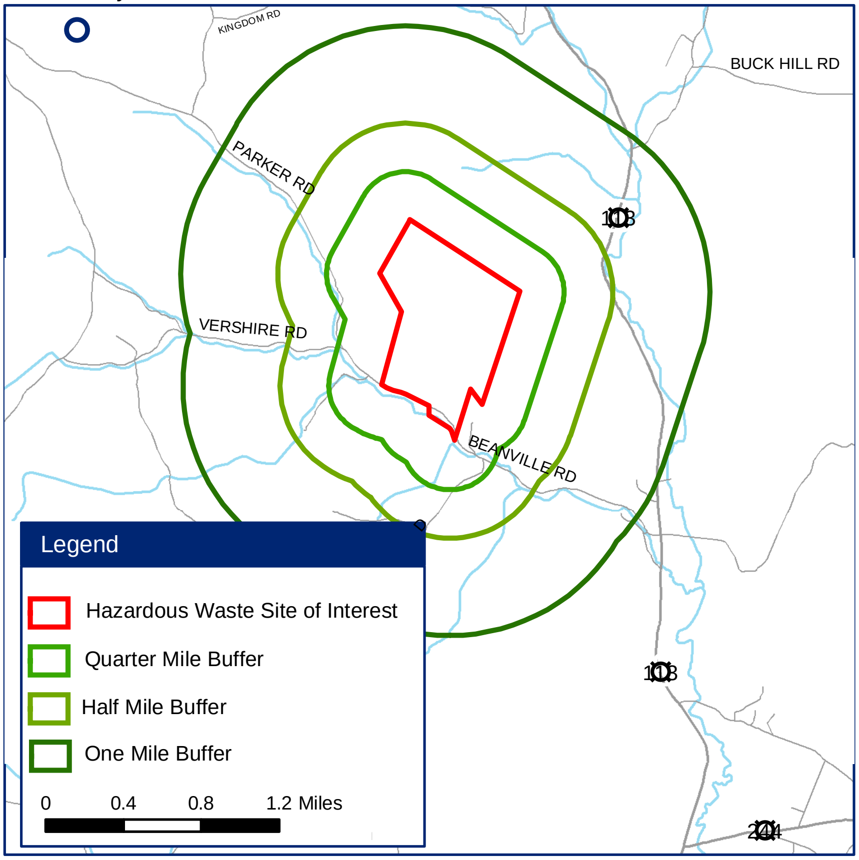
FIGURES

Ely Copper Mine
Vershire, VT

EPA Facility ID: VTD988366571



Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program,
Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane Vermont FIPS 4400 Feet

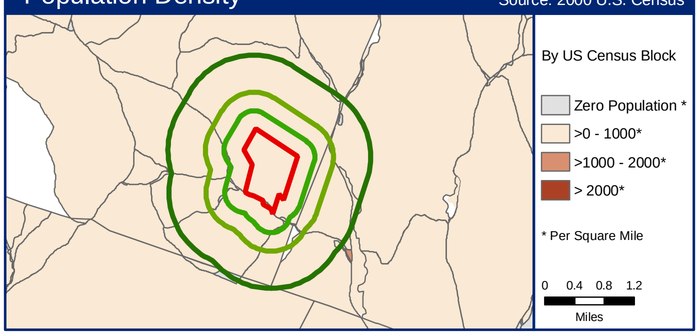
Site Location: Orange County, VT

Demographic Statistics
Within Area of Concern

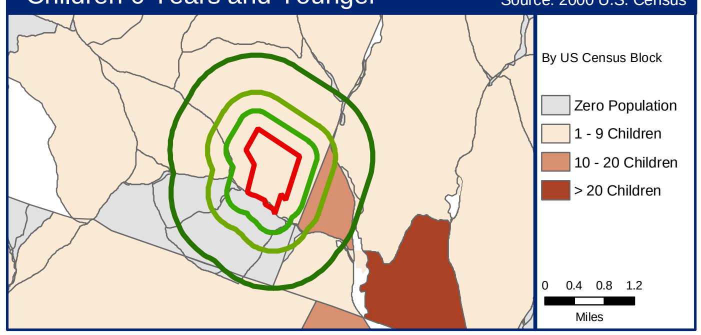
	.25mi	.5mi	1mi
Total Population	22	74	239
White Alone	21	72	235
Black Alone	0	0	1
Am. Indian & AK Native Alone	0	0	0
Asian Alone	1	1	2
Native Hawaiian & Other Pacific Islander Alone	0	0	0
Some Other Race Alone	0	0	0
Two or More Races	0	0	1
Hispanic or Latino**	0	0	0
Children Aged 6& Younger	1	5	18
Adults Aged 65 & Older	3	7	20
Females Aged 15 to 44	4	16	51
Total Housing Units	12	35	111

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

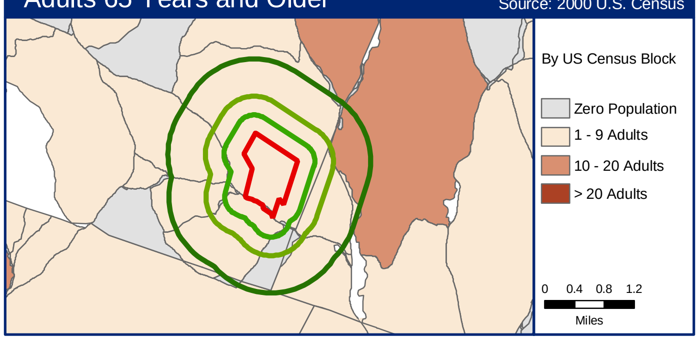
Population Density
Source: 2000 U.S. Census



Children 6 Years and Younger
Source: 2000 U.S. Census



Adults 65 Years and Older
Source: 2000 U.S. Census



Females Aged 15 to 44
Source: 2000 U.S. Census

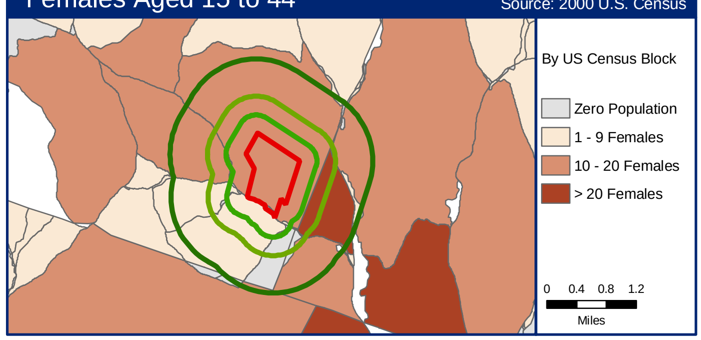


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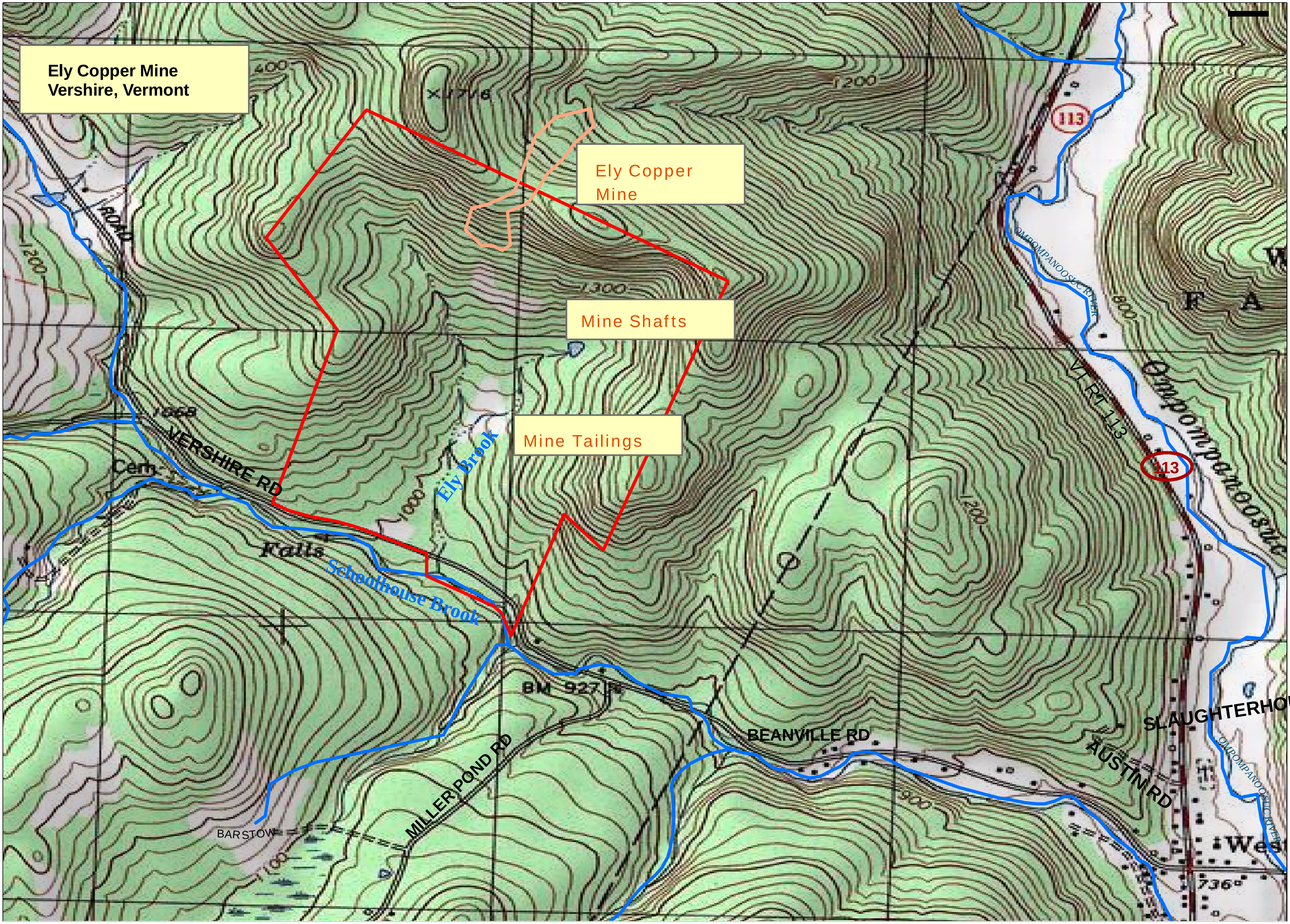
Figure 1



Source: USGS Topographic - National Geographic Society Topo!

0 0.125 0.25 0.5 0.75 1 Miles

JVA012307

Figure 2

GRASP
GEOSPATIAL RESEARCH, ANALYSIS & SERVICES PROGRAM

Figure 3. Photos from Site Visit on May 22, 2002.

Property Sale Sign on Waste Pile

On-site Red/Brown Run-off

Erosion through Mine Waste

Smelter Slag South of Beanville Road

Schoolhouse (Ely) Brook Looking East

No Hunting Sign
by Ely Mine Hunting Club

Figure 4: ATSDR's Exposure Evaluation Process

REMEMBER: For a public health threat to exist, the following three conditions must all be met:

- Contaminants must exist in the environment
- People must come into contact with areas that have potential contamination
- The amount of contamination must be sufficient to affect people's health

Are the Environmental Media Contaminated? → **Are People Exposed To Areas With Potentially Contaminated Media?** → **For Each Completed Exposure Pathway, Will the Contamination Affect Public Health?**

Are the Environmental Media Contaminated?

ATSDR considers:

Soil
Ground water
Surface water and sediment
Air
Food sources

Are People Exposed To Areas With Potentially Contaminated Media?

For exposure to occur, contaminants must be in locations where people can contact them.

People may contact contaminants by any of the following three exposure routes:

Inhalation
Ingestion
Dermal absorption

For Each Completed Exposure Pathway, Will the Contamination Affect Public Health?

ATSDR will evaluate existing data on contaminant concentration and exposure duration and frequency.

ATSDR will also consider individual characteristics (such as age, gender, and lifestyle) of the exposed population that may influence the public health effects of contamination.

APPENDICES

Appendix A. List of Comparison Values Used by ATSDR

Comparison Values

ATSDR comparison values are media-specific concentrations that are considered to be safe under default conditions of exposure. They are used as screening values in the preliminary identification of site-specific “contaminants of concern.” The latter term should not be misinterpreted as an implication of “hazard.” As ATSDR uses the phrase, a “contaminant of concern” is a chemical substance detected at the site in question and selected by the ATSDR scientist for further evaluation of potential health effects. Generally, a chemical is selected as a “contaminant of concern” because its maximum concentration in air, water, or soil at the site exceeds one of ATSDR's comparison values.

Nevertheless, it must be emphasized that comparison values are not thresholds of toxicity. Although concentrations at or below the relevant comparison values could reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. The principal purpose behind conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health hazards before they become actual public health consequences. Thus comparison values are designed to be preventive—rather than predictive—of adverse health effects. The probability that such effects will actually occur does not depend on environmental concentrations alone, but on a unique combination of site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure.

Listed and described below are the various comparison values that ATSDR uses to select chemicals for further evaluation, as well as other non-ATSDR values that are sometimes used to put environmental concentrations into perspective.

CREG	=	Cancer Risk Evaluation Guide
MRL	=	Minimal Risk Level
EMEG	=	Environmental Media Evaluation Guide
IEMEG	=	Intermediate Environmental Media Evaluation Guide
RMEG	=	Reference Dose Media Evaluation Guide
RfD	=	Reference Dose
RfC	=	Reference Dose Concentration
RBC	=	Risk-Based Concentration
MCL	=	Maximum Contaminant Level
LTHA	=	Lifetime Health Advisory

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations expected to cause no more than one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors, or cancer potency factors, using default values for exposure rates. That said, however, neither CREGs nor cancer slope factors can be used to make realistic predictions of cancer risk. The true risk is always unknown and could be as low as zero.

Minimal Risk Levels (MRL) are estimates of daily human exposure to a chemical (doses expressed in mg/kg/day) that are unlikely to be associated with any appreciable risk of deleterious non-cancer effects over a specified duration of exposure. MRLs are calculated using data from human and animal studies and are reported for acute (those occurring for 14 days or less), intermediate (those occurring for more than 14 days and less than 1 year [15-364] days), and chronic (those occurring for one year [365 days] or greater) exposures. MRLs for specific chemicals are published in ATSDR toxicological profiles.

Environmental Media Evaluation Guides (EMEGs) are concentrations that are calculated from ATSDR minimal risk levels by factoring in default body weights and ingestion rates.

They factor in body weight and ingestion rates for acute exposures (Acute EMEGs — those occurring for 14 days or less), for intermediate exposures (Intermediate EMEGs — those occurring for more than 14 days and less than 1 year), and for chronic exposures (Chronic EMEGs — those occurring for one year [365 days] or greater).

Lifetime Health Advisory is an EPA value used for drinking water.

Reference Dose Media Evaluation Guides (RMEGs) represent the concentration of a contaminant in air, water, or soil that corresponds to EPA's RfD for that contaminant when default values for body weight and intake rates are taken into account.

Reference Dose (RfD) is an estimate of the daily exposure to a contaminant unlikely to cause noncarcinogenic adverse health effects. Like ATSDR's MRL, EPA's RfD is a dose expressed in mg/kg/day.

Reference Concentrations (RfC) is a concentration of a substance in air that EPA considers unlikely to cause noncancer adverse health effects over a lifetime of chronic exposure.

Risk-Based Concentrations (RBC) are media-specific concentrations derived by Region III of the Environmental Protection Agency from RfDs, RfCs, or EPA’s cancer slope factors. They represent concentrations of a contaminant in tap water, ambient air, fish, or soil (industrial or residential) that are considered unlikely to cause adverse health effects over a lifetime of chronic exposure. RBCs are based either on cancer or non-cancer effects.

Maximum Contaminant Levels (MCLs) represent contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day.

More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/phamanual/. A hard copy can be obtained by contacting the ATSDR information line toll-free at (888) 422-8737.

Appendix B. ATSDR's Methods

Contaminant Data Evaluation

In public health assessments, ATSDR addresses the likelihood that exposure to contaminants, using the maximum or average concentrations detected, would result in adverse health effects. While the relative toxicity of a chemical is important, the response of the human body to a chemical exposure is determined by several additional factors, including the concentration (how much), the duration of exposure (how long), and the route of exposure (breathing, eating, drinking, or skin contact). Lifestyle factors (i.e., occupation and personal habits) also have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any adverse health effects the individual could suffer as a result of the chemical exposure.

ATSDR has determined levels of chemicals that can reasonably (and conservatively) be regarded as harmless, based on the scientific data the agency has collected in its toxicological profiles. The resulting comparison values and health guidelines, which include ample safety factors to ensure protection of sensitive populations, are used to screen contaminant concentrations at a site and to select substances ("chemicals of concern") that agency environmental health scientists and toxicologists scrutinize more closely.

It is a point of key importance that ATSDR's (as well as state and federal regulatory agency) comparison values, screening numbers and health guidelines define very conservative and protective levels of environmental contamination and are not thresholds of toxicity. This means that although concentrations at or below a comparison value could reasonably be considered safe, it does not automatically follow that any concentration above a comparison value will necessarily produce toxic effects. To the contrary, ATSDR's comparison values are intentionally designed to be much lower, usually by at least two or three orders of magnitude, than the corresponding no-effect levels (or lowest-effect levels) determined from scientific studies. ATSDR uses comparison values (regardless of source) solely for the purpose of screening individual contaminants. In this highly conservative procedure, ATSDR may decide that a compound warrants further evaluation if the highest single recorded concentration of that contaminant in the medium in question exceeds that compound's lowest available comparison value (e.g., cancer risk evaluation guides or other chronic exposure values) for the most sensitive, potentially exposed individuals (e.g., children or pica children). This conservative process results in the selection of many contaminants as "chemicals of concern" that will not, upon closer scrutiny, be judged to pose any hazard to human health. Still, ATSDR judges it prudent to use a screen that "lets through" many harmless contaminants rather than one that overlooks even a single potential hazard to public health. Even those contaminants of concern that are ultimately labeled in the toxicologic evaluation as potential public health hazards are so identified solely on the basis of the maximum concentration detected. The reader should keep in mind the protective nature of this approach when considering the potential health implications of ATSDR's evaluations.

Because a contaminant must first enter the body before it can produce any effect on the body, adverse or otherwise, the toxicologic discussion in public health assessments focuses primarily on completed pathways of exposure, i.e., contaminants in media to which people are known to have been, or are reasonably expected to have been, exposed. Examples are water that could be used for drinking, and air in the breathing zone.

To determine whether people were, or continue to be, exposed to contaminants originating from a site, ATSDR evaluates the factors that lead to human exposure. These factors or elements include (1) a source of contamination, (2) transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) an exposed population. Exposure pathways fall into one of three categories:

- *Completed Exposure Pathway*. ATSDR calls a pathway "complete" if it is certain that people are exposed to contaminated media. Completed pathways require that the five elements exist and indicate that exposure to the contaminant has occurred, is occurring, or will occur.

- *Potential Exposure Pathway*. Potential pathways are those in which at least one of the five elements is missing but could exist. Potential pathways indicate that exposure to a contaminant could have occurred, could be occurring, or could occur in the future. Potential exposure pathways refer to those pathways where (1) exposure is documented, but there is not enough information available to determine whether the environmental medium is contaminated, or (2) an environmental medium has been documented as contaminated, but it is unknown whether people have been, or could be, exposed to the medium.

- *Eliminated Exposure Pathway*. In an eliminated exposure pathway, at least one of the five elements is missing and will never be present. From a human health perspective, pathways can be eliminated from further consideration if ATSDR is able to show that (1) an environmental medium is not contaminated, or (2) no one is exposed to contaminated media.

Appendix C. Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency in Atlanta, Georgia, with 10 regional offices in the United States. ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases from 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 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. For additional 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 an 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.

Bioavailability
The degree to which chemicals can be taken up by organisms

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 occur 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 [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. The Superfund Amendments and Reauthorization Act (SARA) later amended this law.
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 an 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 [see Public health surveillance].
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 followup 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 (t½)
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 evaluate 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, a condition, or an 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.
National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

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 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 comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.
Public health action
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 health 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.
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 an 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 [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]
Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (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 public health 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 Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

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