ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

EUREKA MILLS
EUREKA CITY, JUAB COUNTY, UTAH
EPA FACILITY ID: UT0002240158
APRIL 5, 2005

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

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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PUBLIC HEALTH ASSESSMENT

EUREKA MILLS
EUREKA CITY, JUAB COUNTY, UTAH

EPA FACILITY ID: UT0002240158

Prepared by:

The Utah Department of Health
Environmental Epidemiology Program
Office of Epidemiology
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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SUMMARY

The Eureka Mills site is located in Eureka City, Juab County, Utah, approximately 70 miles south of Salt Lake City. The mining and limited milling activities conducted in this area between 1870 and 1965 resulted in elevated levels of metals in the soil. Much of the impacted area is residential. The Agency for Toxic Substances and Disease Registry (ATSDR) has requested that the Environmental Epidemiology Program (EEP) of the Utah Department of Health conduct this Public Health Assessment to identify public health hazards posed by former mining and milling activities in the Eureka City area. The site is currently a public health hazard[1] (Category B).

Interest in the Eureka Mills site began in July 2000, when the Utah Department of Environmental Quality (UDEQ) discovered elevated levels of metals in residential soil. Subsequent sampling programs by UDEQ and the United States Environmental Protection Agency (EPA) have found levels as high as 25,000 parts per million (ppm) lead in residential areas (background is approximately 150 ppm lead) and 51,000 ppm lead in the non-residential areas that surround Eureka City. In addition to lead, elevated levels of antimony, arsenic, cadmium, iron, manganese, mercury, thallium, vanadium, and zinc were also discovered.

EPA and UDEQ have identified remediation goals of 231 ppm lead in soil from residential areas and 735 ppm lead in soil from non-residential areas. Cleanup of lead to these levels is based on EPA's Baseline Human Health Risk Assessment for this site and is expected to remove the hazards posed by the other metals as well. EEP concurs with these cleanup levels.

After the discovery of elevated lead in residential soils in Eureka City, an ATSDR Exposure Investigation was conducted. Beginning in August 2000 and ending in September 2001, the investigation followed the Centers for Disease Control and Prevention's blood lead testing protocol and concluded that children living in Eureka City are 10 times more likely to have elevated blood lead levels than other Utah children. Prevalence of elevated blood lead levels was high for both young children and teenagers.

In cooperation with Central Utah Public Health Department (CUPHD), EEP continues to hold quarterly blood lead testing sessions in Eureka. A slight decrease has been observed in the percentage of elevated blood lead levels in Eureka children since testing began in 2000. At each testing session, EEP provides activities, incentives, and educational materials to all participants and family members. Guardians of children who are tested receive notification letters of the blood lead test result. When a child's result is above 10 micrograms lead per deciliter of blood (µg/dL), follow-up action is necessary. This follow-up action has consisted of a phone call made to the child's parent or guardian, educational pamphlets mailed to the child's address, and if applicable, notification is made to the child's physician. Children with elevated blood lead levels are encouraged to attend future blood lead testing sessions by personal letters and invitations notifying them of the next blood lead testing session.

[1] ATSDR Public Health Category B: Exposures that can adversely impact public health over time.

People can be exposed to lead and other metals in the soil by accidentally ingesting small amounts of soil. Adults may ingest soil or dust particles that adhere to food or to their hands. Exposure dose estimates for adults living in Eureka City who accidentally ingest small amounts of dust and soil are well within the health guidelines, with the exception of the guideline for thallium. The adult exposure dose for thallium ingestion was slightly higher than the health guideline. Adverse health effects at such a low dose are unlikely, but are discussed in this document.

People can also be exposed to lead and other metals in the soil by inhaling small amounts of dust and soil. Adult exposures to airborne contaminants have not been measured, but personal air monitoring of children living in Eureka suggests that off-road vehicle use and all-terrain vehicle (ATV) recreation could result in inhalation exposures to lead.

The natural behavioral patterns of children (i.e., mouthing of hands and toys) make them more likely to be exposed to soil and dust contaminants than adults. Exposure dose estimates for children living in Eureka City exceed health guidelines for arsenic, lead, and thallium. Furthermore, children who exhibit pica behavior (intentional ingestion of non-food items) may be exposed to harmful levels of antimony, arsenic, cadmium, iron, lead, manganese, mercury, thallium, vanadium, and zinc. Potential adverse health effects are further discussed in this document.

Heavy metals have also been detected in residential basement soil, tap water, and lead-based paint. These media were determined to be inconsistent sources of metal exposure in the Eureka City area and were excluded from exposure dose estimates. Basement soil was sampled in only seven homes in Eureka; it is unknown how many homes actually have basement soil. Although this sample size is not representative of all homes in Eureka City, it does suggest that a potential pathway exists for ingestion or inhalation of these metals present in basement soils. Contamination in tap water and lead-based paint is not associated with the Eureka Mills site.

In 2002, the EPA and UDEQ completed an emergency response cleanup of several residential areas. Cleanup efforts have continued since then, however, due to funding shortages, the timeliness of the project has been delayed. It is projected that cleanup efforts will continue for at least another 4 years. Cleanup activities conducted during 2004 have included remediation of the Gemini, Mayday, Godiva, and Chief #2 mine waste piles, including an ATV trail in Eureka Gulch; soil cleanup in five residential yards and portions of several others; construction of sediment ponds; and grading and capping of portions of the Chief #1 mine.

To help prevent lead poisoning and to protect the health of Eureka residents, EEP recommends the following:

- Children under the age of 18 years should be tested annually for lead, even if they seem healthy. Pregnant women living in Eureka should also have their blood tested. Blood lead tests are recommended both during and after cleanup.
- EEP and CUPHD should continue to hold free quarterly blood lead testing sessions in Eureka and encourage children under the age of 18 and pregnant women to be tested.
- The Utah Blood Lead Registry should continue to be monitored for children in the Eureka area with elevated blood lead levels to ensure adequate follow-up and case management.

- Follow-up activities should be conducted immediately upon identification of a child with an elevated blood lead level. The activities should include phone calls to parents or guardians, educational materials, letters, and invitations to upcoming blood lead testing sessions.
- Residents should reduce potential exposure to contaminated soil and dust by washing hands often, eating healthful foods high in iron and calcium (these nutrients make it more difficult for the body to absorb lead), keeping homes clean and free of soil and dust by methods such as damp dusting surfaces and wet-mopping floors, removing shoes before entering homes, and limiting time spent on dirt roads or trails that have not been cleaned up.
- Children and pregnant women should limit the time they spend participating in off-road recreation such as the use of ATVs, dune buggies, dirt bikes, and other off-road vehicles, until contaminated dirt has been removed or replaced.
- Residents with contaminated basement soil should consider having basement soil professionally removed or place a dust protective type of barrier over the soil to eliminate potential exposure.
- Residents with an elevated level of copper in their tap water will be encouraged to have their tap water resampled and to identify and remove the source of contamination.
- Residents with lead-based paint should reduce their risk of lead exposure by keeping their homes clean and free of dust and paint chips. Residents should not remove lead-based paint. A person with special training in correcting lead-based paint problems should be hired to remove the paint safely with proper equipment.
- Residents with gardens should wait to plant until their property has been completely remediated, and should always wash or peel fruits and vegetables thoroughly before eating.
- Cleanup efforts in Eureka City should continue in a way that is protective of human health. Dust suppression and air monitoring should take place during cleanup activities to ensure minimal impact on the public from airborne dust.
- EPA and UDEQ should consider replacing or removing dirt on trails that children hike, bike or drive off-road vehicles on.
- EEP, CUPHD, UDEQ, and EPA should continue community involvement and education to assess and respond to community information needs.
- EEP should continue efforts to provide educational activities to elementary students on the hazards of lead, method of prevention, and the importance of blood lead testing.

EEP's Public Health Action Plan is designed to mitigate and prevent adverse human health effects resulting from exposure to metals in Eureka City due to former mining activities. The Public Health Action Plan consists of the following actions:

- EEP, in coordination with CUPHD, will continue to provide blood lead testing for children under the age of 18 and pregnant women living in Eureka City. During the blood lead testing, copies of this health assessment and other educational information will be available.
- EEP and CUPHD will continue to encourage children under the age of 18 and pregnant women living in Eureka to attend the quarterly blood lead testing sessions. Fliers and posters notifying resident of upcoming sessions will continue to be distributed to all post office boxes in Eureka and placed at local businesses. Activities will be offered to those attending and incentives given to children who are tested.

- EEP will continue to monitor the Utah Blood Lead Registry for children with elevated blood lead levels (EBLLs) in areas near the site to ensure adequate case management and environmental follow-up.
- EEP and CUPHD will continue follow-up activities for children with EBLLs by placing phone calls to parents or guardians, providing educational materials, and sending letters and invitations to upcoming blood lead testing sessions. In the future, EEP will conduct one-on-one meetings with the guardians of children with EBLLs in which they could discuss the child's health, blood lead test results, and steps that could be taken to decrease the child's blood lead level. EEP will also create a binder for guardians of children with EBLLs that will include the child's blood lead testing history and all available educational pamphlets on blood lead poisoning prevention.
- EEP has provided and will continue to provide Eureka residents with educational materials, such as pamphlets, calendars, growth charts, videos, cassette tapes, brochures and/or fliers, directed at reducing potential exposure to lead.
- EEP will propose to the residents with contaminated basement soil to consider placing a dust barrier (e.g., tarp, concrete) to eliminate potential exposures, primarily to children. This information will be provided to residents in the form of a newsletter and a brief article in the local newspaper. EEP will also provide homeowners with educational resources directed at reducing exposure to contaminated soil.
- Although tap water contamination is unrelated to the site, EEP will work with UDEQ and EPA to identify the home with the elevated level of copper and provide educational material to the residents regarding the potential hazards associated with ingestion of contaminated tap water. Residents will be encouraged to have their water re-sampled, and to identify and remove sources of contamination.
- EEP has provided and will continue to provide educational materials to residents regarding the hazards of lead-based paint and will encourage them to keep their homes clean and free of dust and paint chips.
- EEP will propose that residents cease gardening until their property has been completely remediated. If residents choose to garden, then the EEP recommends that fruits and vegetable be thoroughly washed or peeled before eating. This information will be provided to residents in the form of a newsletter and a brief article in the local newspaper.
- EPA and UDEQ will continue with the cleanup efforts in Eureka City in a way that is protective of human health.
- EPA and UDEQ have considered the removal of dirt on several trails in the area to eliminate the health hazards posed by the soil and selected areas have been remediated.
- EEP, in coordination with CUPHD, UDEQ, and EPA, have and will continue to collect and respond to community concerns and information needs. EEP held an open house on December 11, 2002, for the release of the public health assessment for public comment, and has participated in numerous public meetings held by EPA and UDEQ. EEP has also attended several town meetings in which comments and concerns were collected from community members.

- EEP will continue their attempt to provide educational activities to elementary students on the hazards of lead exposure, methods of prevention, and the importance of blood lead testing. In 2001, EEP gave four presentations to school aged children in Eureka and provided information to teachers so that a lead poisoning prevention curriculum could be implemented at the schools. During the 2003-2004 school year, EEP' s health educator further established the lead poisoning prevention curriculum by teaching twice a month at the Eureka Elementary School.

PURPOSE AND HEALTH ISSUES

This Public Health Assessment is conducted under the authorities of the Comprehensive Environmental Response Compensation and Liability Act of 1980 and the Superfund Amendments and Reauthorization Act of 1986. This document was prepared by the Utah Department of Health's (UDOH) Environmental Epidemiology Program (EEP) under a Cooperative Agreement with the Agency for Toxic Substances and Disease Registry (ATSDR).

The mission of ATSDR is to serve the public by applying the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and disease(s) related to toxic substances. ATSDR has requested that the EEP conduct this public health assessment to identify public health hazards posed by former milling and mining activities in Eureka City and the surrounding area. The public health assessment process serves as a mechanism to help ATSDR and state health departments determine where public health actions should be addressed and for whom.

The Eureka Mills site was proposed for the National Priorities List (NPL) on June 14, 2001. The purpose of this public health assessment is to identify possible harmful exposures associated with the Eureka Mills site and to recommend actions needed to protect public health. In addition, public health concerns are collected, documented, and when possible, addressed.

BACKGROUND

Site Description and History

The Eureka Mills site is located in Eureka City, Juab County, Utah (Figures 1, 2, and 3). Eureka City was a gold and silver mining area in central Utah and the financial center for Tintic Mining District. Eureka City was established as a city in 1892. In 1979, Eureka City was placed on the National Register of Historic Places as part of the Tintic Mining District Multiple Resource Area, recognizing the importance of the remaining buildings and sites (Notarianni 2001).

Mining and limited milling took place in and near Eureka City from 1870 to1965. The former mining sites are along the southern and western boundary of Eureka City, and many are adjacent to residential areas. Apparently, the mining waste contaminated many residential yards in Eureka City. Contaminants associated with mining waste include metals such as antimony, arsenic, cadmium, chromium, copper, iron, lead, mercury, thallium, silver, and zinc. Children play in the yards where elevated lead levels in soil have been found. Older children and adults reportedly ride their bicycles and all-terrain vehicles (ATVs) near the former mining sites.

Interest in the Eureka Mills site began in July 2000, when the Utah Department of Environmental Quality (UDEQ) discovered elevated levels of metals in residential soil. Subsequent sampling programs by UDEQ and the United States Environmental Protection Agency (EPA) have found levels as high as 25,000 parts per million (ppm) lead in residential areas (background is

approximately 150 ppm lead) and 51,000 ppm lead in the non-residential areas that surround Eureka City. In addition to lead, elevated levels of antimony, arsenic, cadmium, iron, manganese, mercury, thallium, vanadium, and zinc were also discovered.

During EPA's Removal Preliminary Assessment (between August and November of 2000), 642 access consent forms were distributed to allow EPA or authorized representatives of EPA access to sample on residential and commercial soil in Eureka. Of this total, 570 property owners granted consent, 31 denied access, and 41 property owners could not be contacted or were undecided. For the interim sampling in 2001, an additional 23 consent forms were obtained from property owners (WGI 2002b).

In 2002, EPA and UDEQ completed an emergency response cleanup of the residential areas (WGI 2002a,b). Since then, due to funding shortages, cleanup efforts have been limited and the timeliness of the project has been delayed. Cleanup activities conducted during 2004 have included remediation of the Gemini, Mayday, Godiva, and Chief #2 mine waste piles, including an ATV trail in Eureka Gulch; soil cleanup in five residential yards and portions of several others; construction of sediment ponds; and grading and capping of portions of the Chief #1 mine (EEP 2004c).

Demographics and Land Use

The current population of Eureka City is 767 (Figure 3). Of these, 91 are children ages 6 and younger (Figure 3). A comparison of 1990 and 2000 Census data shows that the population of Eureka City is growing and getting younger. In 1990, the population of Eureka City was 562; by the year 2000, the population had grown to 766. The 2000 Census reported 70 children under the age of 5 years, up from 40 reported in 1990. The median age reported in 1990 was 36.1 years, and the median age reported in 2000 was 30.5 years (USCB 1990, 2000).

According to the 1990 Census, the number of available housing units in Eureka City was 326, with 211 of these units being occupied. The 2000 Census reported 342 available housing units in Eureka City, with 271 of these units being occupied. The 2000 Census also reports that the majority (approximately 98%) of the residents of Eureka City identified themselves as being white. The remaining 2% self-reported as being American Indian, Alaska Native, Asian, Native Hawaiian or Pacific Islander, some other race, and/or two or more races. Only 2.6% of the population reported being of Hispanic or Latino origin.

DISCUSSION

To permit a better understanding of the public health hazards posed by past milling and mining activities in the Eureka City area, this section of the public health assessment includes a review of biomonitoring and environmental data, a look at exposure pathways, and a discussion of public health implications.

Biomonitoring Data

The purpose of biomonitoring is to measure current exposure to determine if immediate intervention is necessary. Initial blood lead testing in the Eureka City area indicated that exposure to lead is occurring. EPA and UDEQ began intervention with the emergency response cleanup of the residential areas in 2002 (WGI 2002a,b). In 2004, soils in five residential yards and portions of several others were remediated.

Blood Lead Testing in Eureka City

EEP, in cooperation with Central Utah Public Health Department (CUPHD), began holding free quarterly blood lead testing sessions in 2000 and will continue to do so through 2006. In August 2000, EEP requested and received Exposure Investigation funds from ATSDR and, along with CUPHD, offered free blood lead testing to the residents. EEP and CUPHD followed the blood lead testing protocol developed by the Centers for Disease Control and Prevention (CDC). The CDC has determined that blood lead levels greater than 10 µg/dL (micrograms of lead per deciliter of blood) could cause adverse health effects (CDC 1997).

Over the past 4 years, the percentage of elevated blood lead levels in Eureka City has been consistently higher than the percentage in the state of Utah, according to the Utah Blood Lead Registry. However, a slight decrease has been observed in the percentage of elevated blood lead levels in Eureka children since testing began in 2000.

In 2000, 209 Eureka residents were screened for elevated blood lead levels. Twenty-two percent of the children ages 0–72 months revealed elevated blood lead levels greater than 10 µg/dL, as compared to the 2000 state's percentage of 1.7% for the same age group. Of the children ages 6–17 years, 16.0% had elevated blood lead levels as compared to the state's 4.2% for the same age group (Table 1). Of the adults who were tested, 2% had elevated blood lead levels. A blood lead risk survey was completed for each individual tested. The results of the survey were analyzed in the Exposure Investigation (ATSDR 2001a). Every person tested was notified of his or her results via a telephone call or letter. For residents who gave consent, primary health care givers of residents with elevated blood lead levels were also notified. Blood lead testing results for the year 2000 are summarized in Table 1.

Additional blood lead testing sessions have shown that elevated blood lead remains a problem in Eureka City. In 2001, a total of 57 children were tested; 19.0% of children ages 0–72 months and 19.4% of children ages 6–17 years revealed elevated blood lead levels. Blood lead testing results for the year 2001 are summarized in Table 2. The percentage of Utah children with elevated blood lead levels in 2001 for children ages 0–72 months was 1.3%, and 2.1% for children 6–17 years old.

In 2002, a total of 113 Eureka children were tested. Almost 10% of children ages 0–72 months and 14.0% of children ages 6–17 years had elevated blood lead levels. In 2002, the Utah Blood Registry reported 1.2% of Utah children between the ages of 0 and 72 months and 2.4% of children ages 6-17 have elevated blood lead levels. These rates are reported in Table 3.

In 2003, the number of children tested for blood lead in Eureka dropped to 86. The percentage of elevated blood lead levels among children ages 0–72 months tested for lead increased to 23.3% and a slight increase was observed among children 6–17 years old (16.1%). Utah rates for 2003 were 1.7% for children 0-72 months of age, and 4.5% for children 6-17 years of age. These results are presented in Table 4.

Between January and October 2004, 139 Eureka children were tested. The percentage of elevated blood lead levels among Eureka children ages 0–72 months tested decreased from 23.3% in 2003 to 2.4% in 2004. For children 6–17 years old, the percentage decreased from 16.1% to 5.2% (Table 5). The percentage of elevated blood lead levels in Utah children tested during the same time period were 1.0% of children ages 0–72 months and 5.5% of children ages 6–17 years.

Follow-up activities for children who have elevated blood lead levels have been conducted by EEP and CUPHD. These activities include phone calls to guardians; personal visits to homes; educational discussions and materials; and letters and invitations to upcoming blood lead testing sessions.

Blood lead levels reflect relatively recent exposures (ATSDR 1999b), and elevated blood lead levels in several Eureka City residents indicate recent exposure to lead. CUPHD and EEP are currently providing free blood lead testing sessions on a quarterly basis. Testing sessions are expected to continue through 2006. EEP recommends that all children under 18 years of age and pregnant women who reside in the Eureka City area have a blood lead test performed at least once a year.

Environmental Data

Background soil, non-residential soil, residential soil, and indoor dust have been sampled by UDEQ, as well as EPA and its contractors. The results of these samples have been applied to estimate exposure doses for adults, children, and pica children (UDEQ 2000, UOS 2001a, WGI 2002a,b). These results are discussed in the section, Public Health Implications. Basement soil, tap water, and lead-based paint have also been sampled for, but such sources of metals were not considered in the exposure dose estimates because sampling indicated that these media were not consistent sources of exposure in the Eureka City area. The data are summarized in Tables 6–11.

Syracuse Research Corporation (SRC), a contractor for the EPA (SRC 2001), performed a Baseline Human Health Risk Assessment for the Eureka Mills site. The risk assessment enabled EPA and UDEQ to set 231 ppm lead as the remediation goal for the Eureka City residential areas; the remediation goal for non-residential areas is 735 ppm lead (EPA 2002b). The environmental data indicate that soil with high concentrations of lead also contains high concentrations of other metals associated with mining and milling.

Analytical Results: Background Soil

Background soil samples were collected by UDEQ and EPA above areas impacted by former mining and milling activities. These soil samples were analyzed for 23 metals by use of X-ray fluorescence (XRF) and/or Inductively Coupled Plasma (ICP). The concentrations of all metals were below health-based comparison values, with the exception of arsenic. As is typical in many

areas of Utah and the United States, the background concentrations of arsenic in soil from the Eureka Mills area exceed health-based comparison values (Table 6). Background concentrations of arsenic in soil from Eureka Mills range from 4.2 – 13.4 ppm (SRC 2001). The health-based comparison value for arsenic in soil is 0.5 ppm, based on studies that indicate that ingestion of inorganic arsenic increases the risk of developing skin cancer (ATSDR 2000a).

Analytical Results: Non-residential Soil

For the Eureka Mills site, non-residential soil is referred to as "off-site" soil. Residents and visitors can come into contact with non-residential soil through dust stirred up by recreational activities, such as dirt-biking and riding in off-road vehicles.

A total of 265 non-residential soil samples were collected and analyzed for 23 metals. A summary of analytical results from sampling of soil from non-residential and mine waste areas is presented in Table 7. Two areas proposed as future residential properties were also sampled (SRC 2001). Soil samples were collected at depths of 0–2, 2–6, 6–12, and 12–18 inches and analyzed for metals by use of XRF, with approximately 10% of the samples (n = 36) also analyzed by ICP for confirmation.

The data presented in Table 7 were selected and summarized by SRC, which found in its Baseline Human Health Risk Assessment for Eureka Mills that surface soils were more or equally contaminated when compared to depth samples (SRC 2001).

Concentrations of lead in non-residential soils ranged from 32 ppm to 51,000 ppm. There is no comparison value for lead in non-residential soil. The EPA has identified 735 ppm lead in non-residential soils as the remediation goal for this site. EEP concurs with this goal.

Several metals that exceeded health-based comparison values were antimony, arsenic, cadmium, chromium, copper, iron, manganese, mercury, thallium, vanadium, and zinc. These metals and lead are further evaluated in the Exposure Dose Estimates and Toxicological Evaluation section.

Analytical Results: Residential Soil

For the Eureka Mills site, residential soil is referred to as "on-site" soil. Some of the ways people can come into contact with residential soil is through contacting the soil and/or dust during activities such as playing, gardening, or digging. In soils with high levels of metals, a small amount of metals could be absorbed into plants.

EPA reported a total of 592 lots in Eureka, however not all are residential. Of the 592 lots, 547 were sampled. EPA sampled each residential yard of less than 15,000 square feet. Two surface soil composite samples were collected (five scoops in each composite) from 0–2 inches at the surface. Surface soil samples were composite samples at 0–2 inches or 0–6 inches in areas of bare soil. If sod was present, sampling began with the soil under the grass and sod layer. Subsurface soil samples were grab samples. In addition, three depth samples were taken from a single borehole at 0–6, 6–12, and 12–18 inches. EPA also sampled gardens and play areas separately. If a residential yard was larger than 15,000 square feet, then the EPA split it into two or more zones and sampled each zone as described above. Over 4,000 soil samples were

collected and analyzed for 23 different metals by use of XRF, with approximately 10% of the samples (n = 394) confirmed by ICP. Twelve percent of the lots sampled had 0–500 ppm lead, 56% had 501–2,000 ppm lead, and 15% of the lots had 2,000–3,000 ppm lead. The other 11% of the lots had lead levels greater than 3,000 ppm. Only 11 properties contained lead concentrations below 231 ppm. Background soil lead concentrations in the area are around 150 ppm. A summary of analytical results from sampling soil from residential areas within Eureka City is presented in Table 8. The data presented in Table 8 were selected and summarized by SRC, which found in its Risk Assessment that surface soils were more or equally contaminated compared to depth samples (SRC 2001).

Concentrations of lead in residential soils ranged from 18 ppm to 25,000 ppm. The risk assessment performed by SRC enabled the identification of 231 ppm lead in Eureka City residential soil as the remediation goal (EPA 2002b). EEP concurs with this goal.

Several metals that exceeded health-based comparison values were antimony, arsenic, cadmium, copper, iron, manganese, mercury, thallium, vanadium, and zinc. These metals and lead are further evaluated in the Exposure Dose Estimates and Toxicological Evaluation section.

Analytical Results: Dust

Indoor dust samples were taken from 57 residences in Eureka City. Samples were a single composite collected from three 1-square-meter areas within each residence by use of an HVS3 vacuum, as described in the site sampling and analysis plan (URS 2000). Dust samples were analyzed via ICP for 23 metals. Dust sampling data are summarized in Table 9 (SRC 2001).

Concentrations of lead in indoor dust samples ranged from 193 ppm to 2,010 ppm. There is no comparison value for lead in dust.

Dust samples exceeded the health based soil comparison values for antimony, arsenic, and cadmium. These metals and lead are further evaluated in the Exposure Dose Estimates and Toxicological Evaluation section.

Analytical Results: Basement Soil

Basement soil was sampled in only seven homes in Eureka City. Data are summarized in Table 10. Residents with basements that have soils high in arsenic, cadmium, lead, or thallium should consider removing soils according to applicable standards or placing a suitable barrier (such as concrete or a tarp) over the basement soil.

Concentrations of lead in basement soil samples ranged from 122 ppm to 5,330 ppm. There is no ATSDR comparison value for lead in basement soil, but EPA's remediation goal for residential soil is 231 ppm lead.

At this time, it is unknown how many homes in Eureka City have basement soil. The seven homes sampled may or may not represent all homes in the area. Therefore, this data was not used in the exposure dose calculations.

Analytical Results: Tap Water

First-draw tap water samples were analyzed from 54 homes. Most initial samples were below current National Drinking Water Standards, with the exception of copper, lead, and thallium (Table 11).

A high level of copper was detected in one sample. This sample exceeded the Maximum Contaminant Level (MCL) for copper, based on EPA's National Drinking Water Standards. Since the elevated level of copper came from only one home, the data is not representative of Eureka City tap water, and therefore, was not used in the exposure dose calculations.

Concentrations of lead in tap water samples ranged from 2.1 to 13.8 parts per billion (ppb). The comparison value for lead in tap water is 15 ppb. Lead concentrations in tap water are at safe levels. Analytical results for one tap water sample showing 38 ppb lead were questioned, and this home was revisited for the purpose of re-sampling tap water. The second test showed levels below 15 ppb.

During the initial sampling, a detection limit higher than the MCL was used for thallium. EPA collected an additional ten tap water samples from Eureka homes and submitted these for analysis at a lower detection limit. Thallium was not detected in any sample at the detection limit of 1 ppb, which is below the corresponding MCL; therefore thallium concentrations in Eureka City tap water are also at safe levels.

Surface Water

Contamination of surface water from former mining activities is possible, however, limited sources of surface water exist. In Eureka City, runoff flows toward Eureka Gulch. Eureka Gulch is an intermittent stream that drains west into Tanner Creek. Tanner Creek is an ephemeral stream that flows south and eventually disappears into the sand dune sinks near Little Sahara National Recreation area, approximately 30 miles southwest of Eureka City.

Eureka Gulch runs parallel to Main Street in Eureka City, which has a mix of commercial and residential areas. Movement of contaminants into Eureka Gulch would occur during snowmelt or flooding associated with torrential rains.

No data were available to confirm if the seasonal surface water is contaminated.

Groundwater

Groundwater contamination from former mining activities is possible; however, no data are available to confirm this possibility. The municipal water supply comes from wells 2 miles up-gradient from Eureka City (EPA 2001a). Municipal water has been tested and is safe to drink.

Private Wells

Eureka City has many private wells ranging from 15 – 125 feet in depth (WGI 2002b). Sampling data for private wells were not available to assess contamination. UDEQ has reported that all private wells in the area are used for irrigation only (EEP 2004b).

Other Possible Sources of Metals in the Eureka City Environment

Of the reported 271 occupied homes in Eureka City, 23 were tested for interior and exterior lead-based paint. Lead-based paint was found in approximately 30% of homes tested (SRC 2001). This contamination is not associated with the Eureka Mills site, and since this sample size is not representative of all homes in Eureka City, this data was not used to estimate exposure doses for lead.

Quality Assurance/Quality Control (QA/QC)

In preparing this document, EEP relied on the information provided in the referenced documents and contacts. Data with demonstrated QA/QC problems were noted and included in the tables and calculations if they provided unique and relevant information.

Exposure Pathways Analysis

To determine whether nearby residents are exposed to contaminants at a site, EEP and ATSDR evaluate the environmental and human components that make up a human exposure pathway. An exposure pathway consists of five elements (ATSDR 1992b):

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

ATSDR categorizes an exposure pathway as either *completed*, *potential or eliminated*. In *completed* exposure pathways, all five elements exist to indicate that exposure to a contaminant has occurred in the past, is occurring, or will occur in the future. In *potential* exposure pathways, at least one of the five elements has not been confirmed, but may exist. Exposure to a contaminant could have occurred in the past, could be occurring, or could occur in the future. An exposure pathway can be *eliminated* if at least one of the five elements is missing and will never be present (ATSDR 1992b).

Completed Exposure Pathways

There are two completed exposure pathways for residents living near the Eureka Mills site: soil/dust ingestion and soil/dust inhalation. Elements of the completed exposure pathways are described here.

Completed Exposure Pathway: soil ingestion

Exposure element	Eureka City
1) a source of contamination	soil impacted by former mining activities
2) transport through environmental medium	contaminated soil and related dust
3) a point of exposure	contact with contaminated soil and related dust
4) a route of human exposure	ingestion
5) a receptor population	residents and visitors

Although few individuals intentionally ingest soil, a number of studies show that most people do ingest small amounts of soil and/or dust derived from soil, mainly because of hand-to-mouth contact (EPA 1997). For example, a person could be exposed to lead and arsenic in the soil by gardening or playing in soil and then eating or smoking without first washing the hands. House dust high in lead and arsenic might settle on dishes and in food. This pathway has been demonstrated to exist in the past; because the site is residential with unrestricted access, it is also a current and future exposure pathway until cleanup efforts are complete.

C*ompleted Exposure Pathway: dust inhalation*

Exposure element	Eureka City
1) a source of contamination	soil and dust impacted by former mining activities
2) transport through environmental medium	airborne contaminated dust
3) a point of exposure	contact with contaminated dust
4) a route of human exposure	inhalation
5) a receptor population	residents and visitors

A completed pathway of exposure to airborne contaminants was also found. Between June and August of 2002, the EPA contractor URS Operating Services provided 20 children ages 6 – 13 with personal air monitors to wear throughout the day. The air monitors are designed to measure breathing zone concentrations of lead and other metals in the air. The 20 children wore the air monitors during the day (typically 7 hours), and their activities were recorded. Activities included walking around town, hiking on a near hillside, and riding ATVs and dune buggies on dirt roads in the area. The results showed that at least 12 of the 20 children were exposed to lead in the air they breathed. These exposures ranged from 0.0004 – 0.089 milligrams of lead per cubic meter of air (mg/m^3). The average concentration was 0.0121 mg/m^3.

If the sampling represents routine exposures to lead, dust in air represents a significant source of lead exposure for these children. Unfortunately, blood lead testing was not coordinated with the air sampling. The children's blood lead levels that were measured weeks later did not correlate with the lead exposures they received during the day they wore air monitors.

Examples of this exposure pathway include children playing outside or dirt-biking in the area and breathing in small amounts of dust containing lead or other metals. A resident working in his/her yard or running on one of the dirt paths in the area might breathe in small amounts of dust containing metals. This pathway, which may have existed in the past, is a current exposure pathway, and may be a potential exposure pathway in the future.

Table 12 shows the completed exposure pathways for the Eureka Mills Site.

Potential Exposure Pathways

Potential Exposure Pathway: Incidental ingestion and/or inhalation of basement soil

Exposure element	Eureka City
1) a source of contamination	soil impacted by former mining activities
2) transport through environmental medium	basement soil
3) a point of exposure	contact with contaminated basement soil and related dust
4) a route of human exposure	ingestion and inhalation
5) a receptor population	residents with contaminated basement soil

A potential pathway of exposure to contaminants in basement soil was also found. Maximum concentrations of cadmium and thallium in basement soil samples exceeded the CVs for children. Average concentrations of arsenic and lead in basement soil exceeded the CVs for both children and adults (Table 10). Exposure to contaminated basement soil can occur through incidental ingestion and/or inhalation. Element #2 of the exposure pathway for basement soil has not been investigated for most Eureka City homes. This pathway may have existed in the past, and it may also be a current and a future potential exposure pathway.

Potential Exposure Pathway: Ingestion of tap water

Exposure element	Eureka City
1) a source of contamination	unknown
2) transport through environmental medium	water
3) a point of exposure	drinking tap water
4) a route of human exposure	ingestion
5) a receptor population	residents with contaminated tap water

A potential pathway of exposure to contaminants in tap water was also found. Element #1 is missing because municipal water comes from a clean source; however, tap water sampling was performed for 54 homes, and one sample exceeded the MCL for copper (Table 11). It is unlikely that this contamination is associated with the Eureka Mills site.

Potential Exposure Pathway: Incidental ingestion or inhalation of paint chips

Exposure element	Eureka City
1) a source of contamination	lead-based paint
2) transport through environmental medium	paint chips
3) a point of exposure	contact with lead-based paint chips
4) a route of human exposure	ingestion or inhalation
5) a receptor population	residents with chipping or peeling lead-based paint

A potential pathway of exposure to lead-based paint was found. Element #2 of the exposure pathway for paint chips is missing for many Eureka City homes. Of the 23 homes tested, about 30% showed the presence of lead-based paint in either indoor or outdoor paint samples. There are approximately 271 homes in the Eureka City area.

Potential Exposure Pathway: Ingestion of home-grown produce

Exposure element	Eureka City
1) a source of contamination	soil impacted by former mining activity
2) transport through environmental medium	soil to vegetable
3) a point of exposure	eating home-grown produce
4) a route of human exposure	ingestion
5) a receptor population	residents with gardens using contaminated soil

A potential pathway of exposure to homegrown produce in contaminated soil was found. This exposure pathway is missing elements #2 and #5. In soils with high levels of metals, a small amount of the metals could be taken up into plants. This route has not been evaluated for gardens in Eureka City. People who eat fruits or vegetables grown in soil with high concentrations of metals could be exposed to small amounts of metals in soil that stick to the vegetable or fruit, unless it is washed thoroughly.

The potential exposure pathways are shown in Table 13.

Eliminated Exposure Pathways

Eliminated Exposure Pathway: Absorption of metals through skin

Metals in soil are not readily absorbed through the skin (ATSDR 1999b, 2000). Consequently, the soil and skin exposure pathway is not considered significant for this site.

Eliminated Exposure Pathway: Ingestion of surface water

Very little surface water exists in the Eureka City area. Therefore, this pathway is not considered a likely source of exposure.

Eliminated Exposure Pathway: Ingestion of water from private wells

Residents of Eureka City are connected to municipal water supplies and all existing private wells serve only for the purpose of irrigation. Therefore, this pathway is not considered significant for this site.

Public Health Implications

For the purpose of determining whether the concentrations of metals found in the environment pose a public health threat, the exposure doses to chemicals of interest were estimated (Appendix B). Metal concentrations in residential soil, non-residential soil, and indoor dust were compared to health-based comparison values (Tables 6–11). Twelve metals of interest were identified for further evaluation: antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, thallium, vanadium, and zinc. Exposure doses for these metals are estimated and pertinent toxicity information is discussed in this section.

Exposure Dose Estimates and Toxicological Evaluation

The comparison values reported in Tables 6–11 are derived by the use of standardized exposure assumptions (Appendix B). The exposure scenario for Eureka City residents is different from the

standard exposure assumptions in that residents are exposed to a variety of sources of metals, but each exposure does not occur all day, every day. Site-specific exposures to dust and soil were estimated for Eureka City residents and compared to appropriate toxicity values (Table 14).

Such sources of metals in the environment as basement soil, tap water, and lead-based paint were not considered in the exposure dose estimate because sampling performed indicated that these media were not consistent sources of heavy metal exposure in the Eureka City area. Exposure dose calculations are described in Appendix B. Results are summarized in the following sections.

Antimony

Exposure dose estimates for antimony in soil and dust are within safe limits for both children and adults living in Eureka City, with the exception of children with pica behavior. Soil-pica is the recurrent ingestion of unusually high amounts of soil. Pica behavior is relatively uncommon (EPA 1997). Children who deliberately ingest soil are displaying pica behavior. The exposure dose for pica children exposed to antimony in soil and dust in Eureka City is estimated at 0.009 milligrams per kilogram body weight per day (mg/kg/day). At much higher exposures (0.0748 mg/kg/day), animals given antimony in drinking water showed decreased maternal weight gain and decreased hypotensive response in newborns (ATSDR 1992).

Arsenic

Exposure dose estimates for arsenic in Eureka City soil and dust are within safe limits for adults, however, they do exceed the health guidelines for both children and pica children. Exposure dose estimates for children and pica children exposed to arsenic in soil and dust in Eureka City are 0.0006 and 0.01 mg/kg/day, respectively. The health guideline is 0.0003 mg/kg/day (Table 14).

Assuming much of the arsenic in Eureka City soil and dust is inorganic, comparisons between doses observed in Eureka City can be made to those in the literature. For example, exposure to as little as 0.0075 mg/kg/day inorganic arsenic in drinking water for more than 1 year has been implicated in increased skin cancer rates in people.

Arsenic can adversely affect a child's development. There is the possibility that a very sensitive child might develop anemia because of chronic arsenic exposure. Anemia would then make that child much more susceptible to lead toxicity. Arsenic levels in urine have not been tested for any of the children living on the site. This test can identify only people who have been recently exposed to arsenic (1–2 days prior to the test). Other tests can provide information on arsenic exposures over the past year, but if the exposure level was low, the arsenic might not be detected (ATSDR 1998).

Cadmium

Exposure dose estimates for cadmium in Eureka City soil and dust are within safe limits for both children and adults, with the exception of pica children who may be exposed to an estimated 0.002 mg/kg/day, a dose that is 10 times higher than the health guideline of 0.0002 mg/kg/day.

The health guideline is based on a NOAEL (No Observable Adverse Effect Level)[1] of 0.0021 mg/kg/day with an uncertainty factor of 10 to account for sensitive members of the population. The NOAEL was based on a study of residents living in cadmium-polluted areas of Japan in which chronic exposure to cadmium was implicated in changes in kidney function (tubular proteinurea) (ATSDR 1999a).

Chromium and Copper

Exposure dose estimates for chromium and copper in Eureka City soil and dust are within safe limits for both children and adults and did not exceed health guidelines; therefore, adverse health effects from chromium and copper are not likely.

Iron

Exposure dose estimates for iron in Eureka City soil and dust are within safe limits for both children and adults, with the exception of pica children.

Iron is important to the healthy development of children. If a child ingests too little iron, the child could suffer anemia, weakness, depressed immune function, and other adverse health effects (ADA 1996). Another reason iron is important for health is that higher levels of iron intake are associated with lower blood lead levels (Lanphear, et al. 2002).

Even though iron is an important mineral for human health, too much iron can cause health problems such as liver damage. Pica children living in the Eureka City residential area are exposed to an estimated 1 mg of iron/kg/day. The health guideline for iron is based on recommended daily allowances. If the pica child is older than 6 months and weighs more than 16 kilograms, the recommended daily allowance for that child is 0.6 mg/kg/day (ADA 1996). Adverse health effects at less than twice this dose are unlikely, but parents and guardians of children should discourage pica behavior.

Lead

Blood lead testing in Eureka City has already shown that exposure to lead is occurring primarily in children under the age of 18 years. Exposure dose estimates for lead in soil and dust are within safe limits for adults living in Eureka City, but they exceed health guidelines for both children and pica children (Table 14).

Children are more sensitive to the effects of lead than adults. Preschool-age children and developing fetuses are usually the most vulnerable segments of the population for exposure to lead. Children who are 2–3 years of age may have the highest risk for exposure to lead-contaminated soil (ATSDR 1992a). Lead-contaminated house dust is the major source of lead intake during early childhood (Lanphear, et al. 2002).

[1]The No Observable Adverse Effect Level (NOAEL) is the exposure level that produces no significant increases in frequency or severity of adverse effects. Effects may be produced at this dose, but they are not considered to be adverse.

CDC has determined that blood lead levels greater than 10 micrograms per deciliter of blood (µg/dL) are considered elevated, and some studies suggest that intelligence might be affected when children have levels as low as 7 µg/dL (CDC 1997, ATSDR 1999b). Blood lead levels as low as 10 µg/dL can adversely affect the behavior and development of children (CDC 1991, ATSDR 1999b). Learning disabilities have been observed in children with blood lead levels exceeding 40 µg/dL (ATSDR 1999b). An estimated 890,000 U.S. children have blood lead levels equal to or greater than 10 µg/dL (CDC 1997). At very high levels—greater than 40 µg/dL—lead exposure in adults may decrease reaction time, cause weakness in fingers, wrists, or ankles, and possibly affect the memory and cause anemia. Lead exposure may also damage the kidneys and the reproductive system. Health effects due to exposure to lower levels of lead are uncertain. Lead exposure in middle-aged men may increase blood pressure.

Pregnant women and their developing fetuses are also of particular concern. Lead poses a substantial threat to pregnant women and their developing fetuses because blood lead readily crosses the placenta (ATSDR 1999b). This is especially important in the neurological development of the fetus because there is no blood-brain barrier. Exposure to high levels of lead may even cause miscarriage. The mother's blood lead level is an important indication of risk to the fetus. In addition, mothers who had previous elevated exposure to lead may store it in their bones, from which it could be released during times of calcium stress, such as pregnancy and lactation.

Exposure to lead should be minimized whenever possible, because studies are inconclusive about how much lead present in the environment might result in adverse health effects (ATSDR 2000c). Lead is classified as a probable human carcinogen based on studies in rats and mice. However, the high doses used in those studies make it difficult to estimate adverse health effects from levels seen in Eureka City (ATSDR 1999b).

Manganese

Exposure dose estimates for manganese in Eureka City soil and dust are within safe limits for both children and adults, with the exception of pica children. Pica children living in the Eureka City residential area are exposed to an estimated 0.7 mg/kg/day of manganese, a level that exceeds the health guideline of 0.1 mg/kg/day (Table 14). Chronic oral exposures to low levels of manganese in drinking water have been implicated in poor verbal skills and visual memory (Woolf, et al., 2002).

Mercury

Exposure dose estimates for mercury in Eureka City soil and dust are within safe limits for adults and children, but they exceed health guidelines for pica children. Children and pica children living in Eureka City are exposed to an estimated 0.0007 mg/kg/day and 0.02 mg/kg/day mercury, respectively. The form of mercury in Eureka City soil was not evaluated. The most common forms of mercury in the environment are metallic mercury, mercuric sulfide (cinnabar ore), mercuric chloride, and methylmercury (ATSDR 1999c). The health guideline of 0.002 mg/kg/day for mercuric chloride was used in this health assessment.

At high enough exposures, mercury compounds can cause damage to the kidney, the nervous system, and the unborn fetus (ATSDR 1999c). Irritability, shyness, tremors, changes in vision, and memory problems are all symptoms of mercury poisoning.

Thallium

Exposure dose estimates for thallium in Eureka City soil and dust exceed health guidelines for adults, children, and pica children. The exposure dose estimates were found to be 0.0001, 0.001, and 0.03 mg/kg/day, respectively. The health guideline is 0.00008 mg/kg/day. Case studies in humans who ingested various thallium compounds show the respiratory and cardiovascular systems as being susceptible, as well as the liver, kidney, and muscles. Hair loss may also occur. Toxicity appears to start at 0.1 mg/kg/day in laboratory animals (ATSDR1992c).

Vanadium

Exposure dose estimates for vanadium in Eureka City soil and dust are within safe limits for both children and adults, with the exception of pica children. Pica children living in the Eureka City residential area are exposed to an estimated 0.05 mg/kg/day of vanadium, a dose estimate that exceeds the health guideline of 0.003 mg/kg/day (Table 14). Adequate information on oral exposure to vanadium is not available; however, the literature suggests that there are biologically significant effects of exposure to this metal (i.e., changes in heart function) [HSDB 2002].

Zinc

Exposure dose estimates for zinc in Eureka City soil and dust are within safe limits for both children and adults, with the exception of pica children. Pica children living in the Eureka City residential area are exposed to an estimated 6 mg/kg/day of zinc, a level that exceeds the health guideline of 0.3 mg/kg/day (Table 14). Zinc is a trace mineral important for health and normal development in children. It is involved in normal healing, the transport of vitamin A, enzyme activity, and many other important functions. Too much zinc, however, can cause vomiting, diarrhea, gastric problems, and dizziness. If the pica child is older than 1year and weighs more than 16 kilograms, the recommended daily allowance for that child would be 0.6 mg/kg/day (ADA 1996). The health guideline of 0.3 mg/kg/day was calculated based on adult dietary allowances. Adverse health effects from zinc exposures estimated for pica children are unlikely.

CHILD HEALTH CONSIDERATIONS

ATSDR and EEP recognizes that the unique vulnerabilities of infants and children require special emphasis in communities faced with contamination of their water, soil, air, or food. Children are at greater risk than adults from some environmental hazards. For example, children are more likely to be exposed to contaminants because they play outdoors, often bring food into contaminated areas, and are more likely to come into contact with dust and soil. Also, because their bodies are still developing, children can sustain permanent damage if toxic exposures to some contaminants occur during critical growth stages.

Children are the most sensitive population considered in this health assessment. Exposure dose estimates show that children living in Eureka City could be exposed to unhealthy levels of

arsenic, lead, and thallium. Pica children living in Eureka City could be exposed to unhealthy levels of antimony, arsenic, cadmium, iron, lead, manganese, mercury, thallium, vanadium, and zinc. The main source of these metals in the Eureka City environment is soil and associated dust. A toxicological evaluation of the health effects of these metals on pica children is discussed in the previous section, Exposure Dose Estimates and Toxicological Evaluation.

Children living in Eureka City are 10 times more likely to have elevated blood lead levels than other Utah children. Prevalence rates of elevated blood lead were high for both young children and teenagers in Eureka City.

COMMUNITY HEALTH CONCERNS

A community needs assessment has been performed for this community (Appendix C). Health concerns collected by EEP staff during blood lead testing sessions, public meetings, and the public comment period for the public health assessment are listed here:

Community concern	At least three guardians or parents complained of the wait during the blood lead testing session on May 16, 2002.
EEP response	*The community response to the May 16th, 2004, blood lead testing session was well attended. The number of residents who showed up for testing was much higher than estimated. In response, EEP staff stayed late and continued blood lead testing until 11:00 p.m. On the following day, EEP staff followed up with residents who could not participate in the May 16th testing and rescheduled testing for May 24, 2002. Blood lead testing sessions continue to be held quarterly and waiting periods for testing have been minimal. EEP now provides activities and educational videos to entertain participants while waiting.*
Community concern	One parent (or guardian) had concerns that the results of the blood lead tests could change once the yard is cleaned by EPA. It was clear that this individual did not want the custodial child to be exposed to dangerously high levels of lead.
EEP response	*In 2002, EPA completed the emergency response cleanup of several residential areas. Properties with soil lead concentrations exceeding 3,000 ppm lead and properties where children have blood lead levels greater than 10 µg/dL were the target of the emergency removal. Cleanup efforts have continued since then, however, due to funding shortages the timeliness of the project has been delayed. It is projected that cleanup efforts will continue for at least another four years. For more information, contact Dave Allison of UDEQ at (801) 536-4479 or Paula Schmittdiel of EPA at 1-800-227-8917, extension 6861.*
Community concern	One resident said, “I would like to know exactly where the lead is coming from. Is the lead in the soil or water? We keep hearing different stories."

EEP response	*The lead is coming from the soil. Lead occurs naturally, but because of the mining, milling, and smelting that happened in Eureka years ago, lead is in the soil at unusually high concentrations. Once it is in the soil, it can show up in dust, too.*
Community concern	One resident stated, "We continue to get bad publicity from the EPA, UDEQ, and the media. It is either the lead contamination or the crickets. No one will want to move here."
EEP response	*EEP's focus is on public health. One of EEP's objectives is to ensure that children living in Eureka can live in a healthy environment and with blood lead levels well below 10 µg/dL. EEP supports the cleanup efforts of EPA and UDEQ.*
Community concern	Many residents have made the comment, "Will this hurt our real estate values?"
EEP response	*This comment has been noted. EEP's focus is on public health and believes that the cleanup efforts of EPA and UDEQ will be good for the health of those living in Eureka City.*
Community concern	At least five residents expressed concern by comments such as "I grew up here and I have been fine, so my kids are fine too."
EEP response	*Children living in Eureka City have blood lead levels that are much higher than the blood lead levels of children in other areas of Utah. Lead can cause both subtle and serious health problems. EEP supports all efforts to reduce exposure to lead in the community.*
Community concern	One comment taken from EPA's Community Involvement Plan (EPA 2001c) expressed the concern that "there is a not a lead problem in the area and the only problem is the presence of EPA/UDEQ."
EEP response	*The blood lead levels in children living in Eureka City are much higher than in other areas of the state. Lead can cause many health problems. For example, lead exposure may cause learning difficulties and reduce the growth of young children.*
Community concern	One resident was very concerned about replacing the dirt on the bike trails the children are always riding on.
EEP response	*This is an excellent suggestion. It is now one of the recommendations that this document makes to EPA.*
Community concern	Several of the residents expressed concern about where the contaminated dirt will be dumped.
EEP response	*There is an area near the western end of Chief Mine #1 where EPA dumped soil excavated during the emergency removal. EPA capped and*

	re-graded this area in 2004. For more information, contact Paula Schmittdiel at EPA in Eureka (435-433-2157).
Community concern	One resident complained of the settling ponds near the non-residential cleanup areas. The resident feared that since the ponds were not enclosed, children might be swimming in the contaminated water.
EEP Response	*Upon completion, fencing was placed around the ponds to keep trespassers out. Unfortunately, the fence has been cut and not replaced. Environmental officials have determined that the ponds will not hold much water for extended periods of time and it is therefore not likely that children will be swimming in them. Eureka parents and guardians should educate their children on the hazards of trespassing into potentially contaminated areas.*

Public Health Assessment Public Comment Release

The public health assessment was released for public comment in Eureka, Utah, on December 11, 2002. The public health comment period covered the period from December 1, through December 31, 2002.

No comments were received by the Office of Environmental Epidemiology during the public comment period.

CONCLUSIONS

The Eureka Mills site is a public health hazard (ATSDR health hazard category B) because of the elevated levels of arsenic, lead, and thallium found in residential and non-residential soil.

EPA and UDEQ have identified remediation goals of 231 ppm lead in soil from residential areas and 735 ppm lead in soil from non-residential areas. Cleanup of lead to these levels is based on EPA's Baseline Human Health Risk Assessment for this site and is expected to remove the hazards posed by the other metals as well. EEP concurs with these levels.

Site-specific exposures to dust and soil were estimated for Eureka City residents and compared to appropriate toxicity values. Other sources of metals in the environment, such as basement soil, tap water, and lead-based paint were not considered in the exposure dose estimates because sampling results indicated that these media were not consistent or significant sources of exposure in the Eureka City area.

Exposure dose estimates for adults living in Eureka City who accidentally ingest small amounts of dust and soil are well within ATSDR health guidelines, with the exception of thallium. The estimated adult exposure dose for thallium ingestion was slightly higher than the health guideline. Adverse health effects at such a low doses are unlikely.

Children are the most sensitive population considered in this health assessment. Children living in Eureka City could be exposed to unhealthy levels of arsenic, lead, and thallium. Children living in Eureka City who deliberately ingest soil (pica children) could be exposed to unhealthy levels of antimony, arsenic, cadmium, iron, lead, manganese, mercury, thallium, vanadium, and zinc. The main source of these metals in the Eureka City environment is soil and associated dust.

Blood lead levels in several Eureka City children indicate recent exposure to lead. An ATSDR Exposure Investigation conducted in 2001 concluded that children living in Eureka City are 10 times more likely to have elevated blood lead levels than other Utah children. The percentages of elevated blood lead levels were high for both young children and teenagers. Of particular concern is the potential for long-term developmental health effects on children residing near the site as a result of lead exposure. The main routes of exposure are through ingestion and inhalation of contaminated dust and soil. EEP and CUPHD are currently providing free blood lead testing sessions to Eureka residents on a quarterly basis. Testing sessions are expected to continue through 2006. A slight decrease has been observed in the percentage of elevated blood lead levels in Eureka children since testing began in 2000.

Personal air monitoring of 20 children during a normal 7-hour day in Eureka City revealed exposure to lead and other metals. Activities that these children were recorded as participating in while wearing the personal air monitors included hiking, biking, and riding ATVs and dune buggies on dirt roads in the area.

Testing of seven homes with basement soil revealed high levels of arsenic, cadmium, lead, and thallium. Although this sample size is not representative of all homes in Eureka City, it does suggest that a potential pathway exists for ingestion or inhalation of these metals present in basement soils.

One of the 54 tap water samples taken from homes in Eureka City revealed elevated levels of copper. All residents are connected to a clean source of municipal water, and therefore contamination from the Eureka Mills site is unlikely.

Interior and exterior paint was tested for lead in 23 homes in Eureka City. Lead-based paint was found in 30% of these homes. Residents with chipping or peeling lead-based paint may be at risk for exposure to lead by ingestion or inhalation of paint chips.

People who eat fruits or vegetables grown in soil with high concentrations of metals could be exposed to small amounts of metals in soil that stick to the vegetable or fruit, unless it is washed thoroughly. This route has not been evaluated for gardens in Eureka City.

Cleanup efforts in Eureka have continued gradually since the emergency response cleanup of residential areas in 2002. Funding shortages have delayed the timeliness of the project. Cleanup efforts are projected to continue for at least another four years. Cleanup activities conducted during 2004 have included remediation of the Gemini, Mayday, Godiva, and Chief #2 mine waste piles, including an ATV trail in Eureka Gulch; soil cleanup in five residential yards and

portions of several others; construction of sediment ponds; and grading and capping of portions of the Chief #1 mine.

RECOMMENDATIONS

To help prevent lead poisoning and to protect the health of Eureka residents, EEP recommends the following:

- Children under the age of 18 years should be tested annually for lead, even if they seem healthy. Pregnant women living in Eureka should also have their blood tested. Blood lead tests are recommended both during and after cleanup.
- EEP and CUPHD should continue to hold free quarterly blood lead testing sessions in Eureka and encourage children under the age of 18 and pregnant women to be tested.
- The Utah Blood Lead Registry should continue to be monitored for children in the Eureka area with elevated blood lead levels to ensure adequate follow-up and case management.
- Follow-up activities should be conducted immediately upon identification of a child with an elevated blood lead level. The activities should include phone calls to parents or guardians, educational materials, letters, and invitations to upcoming blood lead testing sessions.
- Residents should reduce potential exposure to contaminated soil and dust by washing hands often, eating healthful foods high in iron and calcium (these nutrients make it more difficult for the body to absorb lead), keeping homes clean and free of soil and dust by methods such as damp dusting surfaces and wet-mopping floors, removing shoes before entering homes, and limiting time spent on dirt roads or trails that have not been cleaned up.
- Children and pregnant women should limit the time they spend participating in off-road recreation such as the use of ATVs, dune buggies, dirt bikes, and other off-road vehicles, until contaminated dirt has been removed or replaced.
- Residents with contaminated basement soil should consider having basement soil professionally removed or place a dust protective type of barrier over the soil to eliminate potential exposure.
- Residents with an elevated level of copper in their tap water will be encouraged to have their tap water resampled and to identify and remove the source of contamination.
- Residents with lead-based paint should reduce their risk of lead exposure by keeping their homes clean and free of dust and paint chips. Residents should not remove lead-based paint by themselves. A person with special training in correcting lead-based paint problems should be hired to remove the paint safely with proper equipment.
- Residents with gardens should wait to plant until property has been completely remediated, and should always wash or peel fruits and vegetables thoroughly before eating.
- Cleanup efforts in Eureka City should continue in a way that is protective of human health. Dust suppression and air monitoring should take place during cleanup activities to ensure minimal impact on the public from airborne dust.
- EPA and UDEQ should consider replacing or removing dirt on trails that children hike, bike or drive off-road vehicles on.
- EEP, CUPHD, UDEQ, and EPA should continue community involvement and education to assess and respond to community information needs.

- EEP should continue efforts to provide educational activities to elementary students on the hazards of lead, method of prevention, and the importance of blood lead testing.

PUBLIC HEALTH ACTION PLAN

EEP's Public Health Action Plan is designed to mitigate and prevent adverse human health effects resulting from exposure to metals in Eureka City due to former mining activities. The Public Health Action Plan consists of the following actions:

- EEP, in coordination with CUPHD, will continue to provide blood lead testing for children under the age of 18 and pregnant women living in Eureka City. During the blood lead testing, copies of this health assessment and other educational information will be available.
- EEP and CUPHD will continue to encourage children under the age of 18 and pregnant women living in Eureka to attend the quarterly blood lead testing sessions. Fliers and posters notifying residents of upcoming sessions will continue to be distributed to all post office boxes in Eureka and placed at local businesses. Activities will be offered to those attending and incentives given to children who are tested.
- EEP will continue to monitor the Utah Blood Lead Registry for children with elevated blood lead levels (EBLLs) in areas near the site to ensure adequate case management and environmental follow-up.
- EEP and CUPHD will continue follow-up activities for children with EBLLs by placing phone calls to parents or guardians, providing educational materials, and sending letters and invitations to upcoming blood lead testing sessions. In the future, EEP will conduct one-on-one meetings with the parents or guardians of children with EBLLs in which they will discuss the child's health, blood lead test results, and steps that can be taken to decrease the child's blood lead level. EEP will also create a binder for parents or guardians of children with EBLLs that will include the child's blood lead testing history and all available educational pamphlets on blood lead poisoning prevention.
- EEP has provided and will continue to provide Eureka residents with educational materials, such as pamphlets, calendars, growth charts, videos, cassette tapes, brochures and/or fliers, directed at reducing potential exposure to lead.
- EEP will propose to the residents with contaminated basement soil to consider placing a dust barrier (tarp, concrete) to eliminate potential exposures, primarily to children. This information will be provided to residents in the form of a newsletter and a brief article in the local newspaper. EEP will also provide homeowners with educational resources directed at reducing exposure to contaminated soil.
- Although tap water contamination is unrelated to the site, EEP will work with UDEQ and EPA to identify the home with the elevated level of copper and provide educational material to the resident regarding the potential hazards associated with ingestion of contaminated tap water. The resident will be encouraged to have their water re-sampled, and to identify and remove sources of contamination.

- EEP has provided and will continue to provide educational materials to residents regarding the hazards of lead-based paint and will encourage them to keep their homes clean and free of dust and paint chips.
- EEP will propose that residents cease gardening until property has been completely remediated. If residents choose to garden, then the EEP recommends that fruits and vegetable be thoroughly washed or peeled before eating. This information will be provided to residents in the form of a newsletter and a brief article in the local newspaper.
- EPA and UDEQ have considered the removal of dirt on several trails in the area to eliminate the health hazards posed by the soil and selected areas have been remediated.
- EEP, in coordination with CUPHD, UDEQ, and EPA, have and will continue to collect and respond to community concerns and information needs. EEP held an open house on December 11, 2002, for the release of the public health assessment for public comment, and has participated in numerous public meetings held by EPA and UDEQ. EEP has also attended several town meetings in which comments and concerns were collected from community members.
- EEP will continue to provide educational activities to elementary students on the hazards of lead exposure, methods of prevention, and the importance of blood lead testing. In 2001, EEP gave four presentations to school aged children in Eureka and provided information to teachers so that a lead poisoning prevention curriculum could be implemented at the schools. During the 2003-2004 school year, EEP' s health educator further established the lead poisoning prevention curriculum by teaching twice a month at the Eureka Elementary School.

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CERTIFICATION

This Public Health Assessment for the Eureka Mills site in Eureka, Utah, was prepared by the Utah Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health assessment was begun.

Tammie McRae, MS
Technical Project Officer, DHAC

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

for Roberta Erlwein
Cooperative Agreement Team Leader, DHAC, ATSDR

FIGURES AND TABLES

Figure 1. Location Map of Eureka City and Surrounding Area

Figure 2. Topographic Map of Eureka City and Surrounding Area

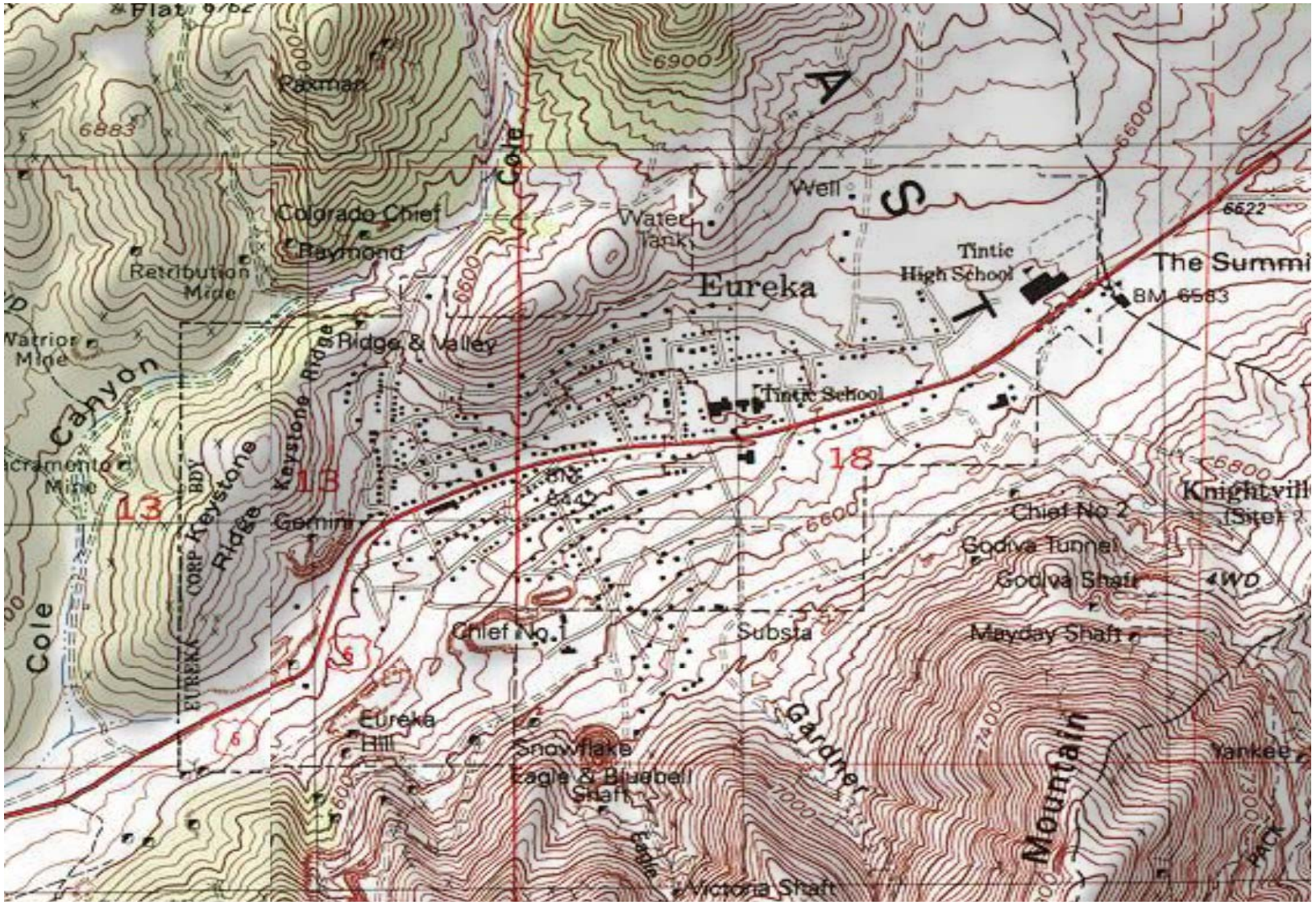

Figure 3. Eureka Mills Demographic Map

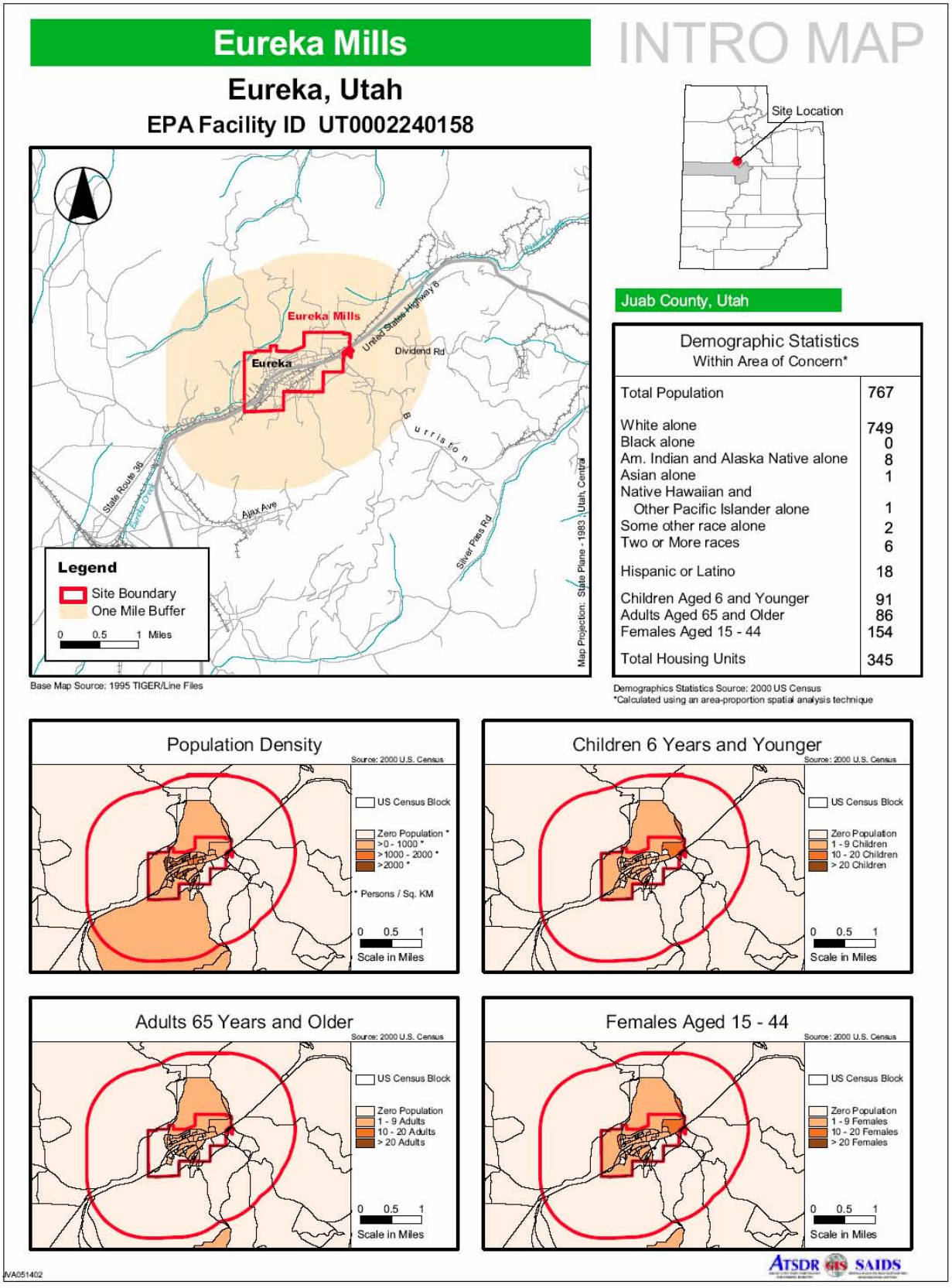

Table 1. 2000 Blood Lead Test Results, Eureka City, Utah

Resident Status	Participants		Number of persons with a BLL ≥ 10 µg/dL	Percentage (%) of elevated BLL	Geometric Mean of BLLs (µg/dL)	BLL Range (µg/dL)
	Age	*n*				
Eureka City 2000	0–72 months	59	13	22.0	6.7	1.6–34.2
	6–17 years	81	13	16.0	5.0	0.9–32.5
UBLR 2000	0–72 months	3526	59	1.7	2.6	0.0–34.2
	6–17 years	545	23	4.2	2.2	0.2–44.0

UBLR = Utah Blood Lead Registry
BLL = blood lead level
n= number of children tested

Table 2. 2001 Blood Lead Test Results, Eureka City, Utah

Resident Status	Participants		Number of persons with a BLL ≥ 10 (µg/dL)	Percentage (%) of elevated BLL	Geometric Mean of BLLs (µg/dL)	BLL Range (µg/dL)
	Age	*n*				
Eureka City 2001	0–72 months	21	4	19.0	7.5	4.0–26.7
	6–17 years	36	7	19.4	6.8	1.6–24.6
UBLR 2001	0–72 months	3639	47	1.3	2.3	0.0–46.7
	6–17 years	410	11	2.7	2.1	0.0–24.0

UBLR = Utah Blood Lead Registry
BLL = blood lead level
n= number of children tested

Table 3. 2002 Blood Lead Test Results, Eureka City, Utah

Resident Status	Participants		Number of persons with a BLL ≥ 10 (µg/dL)	Percentage (%) of elevated BLL	Geometric Mean of BLLs (µg/dL)	BLL Range (µg/dL)
	Age	*n*				
Eureka City 2002	0–72 months	41	4	9.8	5.1	0.0–23.6
	6–17 years	72	10	13.9	4.8	0.9–30.1
UBLR 2002	0–72 months	4409	52	1.2	2.3	0.0–39.0
	6–17 years	418	10	2.4	2.1	0.0–30.1

UBLR = Utah Blood Lead Registry
BLL = blood lead level
n= number of children tested

Table 4. 2003 Blood Lead Test Results, Eureka City, Utah

Resident Status	Participants		Number of persons with a BLL ≥ 10 (µg/dL)	Percentage (%) of elevated BLL	Geometric Mean of BLLs (µg/dL)	BLL Range (µg/dL)
	Age	*n*				
Eureka City 2003	0–72 months	30	7	23.3	5.6	1.7–24.0
	6–17 years	56	9	16.1	5.4	1.6–35.0
UBLR 2003	0–72 months	4137	69	1.7	2.2	0.0– 42.0
	6–17 years	313	14	4.5	2.2	0.0–35.0

UBLR = Utah Blood Lead Registry
BLL = blood lead level
n= number of children tested

Table 5. 2004* Blood Lead Test Results, Eureka City, Utah

Resident Status	Participants		Number of persons with a BLL ≥ 10 (µg/dL)	Percentage (%) of elevated BLL	Geometric Mean of BLLs (µg/dL)	BLL Range (µg/dL)
	Age	*n*				
Eureka City 2004	0–72 months	42	1	2.4	4.4	2.0–18.0
	6–17 years	97	5	5.2	4.6	1.0–29.0
UBLR 2004	0–72 months	3309	34	1.0	3.0	0.0–42.9
	6–17 years	274	15	5.5	1.8	0.0–41.4

* January – October 2004
UBLR = Utah Blood Lead Registry
BLL = blood lead level
n = number of children tested

Table 6. Background Concentrations for Metals in Soil, Eureka City, Utah

	Health-Based Comparison Values (CV)[I] for Soil			Results of background soil sampling (SRC 2001)				
	CV for Adult (ppm)	CV for Child (ppm)	Source	Range			analysis method	detection frequency
				Minimum (ppm)	average[*] (ppm)	maximum (ppm)		
Arsenic	0.5	0.5	CREG	**4.2**	**9.5**	**13.4**	ICP	3/3

Only metals with concentrations exceeding soil comparison values are listed.
[I] See Appendices A and B.
[*] Non-detects evaluated at the detection limit
CREG: Cancer Risk Evaluation Guide
ICP: Inductively Coupled Plasma ; ppm = parts per million

Table 7. Soil Data: Source and Non-Residential Areas, Eureka City, Utah.

	Health-Based Comparison Values (CV)[I] for Soil			Results of soil sampling (SRC 2001, UDEQ 2000)				
	CV for Adult (ppm)	CV for Child (ppm)	Source	Range			analysis method	detection frequency
				Min (ppm)	Avg[*] (ppm)	Max (ppm)		
Antimony	300	20	RMEG	0.5	**43**	**330**	ICP	30/36
Arsenic	0.5	0.5	CREG	0.4	**414**	**1,100**	ICP	35/36
Cadmium	100	10	EMEG-c	0.2	**60**	**171**	ICP	35/36
Chromium	2,000	200	RMEG	0.3	14	**220**	ICP	35/36
Copper	26,000	2,000	RMEG	74	279	**2,200**	XRF	144/266
Iron	400,000	30,000	EMEG-u	61	**21,774**	**48,500**	ICP	36/36
Lead	735	735	EPA	32	**4,065**	**51,000**	XRF	258/265
Manganese	40,000	3,000	RMEG	1	1,759	**5,750**	ICP	36/36
Mercury	1,000	100	EMEG-I	0.05	10.2	**144**	ICP	34/36
Thallium	60	4	RMEG	0.6	**16**	**68**	ICP	27/36
Vanadium	2,000	200	EMEG-I	0.3	26	**238**	ICP	35/36
Zinc	200,000	20,000	EMEG-c	54	4,198	**26,000**	XRF	265/265

Only metals with concentrations exceeding soil comparison values are listed.
[I] See Appendices A and B.
[*] Non-detects evaluated at the detection limit
n/a: Not available ; ppm = parts per million
RMEG: Reference Dose Media Evaluation Guide
CREG: Cancer Risk Evaluation Guide
EMEG-c: Chronic Environmental Media Evaluation Guide
EMEG-i: Intermediate Environmental Media Evaluation Guide
EMEG-u: Unpublished Environmental Media Evaluation Guide
EPA: U.S. Environmental Protection Agency
ICP: Inductively Coupled Plasma
XRF: X-ray Fluorescence

Table 8. Soil Data: Residential Areas, Eureka City, Utah.

	Health-Based Comparison Values (CV)[I] for Soil			Results of soil sampling (SRC, 2001, UDEQ 2000)				
	CV for Adult (ppm)	CV for Child (ppm)	Source	Range			analysis method	detection frequency
				Min (ppm)	Avg[*] (ppm)	Max (ppm)		
Antimony	300	20	RMEG	10	19	**59**	ICP	27/30
Arsenic	0.5	0.5	CREG	**7.7**	**141**	**2,100**	ICP	394/394
Cadmium	100	10	EMEG-c	0.5	**19**	**140**	ICP	394/394
Copper	26,000	2,000	RMEG	13	126	**2,700**	XRF	695/4211
Iron	400,000	30,000	EMEG-u	5,600	19,649	**88,000**	XRF	4208/4211
Lead	231	231	EPA	18	**1,239**	**25,000**	XRF	3674/4211
Manganese	40,000	3,000	RMEG	220	1,054	**5,100**	ICP	394/394
Mercury	1,000	100	EMEG-I	0.04	3.3	**130**	ICP	394/394
Thallium	60	4	RMEG	**31**	**56**	**200**	ICP	53/391
Vanadium	2,000	200	EMEG-I	7.7	26	**330**	ICP	394/394
Zinc	200,000	20,000	EMEG-c	26	1,460	**44,000**	XRF	4068/4211

Only metals with concentrations exceeding soil comparison values are listed.
[I] See Appendices A and B.
[*] Non-detects evaluated at the detection limit
n/a: Not available ; ppm = parts per million
RMEG: Reference Dose Media Evaluation Guide
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EMEG-u: Unpublished Environmental Media Evaluation Guide
EPA: U.S. Environmental Protection Agency
ICP: Inductively Coupled Plasma
XRF: X-ray Fluorescence

Table 9. Dust Data: Indoor Dust Samples, Eureka City, Utah.

	Health-Based Comparison Values (CV)[I] for Dust (same as soil)			Results of dust sampling (SRC 2001)				
	CV for Adult (ppm)	CV for Child (ppm)	Class	Range			analysis method	detection frequency
				Minimum (ppm)	Average[*] (ppm)	Maximum (ppm)		
Antimony	300	20	RMEG	0.2	5	**20.5**	ICP	56/57
Arsenic	0.5	0.5	CREG	**10.3**	**40**	**123**	ICP	57/57
Cadmium	100	10	EMEG-c	2	7.3	**18.6**	ICP	57/57
Lead	n/a	n/a	n/a	193	**707**	**2,010**	ICP	57/57

Only metals with concentrations exceeding soil comparison values are listed.
[I] See Appendices A and B.
[*] Non-detects evaluated at the detection limit
n/a: Not available; ppm = parts per million
RMEG: Reference Dose Media Evaluation Guide
CREG: Cancer Risk Evaluation Guide
EMEG-c: Chronic Environmental Media Evaluation Guide
ICP: Inductively Coupled Plasma

Table 10. Basement Soil Data: Eureka City, Utah.

	Health-Based Comparison Values (CV)[I] for Soil			Results of basement soil sampling (SRC 2001, UDEQ 2000)				
	CV for Adult (ppm)	CV for Child (ppm)	Source	Range			analysis method	detection frequency
				Minimum (ppm)	Average[*] (ppm)	Maximum (ppm)		
Arsenic	0.5	0.5	CREG	**6.8**	**29**	**131**	ICP	7/7
Cadmium	100	10	EMEG-c	1.2	7.4	**39.2**	ICP	7/7
Lead	231	231	EPA	122	**1,000**	**5,330**	ICP	7/7
Thallium	60	4	RMEG	0.34	1.7	**6.6**	ICP	5/7

Only metals with concentrations exceeding soil comparison values are listed.
[I] See Appendices A and B.
[*] Non-detects evaluated at the detection limit
n/a: Not available; ppm = parts per million
RMEG: Reference Dose Media Evaluation Guide
CREG: Cancer Risk Evaluation Guide
EMEG-c: Chronic Environmental Media Evaluation Guide
EPA: U.S. Environmental Protection Agency
ICP: Inductively Coupled Plasma

Table 11. Tap Water Data: Eureka City, Utah.

	Health-Based Comparison Values (CV)[I] for Water		Results of tap water sampling (SRC, 2001, UDEQ 2000)				
	MCL (ppb)	CV Source	Range			analysis method	detection frequency
			Minimum (ppb)	Average[*] (ppb)	Maximum (ppb)		
Arsenic	10	NPDWS	2.8	4.33	7.6	ICP	3/54
Cadmium	5	NPDWS	0.34	0.70	2.2	ICP	12/54
Chromium	100	NPDWS	0.51	0.80	0.94	ICP	6/54
Copper	1,300[†]	NPDWS	6.3	281	**1,970**	ICP	54/54
Lead	15	NPDWS	2.1	4.4 (excludes outlier)	13.8 38 (outlier)	ICP	19/54
Mercury	2	NPDWS	0.11	0.11	0.12	ICP	2/54
Selenium	50	NPDWS	2.8	5.12	7.7	ICP	5/54
Thallium	2	NSDWS	4.2	5.83	**6.9**	ICP	3/54
Zinc	5000	NSDWS	45	501	4,330	ICP	54/54

Only selected metals are shown.
ppm = parts per million
[I] See Appendix A.
[*] Results for detects only.
[†] Action level for copper; persons with Wilson's Disease should consult their personal doctor if the amount of copper exceeds the action level.
MCL: the highest level of a contaminant that is allowed in drinking water. See Appendix A for more information.
EMEG-c: Chronic Environmental Media Evaluation Guide
NPDWS: National Primary Drinking Water Standards
NSDWS: National Secondary Drinking Water Standards

Table 12. Completed Exposure Pathways.

Pathway Name	Exposure Pathway Elements					Time Frame	Chemical(s)
	Source	*Environmental Medium*	*Point of Exposure*	*Route of Exposure*	*Receptor Populations*		
Residential soil	Mining waste	surface soil and associated dust	incidental ingestion of soil and related dust	Ingestion	residents	past, present, future*	antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, thallium, vanadium,
Non-residential soil	Mining waste	surface soil and associated dust	incidental ingestion of soil and related dust	Ingestion	residents	past, present, future*	antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, thallium, vanadium, zinc.
Residential and non-residential soil	Mining waste	dust	air	Inhalation, especially during recreation involving dirt	residents, visitors	past, present, future*	antimony, arsenic, cadmium, chromium, copper, iron, lead, manganese, mercury, thallium, vanadium, zinc.

* Future exposure possible until cleanup is complete.

Table 13. Potential Exposure Pathways.

Pathway Name	Exposure Pathway Elements					Time Frame	Chemical(s)
	Source	*Environmental Medium*	*Point of Exposure*	*Route of Exposure*	*Receptor Populations*		
Basement soil	Mining waste	soil	incidental ingestion of soil and related dust	ingestion and inhalation	residents	past, present, future*	arsenic, cadmium, lead, thallium.
Tap water	pipes, mining waste	water	drinking, eating	Ingestion	residents	past, present, future	cadmium, copper, zinc
Paint	lead-based paint	paint chips, dust	ingestion of paint chips	Ingestion	children	past, present, future	lead
Garden	Mining waste	soil	ingestion of fruits & vegetables	Ingestion	residents	past, present, future*	antimony, arsenic, cadmium, copper, iron, lead, manganese, mercury, thallium, vanadium, zinc.

* Future exposure possible until cleanup is complete.

Table 14. Estimated Exposure Dose from Soil* and Indoor Dust Sampling

Element	Receptor Population	Estimated Exposure Dose (mg/kg/day)	Health Guideline (mg/kg/day)	Exceeds Guideline?	Source of Health Guideline	Cancer Class†
Antimony	pica child	0.009	0.0004	**yes**	ATSDR 2004a	NTP=3
	child	0.0003		no		
	adult	0.00004		no		
Arsenic	pica child	0.01	0.0003	**yes**	ATSDR 2004a	EPA=A NTP=1
	child	0.0006		**yes**		
	adult	0.0002		no		
Cadmium	pica child	0.002	0.0002	**yes**	ATSDR 2004a	EPA=B1 NTP=1
	child	0.00007		no		
	adult	0.00003		no		
Chromium	pica child	0.0001	0.003	no	ATSDR 2004a	EPA=A NTP=1
	child	0.000006		no		
	adult	0.000003		no		
Copper	pica child	0.03	0.04	no	HEAST	n/a
	child	0.001		no		
	adult	0.0006		no		
Iron	pica child	1.0	0.6	**yes**	NCEA	n/a
	child	0.04		no		
	adult	0.02		no		
Lead	pica child	2.4	0.01	**yes**	Unpublished‡	EPA=B2 NTP=3
	child	0.1		**yes**		
	adult	0.01		no		
Manganese	pica child	0.7	0.1	**yes**	IRIS	NTP=3
	child	0.03		no		
	adult	0.003		no		
Mercury	pica child	0.02	0.002	**yes**	IRIS	NTP=3 IARC=3
	child	0.0007		no		
	adult	0.00007		no		
Thallium	pica child	0.03	0.00008	**yes**	ATSDR 2004a	NTP=3
	child	0.001		**yes**		
	adult	0.0001		**yes**		
Vanadium	pica child	0.05	0.003	**yes**	ATSDR 2004a	NTP=3
	child	0.002		no		
	adult	0.0002		no		
Zinc	pica child	6.0	0.3	**yes**	ATSDR 2004a	NTP=3
	child	0.2		no		
	adult	0.02		no		

* Residential and non-residential soil

† See Appendix A for more information on cancer class and for a list of acronyms used in this table.

‡ The listed health guideline for lead is unpublished—literature reviews published in ATSDR 1999b were used to estimate the guideline.

n/a: not available

APPENDICES

APPENDIX A: Acronyms & Terms Defined

Background Level — The amount of a chemical that occurs naturally in a specific environment.

Cancer Classes — Each health organizations has a separate method of cancer classification:

EPA

- A = US Environmental Protection Agency (EPA) Classified as a Human Carcinogen.
- B1 = EPA Classified as Probable Human Carcinogen (based on limited human and sufficient animal studies).
- B2 = EPA Classified as Probable Human Carcinogen (based on inadequate human and sufficient animal studies).
- C = EPA Classified as a Possible Human Carcinogen (no human studies and limited animal studies).
- D = EPA Classified as unlikely to be a Human Carcinogen.

IARC

- 1 = International Agency for Research on Cancer (IARC) Classifies as "Carcinogenic to Humans" (sufficient human evidence).
- 2A = IARC Classifies as "Probably Carcinogenic to Humans" (limited human evidence; sufficient evidence in animals).
- 2B = IARC Classifies as "Possibly Carcinogenic to Humans" (limited human evidence; less than sufficient evidence in animals).
- 3 = IARC Classifies as "Not Classifiable".
- 4 = IARC Classifies as "Probably Not Carcinogenic to Humans".

NTP

- 1 = National Toxicology Program (NTP) Classifies as "Known Human Carcinogen".
- 2 = NTP Classifies as "Reasonably anticipated to be a carcinogen".
- 3 = NTP Classifies as "Not Classified".

Comparison Values — CVs: Health-based and media-specific concentrations that are used to select environmental contaminants for further evaluation in public health assessments. These values are not valid for other types of media, nor do concentrations above these values indicate that a health risk actually exists (agency that developed the value is in parenthesis for the examples below):

Examples of Comparison Values for non-cancer health effects:

EMEG-c = Environmental Media Evaluation Guide for chronic (more than 365 days) exposure (ATSDR).
EMEG-I = Environmental Media Evaluation Guide for intermediate exposure (ATSDR).
EMEG-u = Environmental Media Evaluation Guide - unpublished.

RMEG = Reference Dose Media Evaluation Guide (ATSDR).
NPDWR = National Primary Drinking Water Regulations (EPA) accessed on web at: www.epa.gov/safewater/mcl.html.
LTHA = Lifetime health advisory for drinking water (EPA).

Example of a Comparison Value for cancer health effects

CREG = Cancer Risk Evaluation Guide for $1x10^{-6}$ excess cancer risk (ATSDR).

Completed Exposure Pathway

A way in which people can be exposed to a contaminant associated with a site. An exposure pathway is a description of the way a chemical moves from a source to where people can come into contact with it. A completed exposure pathway has all of the five following elements:

1) a source of contamination
2) transport through environmental medium
3) a point of exposure
4) a route of human exposure
5) a receptor population

CREG

Cancer Risk Evaluation Guides are based on a contaminant concentration estimated to increase the cancer risk in a population by one individual in one million people over a lifetime exposure.

EMEG

Environmental Media Evaluation Guides are media-specific comparison values used to select contaminants of interest at hazardous waste sites. EMEGs are derived from Minimal Risk Levels (MRLs), developed by the Agency for Toxic Substances and Disease Registry (ATSDR), and are an estimate of human exposure to a compound that is not expected to cause noncancerous health effects at that level for a specified period. They are intended to protect the most sensitive individuals (i.e. children). MRLs are guidelines and are not used to predict adverse health affects. MRLs do not take into account carcinogenic effects, chemical interactions, or multiple routes of exposure.

EMEG-c

Environmental Media Evaluation Guides for chronic exposures (see entry for "EMEG" and for "Comparison Values").

EMEG-i

Environmental Media Evaluation Guides for intermediate exposures (see entry for "EMEG" and for "Comparison Values").

EMEG-u

Environmental Media Evaluation Guides that are unpublished are designated with an asterisk by the authors of this health

	assessment and used only in the absence of published comparison values and are calculated using equations outlined in Appendix B.
Exposure Dose	At some sites, the existing conditions may result in exposures that differ from those used to derive Comparison Values such as the EMEG. In these situations, the health assessor can calculate site-specific exposures more accurately using an exposure dose. The exposure dose can then be compared to the appropriate toxicity values (MRL, RfC, RfD).
Health-Based Comparison Values	see "Comparison Value" entry.
ICP	Inductively Coupled Plasma.
LOAEL	The **Lowest Observable Adverse Effect Level** (LOAEL) is the lowest exposure level of a chemical that produces significant increases in frequency or severity of adverse effects.
LTHA	**Lifetime Health Advisory** for drinking water from EPA.
MCL	A **Maximum Contaminant Level** (MCL) is the highest level of a contaminant that is allowed in drinking water. MCLs are set by EPA and are as close to MCLGs as feasible using the best available treatment technology and taking cost into consideration.
MCLG	A **Maximum Contaminant Level Goal (MCLG)** is the level of a contaminant in drinking water below which there is no known or expected risk to health. MCLGs allow for a margin of safety and are non-enforceable public health goals.
MRL	A **Minimal Risk Level** (MRL) is defined as an estimate of daily human exposure to a chemical that is likely to be without an appreciable risk of deleterious non-cancer health effects over a specified duration of exposure. Thus, MRLs provide a measure of the toxicity of a chemical.
NOAEL	The **No Observable Adverse Effect Level** (NOAEL) is the exposure level of a chemical that produces no significant increases in frequency or severity of adverse effects. Effects may be produced at this dose, but they are not considered to be adverse.
NPDWR	**National Primary Drinking Water Regulations** are legally enforceable standards that apply to public water systems. Primary standards are available on the web at: http://www.epa.gov/safewater/mcl.html

NPL site

The National Priorities List (NPL) is a list published by EPA ranking all the Superfund sites. Superfund is the common name for the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), a federal law enacted in 1980. This law was preauthorized in 1986 as the Superfund Amendments and Reauthorization Act. CERCLA enables EPA to respond to hazardous waste sites that threaten public health and the environment. A site must be added to the NPL site list before remediation can begin under Superfund.

Potential Exposure Pathway

A possible way in which people can be exposed to a contaminant associated with a site. An Exposure pathway is a description of the way a chemical moves from a source to where people can come into contact with it. A potential exposure pathway has four of the five following elements:

1) a source of contamination
2) transport through environmental medium
3) a point of exposure
4) a route of human exposure
5) a receptor population

PRG

Preliminary Remediation Goals. Used for EPA Planning Purposes only.

Public Health Hazard

The category ATSDR assigns to sites that pose a health hazard to the public as the result of long-term exposures to hazardous substances. See "Public Health Hazard Categories"

Public Health Hazard Categories

Categories defined by ATSDR and used in public health assessments that assess if people could be harmed by conditions present at a site. One of the following categories is assigned to each site:

Urgent Public Health Hazard
Public Health Hazard
Indeterminate Public Health Hazard
No apparent health hazard
No Public Health Hazard

RMEG

Reference Dose Media Evaluation Guides are media-specific comparison values used to select contaminants of interest at hazardous waste sites. RMEGs are derived from reference doses (RfDs), developed by the U.S. Environmental Protection Agency

	(EPA), and are an estimate of human exposure to a compound that is not expected to cause noncancerous health effects at that level for a specified period. They are intended to protect the most sensitive individuals (i.e. children). RfDs are guidelines and are not used to predict adverse health affects. RfDs do not take into account carcinogenic effects, chemical interactions, or multiple routes of exposure.
EPA	The **US Environmental Protection Agency** is the federal agency that develops and enforces environmental laws to protect the environmental and public health.

APPENDIX B: Calculations

Comparison Values

Comparison values (CVs) are used in public health assessments and serve as a screening tool to identify contaminants that will require further evaluation.

Comparison Value Calculations for Water [ATSDR 1992b]:
Each year, ATSDR updates their list of Comparison Values for selected compounds in soil, air, and water. EMEGs, RMEGs, and CREGs are all examples of comparison values. When the compound of interest is not listed, comparison values can be calculated as follows:

for non-carcinogenic health effects:
EMEG = MRL x BW / IR

RMEG = R_fD x BW / IR

for carcinogenic health effects:
CREG = $10E^{-6}$ x BW / IR x OSF

Where:	EMEG	=	Environmental Media Evaluation Guide (ppm)
	MRL	=	Minimal Risk Level (mg/kg/day)
	RMEG	=	Reference Dose Media Evaluation Guide
	R_fD	=	Reference Dose
	CREG	=	Cancer Risk Evaluation Guide for $1x10^{-6}$ excess cancer risk
	OSF	=	Oral Slope Factor
	BW	=	Body Weight (kg)
		=	70 kg for an adult
		=	10 kg for a child
	IR	=	Water Ingestion rate (liter/day)
		=	2 L/day for an adult
		=	1 L/day for a child

Exposure Dose

The comparison value calculations described above are derived using standardized exposure assumptions. At some sites, the existing conditions may result in exposures that differ from those used to derive Comparison Values such as the EMEG. In these situations, the health assessor can calculate site-specific exposures more accurately using an exposure dose. The exposure dose can then be compared to the appropriate toxicity values (MRL, RfC, RfD)

Calculating Exposure Dose (ED) for soil [ATSDR 1992b]:

ED = { (C x IR x EFx10^{-6}) / BW }

Where: C = Contaminant level (mg/kg)

IR = Soil Ingestion rate (mg soil/day)
= 100 mg soil/day for an adult
= 200 mg soil/day for a child
= 5,000 mg soil/day for a pica child

EF = Exposure Factor (see below for calculation)

BW = Body Weight (kg)
= 70 kg for an adult
= 10 kg for a child

Calculating Exposure Dose (ED) for dust:

ED = { C x IR x EFx10^{-6}) / BW }

Where: C = Contaminant level (mg/kg)

IR = Dust Ingestion rate (mg dust/day)
= 2.4 mg soil/day for an adult (EPA, 1997)
= 30 mg soil/day for a child (EPA, 1997)

EF = Exposure Factor (see on the following page for calculation)

BW = Body Weight (kg)
= 70 kg for an adult
= 10 kg for a child

Calculating Exposure Dose (ED) for tap water [ATSDR 1992b]:

ED = { (C x IR x EFx10^{-6}) / BW }

Where: C = Contaminant level (µg/kg)

IR = Water Ingestion rate (liters/day)
= 2 liters/day for an adult
= 1 liter/day for a child

EF = 1 was used for this health assessment
= 1 represents daily exposure to the contaminant rather than intermittent exposure. This assumes that the person is using home water as the primary drinking source.
BW = Body Weight (kg)
= 70 kg for an adult
= 10 kg for a child

Calculating Exposure Factor (EF) [ATSDR 1992b]:

EF = { (#days/week) x (#weeks/year) x (ED) / (ET) x (365days/year) }

Where: ED = exposure duration (years)
ET = exposure time (years)

In estimating EF for adults and children in Eureka City, calculations were made for infants, child not in school, pica child not in school, pica child in school, child in school, teenager, adult staying in Eureka City, and adult leaving Eureka City for work. In summarizing this data in Table 14, the groups were lumped into pica child (0–17 years), child (0–17 years), and adult (age 18+). The worst exposure scenario was listed for each group. If the child at home had a higher exposure dose than the child at school, the child at home's exposure was posted. The following are general examples from the exposure estimates performed. Days per week are a function of hours per day.

Receptor	Days/wk	Wks / Yr	Exposure duration (years)	Exposure time (years) 70 used for carcinogens	Exposure Factor (EF)
For exposure to residential soil					
Child	3.1	52	6	6	0.44
Adult	2.3	52	30	30	0.33
For exposure to non-residential soil					
Child	0.17	52	6	6	0.02
Adult	0.17	52	30	30	0.02
For exposure to dust					
Child	3.9	52	6	6	0.56
Adult	4.6	52	30	30	0.65

APPENDIX C: Community Needs Assessment

Social Diagnosis

Eureka City is a small town in Juab County with a total population of 766 (1). Eureka City is 42 miles west of Provo and 84 miles southwest of Salt Lake City. Eureka City was a wealthy gold and silver mining area in Utah; it was the financial center for Tintic Mining District. Eureka City was established as a city in 1892. In 1979 Eureka City was placed on the National Register of Historic Places as part of the Tintic Mining District Multiple Resource Area, recognizing the importance of remaining buildings and sites (2).

During 1990, four percent of the families in Eureka City made between $25,000 and $34,999 dollars a year. The median household income for Eureka City is $19,732. Thirteen families in Eureka City fell below the poverty level (3). The Eureka City public school system consists of two schools: one elementary school (kindergarten through 8th grade) and one high school (9th through 12th grades). According to the 1990 Census, 71.8% of the residents were high school graduates. 2.3% of Eureka City residents have a bachelor's degree or higher (3). In 1990, 97.7% of Eureka City population was white, while 2.3% was Hispanic or Latino. According to the 2000 Census, seven residents in Eureka City speak a language other than English (1). Eureka City does not have a grocery store, but does have two small convenience stores. The closest medical facility to Eureka City is approximately 26 miles northeast in Payson, Utah. Eureka City has two religious meetinghouses: the Church of Jesus Christ of Latter Day Saints and a Catholic church. Residents of Eureka City participate in a variety of groups: Senior Citizen Group, Elks Club, Book Club, Region Auxiliary, Parent Teacher Organization (PTO), Boy Scout Program, and a Historical Group.

The United States Environmental Protection Agency (EPA) has concluded that the lead and arsenic are contaminants of interest in Eureka City (4). These chemicals could pose a health risk to the community. Children are the most susceptible to the harmful effects of lead.

EPA is removing lead contaminated soil from residential areas. EPA started removing soil in July 2001, after identifying the most seriously contaminated lots. The agency will continue to remove soil from contaminated lots.

Epidemiological Diagnosis

Goals

1. By September 2004 decrease the number of children who have elevated blood lead tests by 100%.
2. Increase awareness among residents in Eureka City of ways to reduce their risk of lead poisoning.

Behavioral and Environmental Diagnosis

Increase awareness of the people in Eureka City; help them understand there is a problem with lead and arsenic poisoning. The health educator needs to focus on teaching the residents of

Eureka City about lead and arsenic contamination. Information will be presented on how to protect themselves and their children from lead and arsenic exposure. Eureka City residents need to understand that there can be long-term health problems associated with lead and arsenic exposure. Lead poisoning is especially harmful to younger children.

Community Concerns

The community has expressed a number of concerns regarding lead contamination. Some residents are concerned with the impact on human health. They fear for their children's safety. The community worries about replacing the dirt for the bike trails for kids. There is also concern for the potential damage to structures around the city. Residents of Eureka City worry about a dropping of real estate values of homes because of the bad publicity Eureka City has received. They worry that EPA will not have enough funding to finish the work it has started. They also worry about the repository site location for disposing the contaminated dirt and plans for cleaning up residential yards (5).

Some residents feel that there is not a problem with lead in Eureka City. Some parents have lived in Eureka City their whole lives and consider themselves fine, so they assume their children are fine, too.

Educational and Organizational Diagnosis

Predisposing—knowledge, attitudes, beliefs, values

Suzanne Stemmons, the health educator from the Utah Department of Health's (UDOH) Environmental Epidemiology Program (EEP) gave four presentations in 2001. The presentations were to 7th through 11th graders at Tintic High School. An intern pediatrician from Central Utah Public Health Department educated the preschool and the Eureka City elementary kids about the effects of lead poisoning. EPA has held two public meetings and an open house in Eureka City. EEP participated in these events and has set up health information tables. Residents were able to visit with the representatives from the agencies and take information.

EEP provided free blood lead testing to Eureka City residents in September and October 2000. Of the 238 residents tested, 30 blood lead levels appeared to be elevated. UDOH revisited Eureka City in September and October 2001 and again held free blood lead testing for residents who wanted to participate. The total number of new residents tested was 32, and eight of the 32 tested showed elevated blood lead levels. The residents who were tested in 2000 returned for testing, and seven of those 23 residents' blood lead levels proved to be elevated. Educational calendars, growth charts, and pamphlets were given out to the participants who came to have their blood tested, to offer additional education on lead. A Sesame Street video about lead poisoning prevention was played on the television while the children were waiting. The health educator was there for both activities to answer questions and provide information about lead poisoning. Letters were sent to the parents or guardians of children with elevated blood lead levels recommending that the child be retested in two to three months. Sixteen percent of the residents tested by UDOH in 2000–2001 had elevated blood lead tests. In 2000–2001, 24 of the children tested by the UDOH under the age of 6 years old had elevated blood lead levels.

One problem the health educator has continuously noticed is the beliefs that some of the residents in Eureka City harbor. Some Eureka City residents do not believe that there is a health concern. Some parents have stated that they have lived in Eureka their whole lives and have had no problems. If the parents perceive that there is not a problem, then they will pass the belief onto their children. The primary goal of the health educator is to change the perception of those people who do not believe there is a health problem. UDOH will continue to present information on lead exposure and provide the entire community with information on lead poisoning. Many residents are concerned about the safety of their children and are taking every possible precaution to avoid any exposure to lead.

On April 11, 2002, Kori Gunn and Suzanne Stemmons met with the high school principal, the elementary school principal, the mayor of Eureka City, and a local resident who is a parent in Eureka City and a writer for the Eureka City newspaper. Ms. Gunn and Ms. Stemmons informed them about UDOH's proposed health education plan and then requested comments and suggestions regarding the plan. Each of the people expressed a number of suggestions along with opinions about what would or would not work.

Ms. Gunn and Ms. Stemmons discussed implementing a lead poisoning prevention curriculum into the schools. Both of the principals were delighted to ask their teachers to incorporate the activities into their curriculum. Copies of the lead poisoning prevention curriculum designed by Ottawa County Health Department in Oklahoma were sent to each of the principals. Ms. Gunn and Ms. Stemmons stated that they would be available to come into the classrooms to present a lead poisoning prevention activity. EEP staff will follow up with the teachers to find out what the kids like and dislike about the activities in the curriculum. The health educators have been working with the high school principal and the Parent Teacher Organization (PTO). A local fair put on by the PTO is planned at the high school in May 2002. UDOH will be at the high school offering free blood lead tests from 4:00 pm until 9:00 pm. The parents of the children having their blood lead tests will also be able to enter into a drawing for $10.00 of gasoline. The drawing will be limited to one entry per family. Pamphlets regarding lead poisoning will also be handed out to the residents.

In the fall, another free blood lead test will be offered to he community. There will be a poster/t-shirt design contest for elementary school students and one for the high school students. The winner and the second place contestant will receive cash awards. The design will be turned into a poster and/or t-shirt. Free t-shirts will be given to participants who are under the age of 18 and who have blood lead tests. Free blood lead tests will be held quarterly during the EPA remediation.

Health Education Plan

Community

- Provide blood lead testing quarterly. Hand out incentives such as t-shirts, cash, gift certificates, etc. and other educational materials to those who participate.
- Provide bi-annual newsletters informing the residents of events and lead poisoning prevention information.
- Talk to the local Eureka newspaper to advertise blood testing sessions and other events.
- UDOH or the Central Utah Public Health Department will go into the homes of the children with elevated blood lead levels and discuss ways that can decrease these levels, with one-on-one attention.
- UDOH stakeholders will hold a meeting with parents and teachers and the principal of the elementary school, where they can voice their concerns and expectations.
- Meet with city officials to discuss activities UDOH would be interested in undertaking, asking for the support and opinions of these officials.
- Emphasize the importance of retesting.
- UDOH will hold a community meeting once a year to give updates and other important information. A postcard survey will be handed out at the end of the community meeting to receive comments; free postage to mail into the state will be provided.

Health care providers

- Mail information to the health care providers in the area to recommend blood lead tests in children 6–72 months of age.
- Upon parent or guardian consent, inform providers of residents with blood lead levels greater than10 µg/dL.

Schools

- Implement the Lead Poisoning Prevention Curriculum into the elementary and high school. Each year, the children will learn more about lead poisoning prevention. Have one lead poisoning prevention activity during lead poisoning prevention week.
- Have a poster/t-shirt design contest for children in both the elementary and high school.

Increase blood lead tests

- Partner with the EPA's Eureka City stakeholders group.
- Mail reminder for blood lead testing (mass mailing two times a year).
- Newsletters (two times a year).
- Keep in contact with teachers, principals, and city officials.

Possible incentives to give away

- Pencils
- Magnets
- Buckets w/soap, cloth, and scrubber
- T-shirts
- Stickers
- Balloons
- Coloring story books and crayons
- Cash

Enabling—skills, resources, or barriers help hinder the desired behavior

Some of the Eureka City residents do not believe there is a health concern in Eureka City. Some of the residents have been offended by the way the media have portrayed them in the past (EPA). Some Eureka City residents have worked at Dugway Proving Ground in the past and have had bad experiences, resulting in some distrust of the government.

Reinforcing—rewards received from others following the adoption of desired behavior

The benefit the Eureka City residents will receive by following these activities are as follows: they will know how to protect themselves from lead poisoning; their children will not be in danger of getting lead poisoning; both children and adults will be healthier; and they will have a better quality of life.

Administrative and Policy Diagnosis

When asked how residents would like to receive their information in the future, the residents stated many different options. They liked the fact sheets. Some suggested more information be given in writing, such as quarterly reports and public notices. They said posting information in the post office and city hall, as well as in Carpenter's Station, V & J Grocery, and Linda's Summit Café would also be beneficial (EPA). Information in this community is also shared through word of mouth.

Implementation

The health educator will give a lead poisoning prevention curriculum to the elementary and high school. The health educator will also talk to each of the teachers to find out what is working or not working with the curriculum. The teachers will also have the option of having the health educator give a short presentation about lead poisoning to the children. A fact sheet will also be handed out once a year to each child.

A poster/t-shirt contest will be announced for children in elementary and in high school. They will design a poster that UDOH will use, and the top two winners for both the elementary school and high school will receive an incentive.

Free blood lead testing by UDOH or CUPHD will be held at least twice a year in Eureka City to encourage the residents to have their blood lead tests. Incentives will also be offered to the residents participating. Some of the incentives may include t-shirts, gift certificates, cash, stickers, etc. UDOH or CUPHD will advertise the blood lead test by undertaking the following activities:

- Mail flyers to each post office box in Eureka City
- Give children flyers at school to take home
- Post flyers around town
- Advertise in the local newspaper
- Advertise in local club newsletters

A class for parents will be held in the evenings each spring every year for all residents of Eureka City. This class will give information to the parents on how they can protect their children from being lead-poisoned. The presenter will also emphasize the importance of having their children re-tested. An incentive will be offered to parents who participate in the class. The following information will be presented to the parents:

- How to reduce exposure to lead
- The effects of lead poisoning
- The signs and symptoms of lead poisoning

The health educator will conduct a community meeting at the Eureka City Hall. This meeting will be held once a year to update the residents on any new information (blood lead results, new activities, etc.). A newsletter will also be mailed out to all Eureka City residents once a year in April. These activities will continue until the goals are met.

Impact evaluation

A survey will be handed out at the end of the parent class to gain information on how the residents are receiving their information that is being taught. This evaluation will ask the residents if they would like to learn more and how often. The health educator will also follow up with the teachers in the elementary and high school to determine how often the teachers taught the lead poisoning prevention curriculum, what the children enjoyed, how the children reacted to the information, and what activities worked.

Outcome evaluation

Blood lead tests were offered to Eureka City resident in September 2000 and again in September 2001. In May and September 2002, blood lead tests were again offered to Eureka City residents to see if their blood lead levels were less than 10 µg/dL.

Blood testing will continue to be offered on a quarterly basis throughout the year around the months of August/September, November/December, February/March, and May/June. This testing will be offered to Eureka City residents to determine if blood lead levels are less than 10 µg/dL. The results of these tests will provide a measurement to evaluate if the goals are being met. The blood lead levels will also determine if the educational activities need to continue.

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