ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

Public Health Assessment for

DAVENPORT AND FLAGSTAFF SMELTERS
SANDY CITY, SALT LAKE COUNTY, UTAH
EPA FACILITY ID: UTD988075719
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

DAVENPORT AND FLAGSTAFF SMELTERS
SANDY CITY, SALT LAKE COUNTY, UTAH

EPA FACILITY ID: UTD988075719

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

THE AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

Section 104 (i) (7) (A) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, states

> "...the term 'health assessment' shall include preliminary assessments of potential risks to human health posed by individual hazardous waste sites and facilities, based on such factors as the nature and extent of contamination, the existence of potential pathways of human exposure (including ground or surface water contamination, air emissions, and food chain contamination), the size and potential susceptibility of the community within the likely pathways of exposure, the comparison of expected human exposure levels to the short-term and long-term health effects associated with identified hazardous substances and any available recommended exposure of tolerance limits for such hazardous substances, and the comparison of existing morbidity and mortality data on diseases that may be associated with the observed levels of exposure. The Administrator of ATSDR [Agency for Toxic Substances and Disease Registry] shall use appropriate data, risk assessments, risk evaluations, and studies available from the Administrator of EPA [U.S. Environmental Protection Agency]."

In accordance with the CERCLA section cited, ATSDR has conducted this public health assessment for the Davenport and Flagstaff Smelters Site in Sandy City, Salt Lake County, Utah. The assessment uses data from the ATSDR site summary form. Additional public health assessments may be conducted for this site as more information becomes available to ATSDR.

The conclusions and recommendations presented in this public health assessment are the result of site-specific analyses and are not to be cited or quoted in other evaluations or public health assessments.

Use of trade names is for identification only and does not constitute endorsement by the Public Health Service or the U.S. Department of Health and Human Services.

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SUMMARY

The Davenport and Flagstaff Smelters site is located approximately 15 miles southeast of Salt Lake City, near Sandy City, in Salt Lake County, Utah. Smelting activities conducted in this area between 1872 and 1875 resulted in elevated levels of arsenic and lead in the soil. Portions of the area are now 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 (PHA) to identify potential health hazards posed by former smelting activities at the Davenport and Flagstaff Smelters site. The site was added to the U.S. Environmental Protection Agency's National Priorities List on April 30, 2003. The site is currently classified as a public health hazard (ATSDR health hazard category B[1]) because of arsenic and lead concentrations in residential soil.

The U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality (UDEQ) detected 6 to 123,000 parts per million (ppm) lead and 5 to 4,690 ppm arsenic in the top 6 inches of soil in residential areas of the site. A Baseline Human Health Risk Assessment was performed by the EPA to determine if health risks associated with contamination were sufficient to warrant remediation. A risk management decision established action levels of 600 ppm lead and 126 ppm arsenic as the health-based cleanup levels for residential surface soils. EEP concurs with these levels. In 2004, EPA conducted an emergency response cleanup on four properties. Enough funding was available to remediate two additional properties. Cleanup on the remaining residential properties will continue in 2005 and 2006.

Arsenic and lead in the environment can come from both natural and man-made sources. The main source of these metals in the Davenport and Flagstaff area is from soil and dust associated with former smelting activities. Most of the soil with high concentrations of arsenic and lead is within a 330-yard (300 meters) radius of the former smelters. An estimated 87 adults and 43 children now live in this area. Dust from inside of homes in the Davenport and Flagstaff area also contains elevated levels of arsenic and lead.

Adults and children can be exposed to arsenic and lead if they ingest or inhale soil or dust from areas near the former smelters. Such exposures were estimated for both adults and children living near the site. Exposure-dose estimates were based on the average and maximum soil concentrations of arsenic and lead found in the top 6 inches of soil in residential areas near the site. Once calculated, exposure doses were compared to ATSDR health guidelines and the following conclusions were made: 1) It is unlikely that adults exposed to the average amounts of arsenic and lead detected in residential soils will experience adverse health effects; however, if adults are exposed to the maximum levels of arsenic and lead, adverse health effects may occur; and, 2) Children and pica children are at risk for possible adverse health effects if exposed to the average and maximum amounts of arsenic and lead detected in the residential soils. Yards in the residential areas are landscaped with sod and dense vegetation, making current exposure to bare soil and dust minimal. Future exposure to contaminants may occur if soil is not removed and/or vegetation is not maintained.

[1] ATSDR health hazard category B: This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances. See Appendix A for more information.

Compared with adults, children are at increased risk from exposure to environmental contaminants; children often play outside and have behaviors that make them more likely to contact soil and dust. Exposure to lead can adversely affect a child's intelligence, behavior, and development, even at relatively low levels (10 micrograms lead per deciliter blood). Studies with laboratory animals show that inorganic arsenic, such as arsenic found in soil near the former smelters, can act as a developmental toxicant. The EPA classifies arsenic as a human carcinogen (ATSDR 2004). Utah Department of Health records show that only six of the estimated 43 children living on the site have been tested for blood lead levels since 1996; none of these children had elevated blood lead levels.

To help protect the health of residents living near the site, EEP recommends the following:

- All children in the Davenport/Flagstaff area, 6 months to 17 years of age, should have their blood tested for lead, even if they seem healthy. Pregnant women living near the former smelters also should consider being tested. A family physician or health-care provider should be able to perform a blood lead test. Blood lead tests are recommended both during and after cleanup. The Utah Blood Lead Registry should be monitored for children in the Davenport/Flagstaff area with elevated blood lead levels to ensure adequate follow-up and case management.
- Community health education continues to be provided to inform residents about the possible health effects from exposure to arsenic and lead and about interim measures that can be taken to reduce exposures.
- 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), and by keeping homes clean and free of soil and dust. Residents will be urged to maintain vegetative ground cover to help limit dust and soil exposure.
- Cleanup efforts in the Davenport/Flagstaff Smelters site should proceed in a way that is protective of human health. Particulate air sampling and dust suppression should be used during remediation.

Current conditions indicate that exposure to contaminants from the Davenport/Flagstaff site pose a current and future public health hazard. EEP has designed a public health action plan to mitigate or prevent adverse human health effects resulting from exposure to arsenic and lead in soil and dust associated with the Davenport/Flagstaff site. The public health action plan includes the following:

- EEP and the Salt Lake Valley Health Department encourage parents and guardians to have children 6 months to 17 years of age tested for blood lead. Pregnant women living near the former smelters also should consider being tested. EEP will continue to monitor the Utah Blood Lead Registry for children with elevated blood lead levels living near the site to ensure adequate case management and environmental follow-up.
- EEP's Community Health Educator has conducted a health-education needs assessment to determine the environmental health education needs and health concerns within the community. The needs assessment will be used to direct future health education activities in the community affected by the site. EEP staff will address health concerns related to the site, provide information on arsenic and lead, and outline measures to reduce exposure to arsenic and lead in the soil.

- EEP will inform residents about the possible health effects from exposure to arsenic and lead and about interim measures that can be taken to reduce exposures. Residents also will be informed of the importance of maintaining vegetative ground cover to help limit dust and soil exposure
- EEP supports EPA and UDEQ efforts to remove soil in residential areas. EEP also supports EPA and UDEQ's plan to monitor air and use dust suppression during construction activities associated with cleanup to ensure minimal impact on the public from airborne dust.

PURPOSE AND HEALTH ISSUES

The Agency for Toxic Substances and Disease Registry (ATSDR) requested that the Environmental Epidemiology Program (EEP) of the Utah Department of Health conduct this public health assessment (PHA) to identify any public health hazards posed by the Davenport and Flagstaff Smelters Site located near Sandy City, in Salt Lake County, Utah [EPA ID No. UTD988075719]. The site was added to the U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL) on April 30, 2003.

For this public health assessment, EEP analyzed results from soil, surface water, and sediment samples to determine the contaminants of concern. EEP evaluated exposure pathways identified for the contaminants and estimated exposure doses for residents living near the former smelters. Ultimately, this assessment provides conclusions on the public health issues relevant to the Davenport and Flagstaff site and makes recommendations to protect the health of area residents.

The 1986 Superfund Amendments and Reauthorization Act amended the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980. This legislation directs ATSDR to perform specific public health activities associated with actual or potential exposures to hazardous substances released into the environment. Among those activities, ATSDR is required to conduct a PHA for each facility/site listed, or proposed to be listed, on the NPL within 1 year of its listing. In addition, ATSDR may conduct a PHA for a particular facility or release when petitioned by a person or group of persons.

BACKGROUND

Site Description and History

In the late 1800s at least three smelters operated at the mouth of Little Cottonwood Canyon near Sandy City, Utah - the Davenport Smelter, McKay and Revolution Silver Mining Smelter and, about ¼ mile north, the Flagstaff Smelter (Figures 1 and 2). The former Davenport Smelter operated from 1872 through 1875, processing lead ore using two vertical blast furnaces on a 3.62-acre property (SLDT 1872). The McKay and Revolution Silver Mining Smelter also processed lead ore in the late 1870s. The Flagstaff Smelter processed "flagstaff", or lead ore, for lead, silver, and gold from 1870 through 1873 (UDEQ 1992; SLDT 1872). The Flagstaff Smelter property included about 14 acres (UDEQ 1992) that contained three vertical blast furnaces (SLDT 1872). These three smelters will be referred to as the Davenport/Flagstaff Smelters for the remainder of this health assessment.

During the smelting process, ore from Little Cottonwood Canyon mines was crushed and melted. Lead, arsenic, and other metals were released into the environment in the form of dust and flue ash (URSGWC 2001). The Davenport Smelter alone had a capacity of 20 tons of bullion per day (Fabian 1873). When these smelters were operating, mining practices were relatively inefficient. The U.S. Commissioner of Mining Statistics at the time estimated that half the lead was "lost in

slag, or up the chimney" (USCMS 1873). "Contaminated ash and dust likely have been subjected to continued erosion, transportation and redeposition since the 1870s by wind, surface water run-off, and infiltration of leachate" (URSGWC 2001).

In 1991, a discovery of ladle casts in Little Cottonwood Creek prompted a study of historical smelter sites in the valley. Investigations in 1992 by the U.S. Environmental Protection Agency (EPA) and in 1994 by the Utah Department of Environmental Quality (UDEQ) detected elevated concentrations of arsenic and lead at the former smelter locations. Except for the slag piles and contaminated soil, there is little physical evidence of the historical smelters.

A Site Characterization of the residential areas surrounding the Davenport/Flagstaff Smelters site was completed in 1998. A total of 740 samples were collected from 32 residences. Surface and subsurface samples were collected in the general area of the former smelter locations in order to provide information regarding the source, nature and extent of contamination. Arsenic and lead was found in soil at concentrations that exceeded EPA's risk-based screening levels (EPA 2002d).

To determine if risks to human health associated with the contamination were sufficient to warrant remediation, EPA conducted a Baseline Human Health Risk Assessment. The action levels for residential soil established for the site are 126 ppm arsenic and 600 ppm for lead. The 126 ppm action level for arsenic was derived from a target cancer risk level of 10^{-4} (meaning the risk of developing cancer related to arsenic exposure is 1/10,000). The 600 ppm action level for lead was based on a target such that no child under the age of 7 has more than a 5% chance of exceeding the blood lead concentration of 10 µg/dL (micrograms of lead per deciliter of blood) (EPA 2002d).

The Remedial Investigation concluded that cleanup take place at all residential properties with arsenic and lead contamination greater than the action levels established for the site. Three cleanup alternatives were suggested, two of which included excavation and institutional controls, the third being "no action". The selected remedy for the Davenport/Flagstaff Smelter site includes excavation of contaminated soil to a depth of 18 inches, placing clean, imported soil, backfill and a 6 inch topsoil layer over all excavated soil, removal and replanting of affected non-native vegetation, and development and implementation of institutional controls for any contamination left in place on properties recommended for remediation (EPA 2002d).

EPA began an emergency response cleanup in July 2004. A total of six properties were remediated. Soil was excavated to a depth of 4–5 feet, dust monitoring took place, and all workers were equipped with personal air monitors to ensure safety. EPA plans to remediate six more properties in 2005, as funding permits. The goal is to clean up most of the remaining residential properties by the end of 2006. EPA and UDEQ will work with Salt Lake County to instill institutional controls on properties where cleanup has occurred.

Demographics and Land Use

The Davenport/Flagstaff Smelters site is located approximately 15 miles southeast of Salt Lake City, Utah, in a residential area near Sandy City and at the mouth of Little Cottonwood Canyon

(Figure 1). The area surrounding the site consists of affluent single-family homes, one of Salt Lake's premier restaurants, and nonresidential property. Due to its proximity to the canyon and extensive natural vegetation, the area is prime for growth and residential development (EPA 2002d).

EPA and UDEQ have divided the area into two operational units during their activities at the site. These include the residential area, "Operable Unit 1" (OU1), and the undeveloped non-residential area, "Operable Unit 2" (OU2). OU1 is divided into three sections; one section surrounds the former Davenport and McKay Smelters, and two sections are located near the former Flagstaff Smelter.

In total, the OU1 area contains at least 43 single-family homes. This information, coupled with U.S. Bureau of the Census data from the 2000 census, gives an estimated 87 adults and 43 children (those 17 years or under) living within OU1. The Davenport/Flagstaff Smelter site is within Census Tract 1101.02, Block Group 2, and includes parts of Blocks 2014, 2013, and 2011 (U.S. Bureau of the Census 2000). A map containing demographic statistics for the site is presented in Figure 3.

Residential lots in the area range from ¼ to 1 acre in size. Landscaping is generally elaborate and well maintained. Most residential yards are predominantly grass covered with some areas of natural vegetation and exposed soils (EPA 2002d).

No plans have been made to determine cleanup action for the OU2 site. OU2 is currently under investigation and includes slag piles, groundwater and surface water, and areas north of the Villas La Montagne Condominiums. No residents live in this area.

DISCUSSION

Nature and Extent of Contamination

Surface Soil

Levels as high as 123,000 parts per million (ppm) lead and 4,690 ppm arsenic have been found in the top 6 inches of soil in the residential areas (OU1) of the Davenport/Flagstaff Smelters site (SAIC 2000, URSGWC 2001). Table 1 shows the results and detailed information about soil sampling in surface soil from the residential areas outlined in Figure 2. Surface soil samples were composite samples at 0 - 2" or 0 - 6" in areas of bare soil. If sod was present, sampling began with soil under the grass and sod. Subsurface soil samples were grab samples. Many of these soil samples contained arsenic and lead concentrations that exceed ATSDR comparison values of 20 ppm and 400 ppm, respectively. Comparison values are used only to select contaminants of concern at a site; these comparison values do not predict adverse health effects nor should they be used to set cleanup levels (see Appendices A and B).

The 2000 and 2001 arsenic and lead soil sampling results are summarized in Table 1. Previous soil sampling took place in 1994. The 1994 samples were analyzed for a spectrum of heavy metals (see Table 2). Levels of antimony, arsenic, cadmium, and lead exceeded ATSDR

comparison values. However, these samples were taken directly from a slag pile in the nonresidential area. All other test samples revealed antimony and cadmium concentrations that are well below ATSDR comparison values (UDEQ 1996a,b).

Dust

Dust samples for lead contamination were collected from 11 homes during January 1999. Three methods of dust collection were used. The results are summarized in Table 3. Homes having the highest levels of lead contamination appear to be the homes with the heaviest foot traffic, or homes that have wooded areas or natural soil landscapes versus imported soil and/or sod. The highest concentration of lead in dust (14 mg/kg) was collected from the west building of the former Alta Academy (south of the former Davenport Smelter). The next highest concentration, 0.7 mg/kg, was found on a carpeted surface within a home next to the former Flagstaff Smelter (URSGWC 2001).

Dust samples were not evaluated for arsenic.

Sediment

Three sediment samples were collected from Little Cottonwood Creek (UDEQ 1996a,b). Samples were analyzed for a spectrum of heavy metals; results are summarized in Table 4. Much of the data were qualified; for example, many of the high values were qualified as "J" values. This means that the analyte was positively identified; however, the associated numerical value is only an approximate concentration of the analyte in a soil sample. Initial results indicated elevated levels of antimony and cadmium at 68.2 and 164 mg/kg, respectively. Arsenic concentrations peaked at 257 mg/kg and lead at 1,480 mg/kg.

Surface Water

Surface water is being investigated by UDEQ as part of the OU2 and there are no plans for immediate cleanup. Initial test results of water from Little Cottonwood Creek (UDEQ 1996a,b) indicate that concentrations of antimony, arsenic, cadmium, and lead exceed ATSDR comparison values for drinking water, indicating that further investigation is warranted. Results for surface-water samples collected from Little Cottonwood Creek are summarized in Table 5.

Previous investigations of the site reported a spring discharging approximately 500 feet northwest of the Davenport Smelter site (UDEQ 1996a). Initial results of the spring revealed elevated levels of lead. UDEQ is planning further sampling as part of the OU2 investigation.

Groundwater

All residences onsite are on a municipal water source that is routinely tested for arsenic and lead. Because the site is near a recharge zone, it is possible that metals from the site could enter the groundwater. UDEQ will investigate this further as part of the OU2 investigation.

Quality Assurance/Quality Control

In preparing this document, EEP relied on quality assurance/quality control information provided in the referenced documents and contacts. Data with demonstrated problems were noted if

included in the tables and calculations if they provided unique and relevant information. Whenever possible, data were taken directly from laboratory sheets, not secondary source documents.

Exposure Pathway Analysis

To determine whether nearby residents are exposed to contaminants at the site, ATSDR and EEP evaluate the environmental and human components that make up a human exposure pathway. An exposure pathway consists of the following 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 a *completed* exposure pathway, all five elements exist and indicate that exposure to a contaminant has occurred in the past, is occurring, or will occur in the future. In a *potential* exposure pathway, at least one of the five elements has not been confirmed, but it may exist. Exposure to a contaminant may have occurred in the past, may be occurring, or may 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).

When an exposure pathway is identified, ATSDR comparison values (CVs) for air, soil, or drinking water are used as guidelines for selecting contaminants that require further evaluation [ATSDR 1992]. To protect the more susceptible population, CVs for children are used when available.

Completed Exposure Pathways

There are two completed exposure pathways for residents living near the Davenport/Flagstaff Smelters site: soil ingestion and dust inhalation. Elements of these completed exposure pathways for residents on the Davenport/Flagstaff site are as follows:

Completed Exposure Pathway: Soil

Exposure element	Davenport and Flagstaff Smelters
1) A source of contamination	former smelting activities
2) Transport through environmental medium	contaminated soil
3) A point of exposure	yards of on-site homes
4) A route of human exposure	ingestion
5) A receptor population	residents

Although few people intentionally ingest soil, some 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 arsenic and lead in the soil by gardening

or playing in soil with high levels of arsenic and lead, then eating or smoking without washing his/her hands. House dust high in arsenic and lead may settle on dishes and in food. The soil pathway has been demonstrated to have existed in the past and, because the site is residential and access is unrestricted, this pathway is also a current and future exposure pathway.

Completed Exposure Pathway: Dust

Exposure element	Davenport and Flagstaff Smelters
1) A source of contamination	former smelting activities
2) Transport through environmental medium	airborne contaminated dust
3) A point of exposure	yards of on-site homes, trails
4) A route of human exposure	inhalation
5) A receptor population	residents and visitors near the site

Examples of this exposure pathway include children playing outside or dirt biking in the area and breathing in small amounts of contaminated dust. Residents working in their yards or visitors running on the dirt paths in the area also may breathe in small amounts of dust. The dust-inhalation pathway existed in the past and, because the site is residential and has unrestricted access, it is a current and future exposure pathway. Table 6 shows these completed exposure pathways for the Davenport/Flagstaff Smelters site.

Because this area is residential, highly landscaped yards and dense vegetation help to minimize current exposure to bare soil and dust. Future exposure could occur if contaminated soil is not removed and/or vegetation is not maintained. These completed pathways represents exposure that may be reduced by simple hygienic practices, such as washing hands and damp dusting and wet mopping regularly.

Potential Exposure Pathways

Potential Exposure Pathway: Little Cottonwood Creek and/or area springs

Exposure element	Davenport and Flagstaff Smelters
1) A source of contamination	former smelting activities
2) Transport through environmental medium	groundwater and/or surface water
3) A point of exposure	contact with groundwater and/or surface water
4) A route of human exposure	accidental oral ingestion
5) A receptor population	residents, visitors

A potential pathway of exposure to contaminants in on-site groundwater and/or surface water was found. Limited sampling indicates that on- and off-site exposure to contaminated surface water may occur through accidental oral ingestion. Maximum concentrations of arsenic and lead detected in surface water samples exceeded the drinking water CVs for children. Accidental oral ingestion may occur while swimming in Little Cottonwood Creek or by drinking water from an area spring. This pathway may have existed in the past, and may also be a current and future exposure pathway. These potential exposure pathways are shown in Table 7.

Eliminated Exposure Pathways

Eliminated Exposure Pathway: Skin contact with water

Immediately upstream of the OU1 area of the Davenport/Flagstaff site are two swimming holes in Little Cottonwood Creek. Residents say these small pools are a favorite spot for swimmers in the summer. Although the limited testing conducted on water from Little Cottonwood Creek shows that the water does not meet drinking water standards, it is unlikely that the low levels of arsenic and lead found in the creek would be absorbed significantly into the skin of swimmers (ATSDR 1999a 2000).

Eliminated Exposure Pathway: Skin contact with soil

Arsenic and lead in soil are not readily absorbed through the skin (ATSDR 1999a 2000). As a result, the soil and skin exposure pathway is not considered significant for this site.

Biomonitoring Data

The purpose of biomonitoring is to measure current exposure to determine whether immediate intervention, such as removing the residents from their homes, is necessary.

Lead in Blood

The best way to determine if a person is exposed to lead is a blood lead test. The Centers for Disease Control and Prevention (CDC) has determined 10 micrograms lead per deciliter (µg/dL) of blood to be the level of health concern (CDC 1997).

UDOH records show that only six of the estimated 43 children living on the site have been tested for blood lead levels since 1996; none of these children had elevated blood lead levels.

EPA has developed an integrated exposure, uptake, and biokinetic (IEUBK) model to estimate the risks of lead exposure for residential children. This model requires (1) input of point estimates of the average concentration of lead in various environmental media in residential properties at the site and, (2) the average amount of those media contacted by a child living at the site.

For the Davenport Flagstaff site, EPA used the following input parameters to evaluate lead risks for each media:

Soil: Lead concentrations from each property were averaged to yield a single representative mean concentration (ISSI 1999).

Indoor dust: Concentration of lead in dust was estimated from the measured level of lead in soil at the property using an equation describing the soil-dust relationship.

Water and Air: Lead concentrations in water at each property were assigned value of 1 microgram per liter (µg/L) (ISSI 1999). Air concentrations were kept at the IEUBK default value of 0.1 microgram per cubic meter (µg/ m^3).

Diet: The default values of lead intake from the diet in the IEUBK model are based on dietary data from 1982 – 1988. Strong evidence from the Food and Drug Administration (FDA) suggests that the average lead concentrations in food have declined as much as 30% since 1988. Therefore, dietary values were obtained by multiplying the model default values by a factor of 0.70 (ISSI 1999). Model default values ranged from 5.53 – 7.0 µg lead per day.

These parameters were used to estimate the average blood-lead value in an exposed child. For the Davenport/Flagstaff Smelters site, the IEUBK model predicts that an unacceptable risk exists for children to be exposed to lead levels that might, over time, result in elevated blood-lead values (ISSI 1999).

In general, blood lead levels reflect relatively recent exposures (ATSDR 1999a). EEP recommends that all children between the ages of 6 months and 17 years who live near the Davenport/Flagstaff Smelters site have a blood lead test performed once a year. Pregnant women should also consider being tested. The core age groups of concern are primarily 6 months to 72 months of age because of the high risk of exposures in these age groups. Historically, the EEP has recommended that adolescents up to 17 years of age be tested because they still are developing and under parental care. Therefore, the option to test adolescents is open for parents who feel their child may have been exposed to lead.

Arsenic in Urine

No urinary arsenic analyses were conducted on residents living near the site. Tests for arsenic in urine captures information on recent arsenic exposure. The tests do not provide information on past or future arsenic exposure (ATSDR 2000).

Public Health Implications

To determine whether the contaminants pose a public health threat, exposure doses were estimated for arsenic and lead (Appendix B). For adults, children, and pica children, the maximum estimated exposure doses exceeded ATSDR's Minimal Risk Levels (MRLs) for arsenic and lead, and adverse health effects are possible (Table 8). If exposed to the average concentration of arsenic and lead, adverse health effects are unlikely for adults; however, children and pica children are still at risk. The potential for exposed persons to experience adverse health effects depends on many factors, including the following:

1. The amount of each chemical to which an individual is or has been exposed,
2. Duration of exposure by an individual,
3. The route by which an individual is or has been exposed (by breathing, drinking, eating, or skin contact),
4. The health condition of the person,
5. The nutritional status of the person, and
6. Exposure to other chemicals (such as cigarette smoke or chemicals in the work place).

Toxicological Evaluation

Arsenic and lead are the chemicals of concern for the Davenport/Flagstaff Smelters site. These metals are present in soil at concentrations that may be of potential health concern for adults and children residing in the area. Estimated exposure doses have been calculated for adults, children and for children displaying pica[2] behavior. As previously discussed, ingestion of contaminated soil is the most likely exposure pathway, although inhalation of contaminated particles also may contribute to the total exposure. Because no air-sampling data are available, evaluation of the inhalation pathway is limited.

Arsenic

Arsenic is a naturally occurring element. Forms of arsenic can be divided into two categories: (1) inorganic arsenic (formed when arsenic combines with oxygen, iron, and sulfur), and (2) organic arsenic (formed when arsenic combines with carbon and hydrogen). The inorganic forms of arsenic are commonly found at smelter sites because they are derived from treating copper and lead ores. Exposures to inorganic forms of arsenic are usually more harmful than exposure to the organic forms. Most inorganic and organic arsenic compounds are white or colorless powders that do not evaporate. They have no smell, and most have no special taste. In most cases one cannot sense if arsenic is present in food, water, or air (ATSDR 2000).

Perhaps the single most characteristic health effect of long-term oral exposure to low levels of inorganic arsenic is a pattern of skin changes. These include a darkening of the skin and the appearance of small “corns” or “warts” on the palms, soles, and torso. Skin changes are not considered a health concern in their own right, but a small number of corns might ultimately become skin cancer. There is not scientific evidence that skin contact with arsenic will cause skin cancer or to damage internal organs. However, swallowing sufficient amounts of arsenic has been reported to increase the risk of cancer in the liver, bladder, kidneys, and lungs (ATSDR 2000).

Exposure doses were estimated using the average and maximum concentrations of arsenic in the residential soil in the Davenport/Flagstaff area. Exposure doses are presented as an amount of arsenic ingested (in milligrams) per kilogram of body weight per day (mg As/kg/day) and are shown in Table 8. These estimated exposure doses have been compared to the MRL for arsenic to evaluate potential health effects.

The estimated exposure dose for adults exposed to the average amount of arsenic in the soil was 0.00002 mg As/kg/day. The maximum exposure dose for adults was estimated to be 0.0022 mg As/kg/day. If adults are exposed to the average amount of arsenic in the soil, it is unlikely that adverse health effects will occur. However, the maximum estimated exposure dose for adults exceeds the MRL of 0.0003 mg As/kg/day and it is possible that adverse health effects may occur. In the Davenport/Flagstaff area it is unlikely that adults exposed to the average amounts of arsenic and lead detected in residential soils will experience adverse health effects; however, if adults are exposed to the maximum levels of arsenic and lead, adverse health effects may occur.

[2] Pica is an eating disorder in which a person repeatedly eats non-food items. Children who deliberately ingest soil are displaying pica behavior.

For children, the estimated dose from exposure to the average amount of arsenic in the soil was 0.0008 mg As/kg/day. If exposed to the maximum amount of arsenic in the soil, the dose is estimated to be 0.768 mg As/kg/day. For pica children, the estimated exposure doses were much higher, with a dose of 0.0205 mg As/kg/day from exposure to the average amount of arsenic in the soil, and 1.9206 mg As/kg/day if exposed to the maximum amount of arsenic in the soil. Both ranges are greater than the MRL and it is possible that adverse health affects may occur. (The discussion below show how the *maximum* estimated doses for children and adults were compared to those found in the literature.)

Children are exposed to arsenic in many of the same ways that adults are. However, children differ from adults in their exposures and may differ in their susceptibility to hazardous chemicals. Children's unique physiology and behavior can influence the extent of their exposure. The health effects of arsenic in children are discussed further in the Arsenic and Children's Health section (ATSDR 1999a). In the Davenport/Flagstaff area children (and pica children) are at risk for possible adverse health effects if exposed to the average and maximum amounts of arsenic in the residential soils.

Assuming that much of the arsenic in soil and dust associated with the smelters is inorganic, a comparison can be made between the estimated exposure dose and those discussed in the literature. One very large study (based on 17,000 people) detected no effects in any person at an average total daily intake (from water plus food) of 0.0008 mg As/kg/day (ATSDR 2000). Chronic oral exposure data from studies in humans indicate that the lowest-observed-adverse-effect level (LOAEL) for skin lesions and other effects is probably about 0.01–0.02 mg As/kg/day, and that the no-observed-adverse-effect level (NOAEL) is probably between 0.0004 and 0.0009 mg As/kg/day (ATSDR 2000). Another prominent dermal effect associated with chronic ingestion of inorganic arsenic is skin cancer. This is based on a number of studies of populations exposed to elevated levels of arsenic in drinking water (ATSDR 2000).

An increase in the risk of lung cancer has been reported with inhalation of inorganic arsenic. Although this has been seen mostly in workers exposed to arsenic at smelters, mines, and chemical factories, residents living near smelters and arsenical chemical factories are also at risk (ATSDR 2000). There are only a few quantitative data on noncancerous effects in humans exposed to inorganic arsenic by the inhalation route. However, it appears that such effects are unlikely below a concentration of about 0.1–1.0 mg As/m^3 (ATSDR 2000). Exposure dose estimates for inhalation of arsenic contaminated dust could not be evaluated due to the lack of sampling data. Currently, there is no scientific evidence that residential exposure to arsenic (unless at high concentrations) causes lung cancer (ATSDR 2000).

The International Agency for Research on Cancer (IARC) and the EPA classify arsenic as a carcinogen. Sufficient evidence from epidemiologic studies supports a causal association between arsenic exposure and skin cancer and lung cancer via inhalation and ingestion (Klaassen 2001). The age-ajusted rates for melanoma and lung cancer were not significantly elevated. The frequency or rate for melanoma was occurring at 21.3 per 100,000 population (almost similar) as compared to Utah's rate of 20.0 per 100,000 population. Lung cancer was occurring at 36.5 per 100,000 population (slightly higher) as compared to Utah's rate of 33.7 per 100,000 population (UCR 2001).

Lead

Lead occurs naturally in the environment; however, most of the lead dispersed throughout the environment results from human usage of lead-containing products. Lead is used in paints, ceramic products, caulking, gasoline additives, ammunition, and many other applications. Its use has been reduced in recent years because of its harmful effects in humans and animals. People living near hazardous waste sites can be exposed to lead and chemicals that contain lead by breathing air, drinking water, eating foods, or swallowing dirt that contains lead. Once in the body, lead is predominantly stored in the bones and teeth until it is excreted in the feces (ATSDR 1999a).

Lead can affect almost every organ and system in the body. At very high levels (resulting in a blood lead level greater than 40 µg/dL), lead exposure in adults may decrease reaction time, cause weakness in fingers, wrists, or ankles; possibly affect the memory; and may 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. Children are particularly sensitive to the toxic effects of lead; this issue is discussed further in the Lead and Children's Health section (ATSDR 1999a).

Exposure doses for residents living near the Davenport/Flagstaff site were estimated using the average and maximum concentrations of lead in the residential soil in the Davenport/Flagstaff area. Exposure doses are presented as the amount of lead a person will ingest (in milligrams) per kilogram of body weight per day (mg Pb/kg/day) and are shown in Table 8. The estimated exposure dose for adults exposed to the average amount of lead in the soil was 0.0003 mg Pb/kg/day. The maximum exposure dose for adults was estimated to be 0.0571 mg Pb/kg/day. For children, the estimated dose from exposure to the average amount of lead in the soil was 0.0022 mg Pb/kg/day; exposure to the maximum amount of lead in the soil would result in a dose as high as 2.015 mg Pb/kg/day. For pica children, the estimated exposure doses are much higher. Pica children exposed to the average amount of lead in the soil would result in a dose of 0.0532 mg Pb/kg/day. If exposed to the maximum amount of lead in the soil, the exposure dose for pica children would be 50.37 mg Pb/kg/day.

ATSDR has not established an MRL for lead. Human studies of acute and intermediate lead exposures have shown LOAELs of 0.01 – 0.03 mg Pb/kg/day. The LOAEL observed in monkeys is 0.05 mg Pb/kg/day and is associated with impaired learning and delays in behavioral tasks.

For adults exposed to lead at an average estimated dose of 0.0003 mg Pb/kg/day, it is unlikely that adverse health effects will occur. However, the higher estimated exposure dose for adults (0.0574 mg Pb/kg/day) exceeds the LOAELs observed in the literature. For children and pica children, the ranges of exposure doses also exceed the LOAELs observed in the literature. Therefore, adverse health effects are possible for adults exposed to the maximum level of lead detected in residential soils, and children and pica children may experience adverse health effects if exposed to the maximum or average levels of lead found in residential soil.

Data on the health effects of lead in humans are often expressed in terms of internal exposure, or blood-lead levels, rather than external exposure levels (i.e., mg/kg/day). CDC has established an acceptable level of lead in children's blood to be less than 10 µg/dL.

The IARC classifies lead as a 2B carcinogen, which means that it is possibly carcinogenic to humans, based on limited human evidence and less-than-sufficient evidence in animals (ATSDR 2003). EPA also classifies lead as a probable human carcinogen based on studies in rats and mice; however, the high doses used in those studies make it difficult to extrapolate the results in mice to low-level exposures to humans (ATSDR 1999a).

CHILD'S HEALTH CONSIDERATIONS

ATSDR and EEP recognize the unique vulnerabilities of infants and children. Children are at greater risk than adults from some environmental hazards. Children are more likely to be exposed to contaminants because they play outdoors, often bring food into contaminated areas, and are more likely to make contact with dust and soil. Because children's bodies are still developing, children can sustain permanent damage if toxic exposures to some contaminants occur during critical growth stages.

Arsenic and Children's Health

Children are exposed to arsenic in many of the same ways that adults are. However, children differ in their exposures and susceptibility to hazardous chemicals. The unique physiology and behavior of children can influence the extent of their exposure. Since arsenic can be found in the soil, water, food, and air, children may be exposed to arsenic by the air they breathe and/or by the food and water they consume. Since children tend to eat or drink less of a variety of foods and beverages than do adults, ingestion of contaminated food or juice or infant formula made with contaminated water may represent a significant source of exposure. In addition, since children often play in dirt, ingestion of arsenic in dirt may be an important source of arsenic exposure for children (ATSDR 2000).

Children who are exposed to arsenic exhibit the same affects as adults (pattern of skin changes, including darkening of the skin and the appearance of small "corns" or "warts" on the palms, soles, and torso). Cancer has been observed in adults who were exposed to arsenic as children or young adults.

Pregnant women and nursing mothers are advised to limit their exposure to arsenic, because like lead, arsenic crosses the placenta, and it may be found in low levels in breast milk. Studies in animals prove that arsenic crosses the placenta and, thus, arsenic may be found in fetal tissues. Animals exposed to arsenic show developmental damage, including neural tube defects and disruption of kidney development (ATSDR 2000).

Arsenic can adversely affect a child's development. It is possible that a very sensitive child may develop anemia because of chronic arsenic exposure. Anemia would then make that child much more susceptible to lead toxicity. Due to a lack of funding, none of the children living on the site have been tested for arsenic levels in their urine. The test can only identify recent exposures to

arsenic (1 – 2 days before the test). Other tests can provide information on arsenic exposures during the past year, but if the exposure level was low, arsenic might not be detected (ATSDR 1998).

Estimated exposure doses for children exposed to arsenic in the residential soil near the Davenport/Flagstaff site exceed the MRL of 0.0003 mg As/kg/day. The estimated exposure dose for children exposed to the average amount of arsenic in the soil was 0.0008 mg As/kg/day, and for pica children, 0.0205 mg As/kg/day. If exposed to the maximum amount of arsenic in the soil, children would receive an estimated dose of 0.768 mg As/kg/day, and pica children, 1.9206 mg As/kg/day. All exposure doses exceed the MRL, and it is possible that adverse health affects may occur.

Several factors determine whether exposure to arsenic will be harmful. These factors include dose, duration of exposure, how a person was exposed (did they ingest, inhale, or touch the arsenic?), other chemicals the person has contacted (i.e., some chemicals interfere with arsenic uptake), and the person's age, sex, diet, lifestyle, family traits, and health status (ATSDR 2000). Under current conditions, the actual exposure doses at the Davenport/Flagstaff site are likely to be much lower than the highest estimated exposure doses, since the majority of the yards where children play are covered with sod. However, if vegetation is not maintained and/or soil is not removed, future exposure may occur at levels similar to the estimated doses, and adverse health affects may occur.

Lead and Children's Health

Lead poisoning is one of the most common and preventable childhood health problems in the United States today. Children living near the Davenport/Flagstaff site may be exposed to lead by inhaling or ingesting contaminated soil or house dust. Preschool-age children and developing fetuses are usually the most vulnerable segments of the population for exposure to lead. Among children, those in the 2 – 3 year age bracket may be most at risk for exposure to lead-contaminated soil (ATSDR 1992a).

Children are more sensitive to the effects of lead than adults are. The central nervous system of children is particularly vulnerable to lead. Many children are repeatedly exposed to lead during childhood. A mother with lead in her body can expose the fetus to lead through the placenta. Fetuses exposed to lead in the womb may be born prematurely and have lower weights at birth. Children can be exposed to lead if they eat food or drink water that contains lead. Children can swallow and breathe lead in dirt, dust, or sand while playing on the floor or the ground. The dirt or dust on a child's hands, toys, and other objects with which the child comes into contact may have lead particles on them.

Compared to adults, a greater proportion of the amount of lead swallowed by children will enter the blood stream (ATSDR 1999a). Lead is stored in bones and can be released into the bloodstream when the body is stressed or when nutrition is poor, as when children refuse to eat healthy foods rich in iron and calcium (ATSDR 1999a).

Lead exposure in the womb, in infancy, or in early childhood also may slow mental development and lower intelligence later in childhood. Evidence has been found that neurobehavioral effects may persist beyond childhood (ATSDR 1999a).

For children living in the Davenport/Flagstaff area, the estimated dose of exposure to the average amount of lead in the soil is 0.0022 mg Pb/kg/day. Pica children exposed to the average amount of lead in the soil would receive an estimated dose of 0.0532 mg Pb/kg/day. A dose of 2.015 mg Pb/kg/day may result if children are exposed to the maximum amount of lead in the soil, and pica children would receive a dose as high as 50.37 mg Pb/kg/day. ATSDR has not established an MRL for lead. Human studies of acute and intermediate lead exposures have shown LOAELs of 0.01 – 0.03 mg Pb/kg/day. The LOAEL observed in monkeys is 0.05 mg Pb/kg/day and is associated with impaired learning and delays in behavioral tasks.

Data on the health effects of lead in humans are often expressed in terms of internal exposure, or blood-lead levels, rather than external exposure levels (i.e., mg/kg/day). CDC considers blood-lead levels to be elevated if greater than 10 µg/dL. This does not imply that a safe level of blood lead has been identified. In the last few years, several studies have been conducted and are still ongoing that suggest children may suffer neurological and developmental deficits at blood lead levels well below the current standard. While not universally accepted, these studies seem to suggest that prenatal and postnatal exposures at levels of 10 – 15 µg/dL are associated with low birth weight, reduced growth rate, cognitive deficits, and a reduction in neurological development as measured by IQ (ATSDR 1999b). Some studies suggest that intelligence may be affected when children have blood lead levels as low as 7 µg/dL (CDC 1997; ATSDR 1999a). Learning disabilities have been observed in children with blood levels exceeding 40 µg/dL (ATSDR 1999a). An estimated 890,000 U.S. children have blood lead levels equal to or greater than 10 µg/dL (CDC 1997).

The EPA has identified a LOAEL for lead in blood of approximately 60 – 100 µg/dL for children. This value is based on a study in which signs of acute lead poisoning, such as severe constipation, anorexia, and intermittent vomiting, occurred at blood lead levels equal to or greater than 60 µg/dL (ATSDR 1999a). Because the levels of lead exposure found in the environment that might result in adverse health effects have not been determined, ATSDR and EEP recommend that any exposure to lead be avoided whenever possible.

An estimated 43 children live within the site boundaries of the Davenport/Flagstaff Smelters site. Only six of these children have been tested for blood-lead levels; none of these six results were elevated. Blood-lead tests do not provide information on what previous lead exposure a child may have had, nor do the tests serve to predict future exposure. However, the IEUBK model did predict an unacceptable risk exists for children who may be exposed to lead levels that may result in elevated childhood blood-lead values overtime (ISSI 1999).

COMMUNITY HEALTH CONCERNS

When performing any public health assessment, EEP's central concern is to recognize and respond to community questions and concerns. EEP has worked cooperatively with EPA and UDEQ to gather information and comments from community members affected by site

contaminants. The concerns that people expressed have been collected through informational open houses and the distribution of this public health assessment requesting public comments.

The community concerns listed here were collected at public meetings sponsored by UDEQ and EPA. General concerns expressed by residents include the possible reduction of property values after the site was listed on the NPL.

Specific concerns of residents, with responses from EEP, include the following:

Resident: There is no evidence of elevated blood lead levels in children living in this area, so why pursue cleanup?

Response: Only 6 of the estimated 43 children living on-site have been tested for elevated blood lead levels. This is not representative of all children on-site; therefore, EEP recommends that all children between the ages of 6 months and 17 years living on-site be tested. Pregnant women should also consider being tested.

The lack of elevated blood lead levels may be in part due to the highly landscaped, sod-covered yards. This is a current barrier to eliminate exposure. However, if sod or landscaping were to be removed in the future, exposure to the contaminated soil would still present health risks for future generations.

Because the levels of arsenic and lead detected in residential soil have been determined a hazard to public heath and the environment, clean up is essential. In addition, the prevention of adverse health effects among current residents and future generations is the top priority for all agencies involved.

Resident: One person expressed frustration at having to choose between the stigma of contaminated soil and the restrictions that could be placed on their yard if cleanup does occur.

Response: EEP can only address health issues related to the Davenport/Flagstaff Smelters. The available information indicates that cleanup of the most contaminated areas would be beneficial for the health of current and future residents as long as cleanup methods incorporate adequate dust control.

Resident: One person suggested that the proposed soil cleanup to a depth of 18 inches below ground surface would be insufficient and that UDEQ and EPA should consider deeper than 18 inches.

Response: Soil cleanup to a depth of 18 inches is protective of human health. It is unlikely that gardening or lawn activities will take place at depths below 18 inches. EPA and UDEQ will work with Salt Lake County to instill institutional controls for construction on properties with contaminated soils.

On September 23, 2003, EEP released the draft of this public health assessment for public comment. In addition to mailing the report to residents, government officials, and interested parties, the public availability of the document was announced as a legal notice in local newspapers. The report also was available at two local repositories. Representatives from EEP, EPA, and UDEQ held an open house at the Granite Elementary School on September 23, 2003, to update residents on site activities and to release the draft public health assessment. Residents were encouraged to submit comments and questions about the draft document and were provided with telephone numbers, email addresses and postage-paid envelopes. The public comment period for the draft PHA ended on October 31, 2003. The majority of responses were obtained through email and telephone. These responses have been transcribed or paraphrased in the following section. Each comment is followed by a response from EEP.

Resident: "I am puzzled why Villas La Montagne was not included in the OU1. It is contiguous with other properties and would have been easy to include. There is much slag and I have always assumed that it was a slag dumping area. Also, the area north of [La Montagne] is a watershed and the run-off on the steep hillside from the rain and snow goes directly downhill into the meadow, swamp and Little Cottonwood Creek, poisoning wildlife and the water downstream."

Response: The immediate area of the La Montagne properties was not included in OU1 because only a very limited area of it was contaminated. It was determined that the amount of risk at La Montagne did not rise to a level that would prompt EPA to consider taking action. In addition, the La Montagne Homeowners Association agreed to enact and enforce institutional controls, such as installing fencing and posting signs to keep children out of the affected area. The slag areas and areas north of La Montagne will be included in the OU2 cleanup.

Resident: "The [PHA] stated that it would be sent to all residents living within ¼ mile of the smelters. According to the GIS map and the 1 mile buffer, I don't live within 400 meters of the Flagstaff Smelter. Is this because the site boundary is larger than on the map, and extends northward? I've also noticed that 147 acres of land is for sale in this area, does that include the 14 acres of the Flagstaff Smelter site?

Response: In addition to sending the public health assessment to all residents living within ¼ mile of the smelters, EEP mailed the draft PHA to those community members who had listed their mailing address on sign-in sheets at open houses or community meetings and placed the PHA at the Sandy City Library for review. Copies of the PHA can also be obtained by contacting EEP staff at 801-538-6191.

The site does not extend past the boundaries shown in Figure 2 of the draft PHA. Because the exact location of the 147 acres in question is unknown, this question cannot be answered with certainty.

Resident: "The assessment stated that most of the area of concern is within 300 meters of the smelters. If this is the case, then why did the [PHA] go to all residents living

within 400 meters? What should I be more concerned about than someone who lives 500 meters from the site?"

Response: The public health assessment was delivered to all residents living within ¼ mile of the smelters, as well as those community members who had listed their mailing addresses on sign-in sheets at open houses or community meetings. When addressing a population at risk, it is EEP practice to include all residents living within ¼ mile of the site, even though they may not live directly on the contaminated area. In the case of the Davenport/Flagstaff Smelters site, the area of concern is land found to be contaminated by arsenic and lead.

Resident: "The assessment also listed this site as an ATSDR category B, but I didn't see anywhere what this meant."

Response: Depending on the specific properties of the contaminant, the exposure situations, and the health status of individuals, a public health hazard may occur. Using data from public health assessments, sites are classified using one of the following ATSDR public health hazard categories.

Category A: Urgent Public Health Hazard
Category B: Public Health Hazard
Category C: Indeterminate Public Health Hazard
Category D: No Apparent Public Health Hazard
Category E: No Public Health Hazard

It has been determined that the Davenport/Flagstaff Smelters site is a public health hazard, category B. The criteria for category B are as follows:

> Evidence exists that exposures have occurred, are occurring, or are likely to occur in the future,
>
> *and*
>
> the estimated exposures are to a substance or substances at concentrations in the environment that, upon long-term exposures (greater than 1 year), can cause adverse health effects to any segment of the receptor population. The adverse health effect can be the result of either carcinogenic or noncarcinogenic toxicity from a chemical exposure. For a noncarcinogenic toxic effect, the exposure exceeds a chronic MRL established in the ATSDR Toxicological Profiles or other comparable value,
>
> *and/or*
>
> community-specific health-outcome data indicate that the site has had an adverse impact on human health that requires intervention.

EEP understands that this was not explained in the draft PHA for public comment, and the agency made certain that a full explanation was included in this final public health assessment in Appendix A.

Resident: "Are there any plans on testing air quality? This is my primary concern, since I live downwind of nighttime canyon winds. These winds, at times, can be very

strong. They could easily pick up particles from the undeveloped area that once was the Flagstaff Smelter. At the undeveloped site, these materials can be on the surface and easily moved by wind or water."

Response: Air monitoring will take place during construction activities associated with cleanup of the Davenport/Flagstaff site to ensure that construction is performed in a manner that minimizes the public health impact of airborne dust. Both EPA and UDEQ require intensive dust control restrictions during construction activities to ensure that exposure and recontamination due to dust dispersion are minimal. To reduce further contaminant migration, the cleanup contractor will be required to provide run-on and run-off controls for any stockpiled material.

EPA's Human Health Risk Assessment of the site examined the potential for exposure to contaminants through air dispersion and inhalation. This exposure pathway was determined to be incomplete due to the extensive vegetation covering the contaminated soil. Only a very small portion of the undeveloped area around the Flagstaff Smelter is bare soil. Most is well vegetated and thus, not subject to wind erosion.

Resident: My house has many fruit trees and a garden in the backyard. Are arsenic and lead taken up by trees and plants? I think that apple seeds naturally contain arsenic. If so, would this increase the level? With increased levels, would it remain in the seeds or be present throughout the entire fruit? If these materials were taken up by organic matter, what precautions would you recommend?

Response: Arsenic and lead occur naturally in the Earth's crust. Plants absorb metals and nutrients from the soil through their roots; hence, all plants contain a small amount of both metals. The amount of arsenic taken up by plants usually depends upon soil properties and the level of arsenic present. Sandier and wetter garden soils tend to contain greater amounts of arsenic. Elevated levels of arsenic in soil can stunt plants and reduce yields. If sufficiently high, soil arsenic can cause plant death. Bean plants are particularly sensitive to arsenic. For this reason, green beans are a good indicator of arsenic in soil. If green beans grow well in a garden, it is unlikely that the uptake of arsenic into other vegetables will be high enough to pose a health risk. Root crops (e.g., carrots, beets, radishes, potatoes) tend to contain higher levels of arsenic than tomatoes and berries. Tree fruits such as apples and apricots contain very low arsenic and lead concentrations.

The most serious source of exposure to soil lead is through direct ingestion (eating) of contaminated soil or dust. In general, plants do not absorb or accumulate lead. However, in soils testing high in lead, it is possible for some lead to be taken up. Studies have shown that lead does not readily accumulate in the fruiting parts of vegetable and fruit crops (e.g., corn, beans, squash, tomatoes, strawberries, apples). Higher concentrations are more likely to be found in leafy vegetables (e.g., lettuce) and on the surface of root crops (e.g., carrots). (Carrington, C.D. and P.M. Bolger. 1992).

Limited research exists concerning arsenic in apple seeds. Apple seeds do contain toxins known as cyanogenic glycosides (cyanide). Cyanogenic glycosides are also

present in other fruit pits/seeds, like apricot pits. However, in order to be toxic, the seeds must be crushed before ingestion.

EEP recommends that you first have your soil tested to determine the actual extent of contamination on your property. Contact Tom Daniels at UDEQ at 801-536-4100 for information on soil testing. If contamination exists, you can reduce the potential hazards by implementing the following practices:

- Wash garden crops with water before bringing them into the house; once inside, wash again carefully using water and edible soap or detergent (sold at many supermarkets), and a scrub brush to remove remaining soil particles. Pay careful attention to leafy plants, which can trap and retain large quantities of dust.
- Pare root and tuber crops and discard the parings.
- Do not compost unused plant parts, peelings, and parings.
- Grow crops in containers or raised beds, or place a barrier (such as a concrete slab or thick plastic sheeting) between uncontaminated topsoil and underlying contaminated soil.
- Do not eat any unwashed produce or other foods that may have been in contact with the soil. Do not drink, smoke, or eat while gardening.
- Keep soil moist to control dust or wear a dust mask in dusty environments to minimize the potential of inhalation or ingestion.
- Wash all exposed body surfaces as soon as possible after gardening.
- Wash soil particles from gardening tools and store outside after each use.
- Designate certain clothing (shirts, pants, shoes and gloves) for gardening use only. Store garden clothing outside and rinse outside by hand to remove adhering soil particles. Wash as a separate load in a household washing machine. Eliminate the potential of carryover of arsenic and lead residues by running the washing machine through a clothing-free cycle.

Resident: "I don't agree with many residents that there is no reason for alarm. More mitigation needs to be done before someone is diagnosed with elevated lead in his/her blood, or even worse, cancer. It seems that this assessment is recommending a-wait-and-see approach. Is this due to budget cuts in EPA or the conclusion that you have reached?

Response: EEP's principle objective is to protect human health. Based on data collected at the Davenport/Flagstaff site, EEP was able to identify and evaluate health hazards. This public health assessment, as well as public meetings and open houses, have served as public notification of these hazards. EEP, EPA, and UDEQ have worked, and will continue to work, actively to educate the community about how to prevent such adverse health affects.

Although it is true that budget cuts do affect all agencies involved, the conclusions made in this health assessment remain constant: contamination at Davenport/Flagstaff Smelters site poses a public health hazard and cleanup is essential.

EPA performed an emergency response cleanup of six properties in 2004. They plan to remediate an additional six properties in 2005. The goal is to clean up most of the remaining residential properties by the end of 2006.

Resident: "The assessment spoke of a mailing list. Is this a list I have to sign up for, or, because of where I live, am I automatically included on the list?"

Response: The mailing list discussed in this document was composed of community members who had listed their mailing addresses on sign-in sheets at open houses or community meetings. EEP used this list, as well as a collection of addresses within ¼ mile of the site for the distribution of this PHA. Others can be added to this list by calling EEP staff at (801) 538-6191.

Resident: "In several places [the report] mentions that this area is part of Sandy City. Although our neighborhood petitioned to be part of Sandy City approximately 1 year ago, I have not heard that we have been formally incorporated into Sandy City. As long as we have been residents, this area has been unincorporated Salt Lake County and has just used the mailing zip code for Sandy."

Response: It has been noted that the site is not officially in Sandy. EPA normally uses the nearest Post Office to provide information about where the site location. To eliminate confusion, EEP also chose to use Sandy as a reference to site location.

Resident: "During 1994 through 1995, EPA and UDEQ sent letters to the president of the Home Owners Association (for the Davenport/Flagstaff area). The president and association officers did not inform the residents of the ground contamination. The president and officers immediately put their homes up for sale and kept all the EPA and UDEQ information from the residents. Therefore, the question to EPA and UDEQ is: Why was this information not sent directly to the residents? Why was there not a representative following up with residents to assure the information was delivered?"

Response: EEP's primary focus for this PHA is addressing community health concerns and health risks associated with the site. Because EEP is unable to address this comment, it has been forwarded to EPA and UDEQ.

CONCLUSIONS

The Davenport/Flagstaff Smelters site is classified as a public health hazard (ATSDR health hazard category B[3]) because of arsenic and lead concentrations in residential soil. Children living in this area should be tested for blood-lead levels. Although limited biomonitoring data have been collected to provide information on actual exposure levels, environmental levels of the

[3] ATSDR health hazard category B: This category is used for sites that pose a public health hazard as the result of long-term exposures to hazardous substances. See Appendix A for more information.

contaminants pose the likelihood that exposure has occurred and continues to occur for residents living near the site and for site visitors. Arsenic and lead are the contaminants of concern at the site. Of particular concern is the potential for long-term developmental health effects of lead exposure on children who reside in the area. The main route of exposure is through ingestion and inhalation of contaminated soil and dust. Current conditions indicate that exposure to contaminants from the Davenport/Flagstaff Smelters site pose a current and future public health hazard.

Adults and children can be exposed to arsenic and lead if they ingest or inhale soil or dust from areas near the former smelters. Such exposures were estimated for both adults and children living near the site. Exposure-dose estimates were based on the average and maximum soil concentrations of arsenic and lead found in the top 6 inches of soil in residential areas near the site. Once calculated, exposure doses were compared to ATSDR health guidelines and the following conclusions were made: 1) It is unlikely that adults exposed to the average amounts of arsenic and lead detected in residential soils will experience adverse health effects; however, if adults are exposed to the maximum levels of arsenic and lead, adverse health effects may occur; and, 2) Children and pica children are at risk for possible adverse health effects if exposed to the average and maximum amounts of arsenic and lead detected in the residential soils. Yards in the residential areas are landscaped with sod and dense vegetation, making current exposure to bare soil and dust minimal. Future exposure to contaminants may occur if soil is not removed and/or vegetation is not maintained.

Compared with adults, children are at increased risk from exposure to environmental contaminants; children often play outside and have behaviors that make them more likely to contact soil and dust. Exposure to lead can adversely affect a child's intelligence, behavior, and development, even at relatively low levels (10 micrograms lead per deciliter blood). Studies with laboratory animals show that inorganic arsenic, such as arsenic found in soil near the former smelters, can act as a developmental toxicant. The EPA classifies arsenic as a human carcinogen (ATSDR 2004). Utah Department of Health records show that only six of the estimated 43 children living on the site have been tested for blood lead levels since 1996; none of these children had elevated blood lead levels.

The U.S. Environmental Protection Agency (EPA) and the Utah Department of Environmental Quality (UDEQ) detected 6 to 123,000 parts per million (ppm) lead and 5 to 4,690 ppm arsenic in the top 6 inches of soil in residential areas of the site. A Baseline Human Health Risk Assessment was preformed by the EPA to determine if health risks associated with contamination were sufficient to warrant remediation. A risk management decision established action levels of 600 ppm lead and 126 ppm arsenic as the health-based cleanup levels for residential surface soils. EEP concurs with these levels. In 2004, EPA conducted an emergency response cleanup on four properties. Enough funding was available to remediate two additional properties. Cleanup on the remaining residential properties will continue in 2005 and 2006.

RECOMMENDATIONS

- All children in the Davenport/Flagstaff area, 6 months to 17 years of age, should have their blood tested for lead, even if they seem healthy. Pregnant women living near the former smelters also should consider being tested. Residents can have free blood lead

testing at the local health department. Parents will be encouraged to take their children to the local health department or other health-care provider to have their blood lead levels tested. Blood lead tests are recommended both during and after cleanup.

- The Utah Blood Lead Registry should be monitored for children in the Davenport/Flagstaff area with elevated blood lead levels to ensure adequate follow-up and case management.
- EEP should provide community health education to residents near the site to inform residents about the possible health effects from exposure to arsenic and lead and about interim measures that can be taken to reduce exposures.
- 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), and by 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. Residents will be urged to maintain vegetative ground cover to help limit dust and soil exposure.
- EPA's and UDEQ's cleanup efforts at the Davenport/Flagstaff Smelters site should proceed in a way that is protective of human health. Particulate air sampling and dust suppression should be used during remediation.

PUBLIC HEALTH ACTION PLAN

This section describes the public health action plan to be taken by EEP and other government agencies involved with the Davenport/Flagstaff Smelters site. The purpose of the public health action plan is to ensure the implementation of actions designed to mitigate or prevent adverse human health effects resulting from exposure to hazardous substances in the environment from the Davenport/Flagstaff Smelters site.

- EEP and the Salt Lake Valley Health Department encourage parents and guardians to have children 6 months to 17 years of age tested for blood lead. Pregnant women living near the former smelters also should consider being tested. EEP will continue to monitor the Utah Blood Lead Registry for children with elevated blood lead levels living near the site to ensure adequate case management and environmental follow-up.
- EEP's Community Health Educator has conducted a health-education needs assessment to determine the environmental health education needs and health concerns within the community. The needs assessment has been used to direct health education activities in the community affected by the site. EEP staff has and will continue to address health concerns related to the site, provide information on arsenic and lead, and outline measures to reduce exposure to arsenic and lead in the soil.
- EEP has informed residents about the possible health effects from exposure to arsenic and lead and the interim measures that can be taken to reduce exposures in a pamphlet that was mailed out in September 2003.

- Residents will be informed of the importance of maintaining vegetative ground cover to help limit dust and soil exposure. This information will be distributed in the form of a mailing pamphlet and will be completed by the release date of this public health assessment.
- EEP, in coordination with UDEQ, and EPA, have and will continue to collect and respond to community concerns and information needs. EEP held an open house on September 23, 2003 for the release of the public health assessment for public comment, and has participated in numerous public meetings held by EPA and UDEQ.
- EEP will evaluate any additional data as it becomes available from EPA's and UDEQ's continued OU2 investigation.

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CERTIFICATION

This public health assessment for the Davenport and Flagstaff Smelters, located in Sandy City, Salt Lake County, Utah, was prepared by the Utah Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). The agreement is in accordance with approved methodology and procedures existing when the public health assessment began.

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

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