

**APPENDICES**

## Appendix A: Acronyms and Terms Defined

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

**Cancer Classes**                    Each health organization has a separate method of cancer classification:

### Environmental Protection Agency (EPA)

- A        =        Human Carcinogen.
- B1      =        Probable Human Carcinogen (based on limited human and sufficient animal studies).
- B2      =        Probable Human Carcinogen (based on inadequate human and sufficient animal studies).
- C        =        Possible Human Carcinogen (no human studies and limited animal studies).
- D        =        Unlikely to be a Human Carcinogen.

### International Agency for Research on Cancer (IARC)

- 1        =        Carcinogenic to Humans (sufficient human evidence).
- 2A      =        Probably Carcinogenic to Humans (limited human evidence; sufficient evidence in animals).
- 2B      =        Possibly Carcinogenic to Humans (limited human evidence; less than sufficient evidence in animals).
- 3        =        Not Classifiable.
- 4        =        Probably Not Carcinogenic to Humans.

### National Toxicology Program (NTP)

- 1        =        Known Human Carcinogen.
- 2        =        Reasonably anticipated to be a carcinogen.
- 3        =        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):

**Completed Exposure Pathway**            A way in which people can be exposed to a contaminant associated with a site. An exposure pathway is 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 (more than 365 days) exposure (ATSDR).

**EMEG-i** **Environmental Media Evaluation Guides** for intermediate exposures intermediate (between 15 and 365 days) exposure (ATSDR).

**EMEG-u** **Environmental Media Evaluation Guides** that are unpublished are designated with an asterisk in this health assessment. EMEGs are calculated using equations outlined in Appendix B, and they are only used in the absence of published comparison values.

**EPA** The **U.S. Environmental Protection Agency (EPA)** is the federal agency that develops and enforces environmental laws to protect the environmental and public health.

**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 then can be compared to the appropriate toxicity values (MRL, RfC, RfD).

**Health-based Comparison Values** See “Comparison Value” entry.

<b>ICP</b>	Inductively Coupled Plasma.
<b>LOAEL</b>	The <b>Lowest Observable Adverse Effect Level (LOAEL)</b> is the lowest exposure level of a chemical that produces significant increases in frequency or severity of adverse effects.
<b>LTHA</b>	<b>Lifetime Health Advisory</b> for drinking water from EPA.
<b>MRL</b>	<b>Minimal Risk Level:</b> An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for an exposure route (inhalation or oral) during a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects.
<b>NOAEL</b>	The <b>No Observable Adverse Effect Level (NOAEL)</b> 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.
<b>NPDWR</b>	<b>National Primary Drinking Water Regulations</b> are legally enforceable standards that apply to public water systems. Primary standards are available on the web at: <a href="http://www.epa.gov/safewater/mcl.html">http://www.epa.gov/safewater/mcl.html</a>
<b>NPL Site</b>	The <b>National Priorities List (NPL)</b> 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.
<b>Potential Exposure Pathway</b>	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 <b>potential exposure pathway</b> has four of the five following elements:  <ol style="list-style-type: none"><li>1) a source of contamination</li><li>2) transport through environmental medium</li><li>3) a point of exposure</li></ol>



## 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 1992]:**

Each year, ATSDR updates its 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:*

$$\text{EMEG} = \text{MRL} \times \text{BW} / \text{IR}$$

$$\text{RMEG} = \text{R}_f\text{D} \times \text{BW} / \text{IR}$$

*for carcinogenic health effects:*

$$\text{CREG} = 10\text{E}^{-6} \times \text{BW} / \text{IR} \times \text{OSF}$$

Where:

- EMEG = Environmental Media Evaluation Guide (ppm)
- MRL = Minimal Risk Level (mg/kg/day)
- RMEG = Reference Dose Media Evaluation Guide
- R<sub>f</sub>D = Reference Dose
- CREG = Cancer Risk Evaluation Guide for 1x10<sup>-6</sup> 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 then can be compared to the appropriate toxicity values (MRL, R<sub>f</sub>C, R<sub>f</sub>D).

**Calculating Exposure Dose (ED) from Soil [ATSDR 1992]:**

$$ED = \{C \times IR \times (EF \times 10^{-6}) / BW\}$$

Where:

- C = Contamination 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
- BW = Body Weight
  - = 70 kg for an adult
  - = 10 kg for a child

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

$$EF = \{((\#days/week) \times (\#weeks/year) \times (ED)) / ((ET) \times (365days/year))\}$$

Where:

- ED = exposure duration (years)
- ET = exposure time (years)

In estimating EF for adults and children onsite, it is assumed that adults are at work outside the home for 8 hours/day and 40 hours/week, children are at school for 8 hours/day and 40 hours/week, and that both adults and children are in the vicinity of the home on the weekends.

On-site adult exposure:

Weekdays:

- Hours at work per day = 8
- Hours at home per day = 16
- # work days / week = 5
- # hours at home during work week = 80

Weekends:

- Hours at home per day = 24
- # days per weekend = 2
- # hours at home during weekend = 48

Total hours at home during a seven day week = 80 + 48 = 128.

Converted to number of days at home during a 7 day week (128/24) = 5.33.

On-site child exposure:

Weekdays:

- Hours at school per day = 8
- Hours at home per day = 16
- # school days / week = 5
- # hours at home during one week of school = 80

Weekends:

- Hours at home per day = 24
- # days per weekend = 2
- # hours at home during weekend = 48

*Davenport and Flagstaff Smelters*

Total hours at home during a 7 day week =  $80 + 48 = 128$ .

Since the academic year lasts 9 months, that is equivalent to  $3/4$  of a full calendar year or 39 weeks.

During the academic year, children are at home for  $128 \times 39 = 4992$  hours = 208 days.

During the summer months, children may be home 24 hours per day for the remaining 13 weeks; therefore, children are at home for  $24\text{hrs/day} \times 7 \text{ days/wk} \times 13 \text{ weeks} = 2184$  hours = 91 days.

The total number of days/year that children are home is  $208 + 91 = 299$ .

Therefore, children are at home 299 days in 52 weeks =  $299/52 = 5.75$  days/week.

Receptor	Days/wk (at home)	Wks / Yr	Exposure duration (years)	Exposure time (years)	Exposure Factor (EF)
Adult	5.33	52	30	70	0.325
Children	5.75	52	6	6	0.819

The EFs can then be substituted into the ED equation given above to estimate the exposure dose to a given contaminant.



## **Appendix C: Davenport/Flagstaff Smelters Needs Assessment**

### **Goals**

1. By December 2004, improve awareness of residents concerning arsenic and lead present in the soil surrounding the site.
2. Continually encourage parents to have children ages 6 months to 17 years tested for blood lead.

### **Social Assessment**

The Davenport/Flagstaff Smelters are located at the base of Little Cottonwood Canyon near Sandy, Utah. The total population for this area of Salt Lake County is 88,418 (1). Seventeen percent of the population is under the age of 9. Based on a 2000 U.S. Census Bureau study, 94% of the residents in this area have a high school degree or higher, while 35% have a bachelor's degree or higher. The median family income for the area is \$70,801(1).

In the 1870's, several smelters in the area were in operation. The Flagstaff Smelter was on the north bank of Little Cottonwood Creek, and the Davenport Smelter was south of Little Cottonwood Creek. The Davenport Smelter was in operation from 1872 until 1875 and processed silver and lead. Early smelting activities in the Salt Lake Valley were reported to be conducted in a "...sadly careless and ignorant manner" and "...that in many cases half the lead is lost to the slag or up the chimney (2)." L. E. Despain wrote in a letter, "...the smoke stacks were not built very high, and the flue dust that fell on the vegetation poisoned all the horses, cattle, sheep, and honey bees." Because of these activities, elevated arsenic and lead levels have been found in the soil surrounding the smelters.

A residential neighborhood now occupies the land where the Davenport/Flagstaff Smelters once stood. Residents have reported finding large amounts of slag in their backyards. Of the properties tested, 15 have documented levels of arsenic that are greater than three times the regional background level.\* Twenty-two properties have documented levels of lead in residential soil that are also greater than three times the regional background level.

According to the Environmental Protection Agency's (EPA) remedial investigation of the site, the levels of lead discovered pose a threat to human health. Inhalation and ingestion of arsenic and lead can cause serious health problems in residents, especially children. Compared to adults, children are at increased risk from exposure to environmental contaminants; children often play outside and have behaviors that make them more likely to come in contact with pollutants in dust and soil.

EPA and the Utah Department of Environmental Quality (UDEQ) held a public meeting in June 2002 to present their proposed cleanup plan to the community. Since then, EPA funding has been cut, and it is unclear as to when remediation will continue for the remaining properties.

---

\* Regional background level is the concentration of a substance in an environmental media (e.g., air, water, or soil) that occurs naturally or is not the result of human activities.

### **Behavioral and Environmental Assessment**

The residents of this community shall be informed by the Environmental Epidemiology Program of the health effects associated with arsenic and lead poisoning. With the proper education, residents will be able to make informed decisions to help reduce the amount of arsenic and lead that they, or their children, are exposed to in the environment. The children in this community also will be educated on the importance of hand washing and the hazards of putting unnecessary objects in their mouths. The community will be made aware of the importance of blood lead testing and advised to have their children's blood lead levels tested by the local health department or their health care provider. Knowing that these resources are available in their community will allow residents to participate more readily in the public health assessment process.

### *Community Concerns*

Community residents have expressed a number of concerns regarding the listing of the Davenport/ Flagstaff site on the NPL. The following comments are from EPA's Community Involvement Plan, completed in May of 2002 (2). Some of the community concerns expressed were the following:

- "Our property values are going down."
- "I do not want institutional controls on my property. I want to be able to dig or plant in my yard without having it okayed from the government."
- "There is no evidence of any children having increased or high blood lead levels in the area."
- Some residents were concerned that through the cleanup process, much of the natural growth and beauty of the area would be destroyed (Community Involvement Plan, UDEQ, 2002).
- Many of the residents would like the area cleaned up as soon as possible.
- Some of the residents feel that the EPA has issued this site for "personal gains" and not for environmental issues.
- One resident stated that the children in the community have not had elevated blood lead levels, so it is not affecting the communities health.

### **Educational and Organizational Assessment**

EPA will remediate the properties with elevated levels of arsenic and lead. Until EPA can remove the contaminated soil, the residents will need to know how to protect themselves and their children from the contaminants. Residents will be informed of the health risks these elements can pose on a child and an adult. The Utah Department of Health (UDOH) or the Salt Lake Health Department (SLHD) will mail the residents educational materials regarding the contaminants. Residents also will be given information on how they can protect themselves and their children from the chemicals in their environment.

Residents also will be informed of free blood lead testing available 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.

## *Davenport and Flagstaff Smelters*

UDOH or SLHD will annually mail a newsletter to residents of the community. The newsletter will provide information about the contaminants (arsenic and lead) and their health effects, exposure pathways and minimizing exposure, blood lead testing, and who to contact for questions. This annual newsletter will insure that every person in the community is reached and informed about the arsenic and lead contamination in the area.

### *Predisposing-knowledge, attitudes, beliefs, values*

Many residents in this area do not believe that arsenic and lead is a problem in the soil. They have argued that no elevated blood lead levels have been found in children in the area. Very few residents have had their blood lead levels tested. More residents need to have their blood lead tested. Some residents believe that the government will be telling the owners of the land what they can and cannot do. They do not like the restrictions placed on their land. They also believe that the price of their homes will decrease in value because of the contaminants on their land.

### *Enabling-skills, resources, or barriers hinder the desired behavior*

Because of the skepticism that some residents have towards the contamination at the Davenport and Flagstaff Smelter sites, education and resources available may be overlooked. Therefore, it is imperative that the state and local health departments emphasize the importance of blood lead testing for children. Informative pamphlets discussing the hazards of arsenic and lead in the body and methods of exposure prevention, as well as testing centers and contact information, will be mailed directly to residents. All documents regarding the site will be made available at local repositories, including UDEQ, UDOH, and other participating offices.

### *Reinforcing-rewards received from others following the adoption of desired behavior*

By having the knowledge of the dangers of the arsenic and lead in the soil, residents will be able to protect themselves and their children and to prevent long-term or short-term adverse health effects. Blood lead tests will confirm any high levels of lead found in the blood of neighborhood children. Based on these results and the education received, residents will be able to identify their own sources of lead contact and possibly eliminate any pathway that may lead to exposure.

## **Administrative and Policy Assessment**

Based on a 2002 Community Involvement Study completed by UDEQ and EPA, residents of the Davenport/Flagstaff Smelters site receive the majority of local information through newspapers, primarily the Salt Lake Tribune and the Deseret News. Interviewees stated that they would prefer to receive future information via newspaper, mail, or public meetings. It has been determined that the public health assessment created by UDOH Environmental Epidemiology Program (EEP) will be mailed directly to residents who have attended past public meetings and signed up on the mailing list. The PHA also will be available at UDOH and a local repository, possibly the Sandy Public Library. Notification of the availability of the PHA will be published in the local newspaper.

**Process evaluation**

SLHD will monitor the lead database to confirm that blood lead levels in this area are being collected.

**Impact evaluation**

Based on the information collected from blood lead monitoring, it will be determined if further education is necessary to increase awareness of the available testing and the urgency for children to be tested.

**Outcome evaluation**

The outcome evaluation will be conducted when more information becomes available.

***References***

1. Bureau of the Census. 2000. United States Census 2000. Available at <http://factfinder.census.gov>. Accessed May 2003.
2. U.S. Environmental Protection Agency. 2002. *Community Involvement Plan, Flagstaff and Davenport Smelter Superfund Site, Salt Lake County, Utah.*